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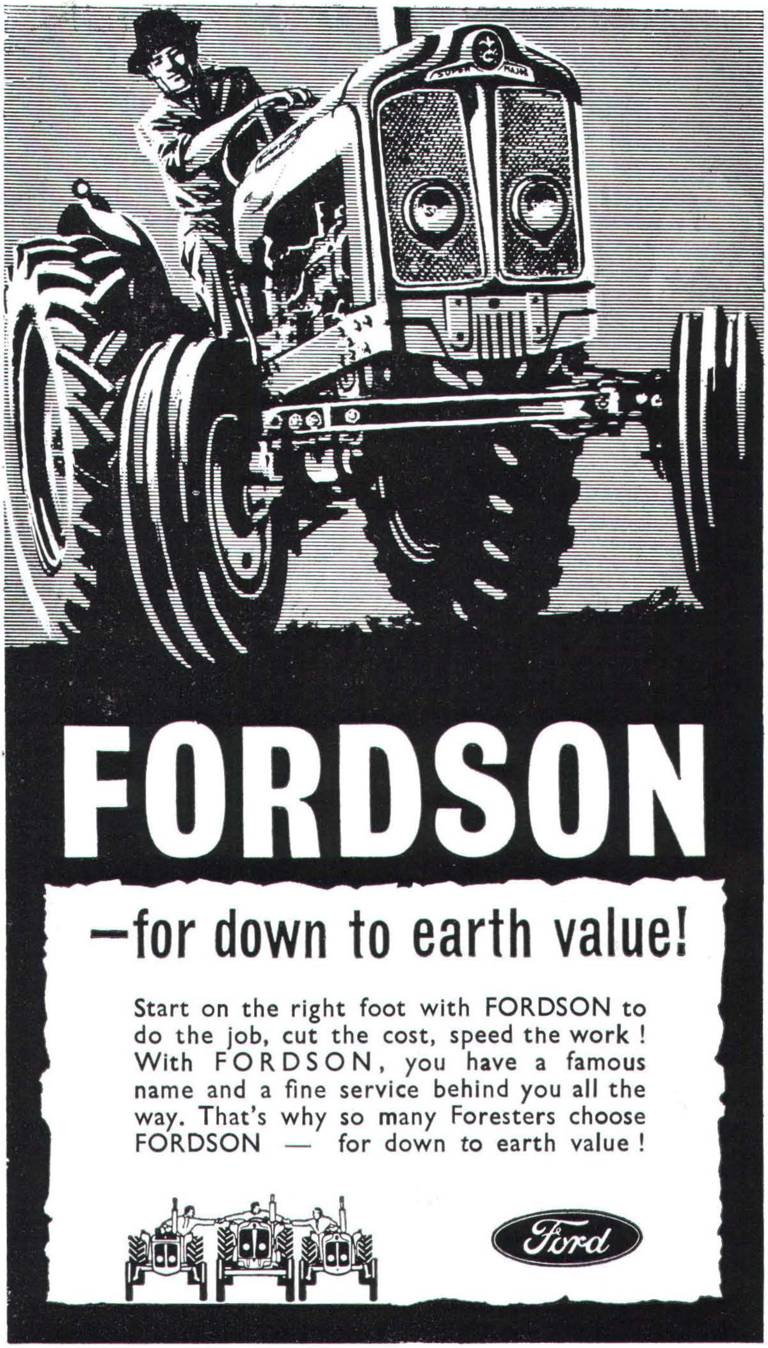
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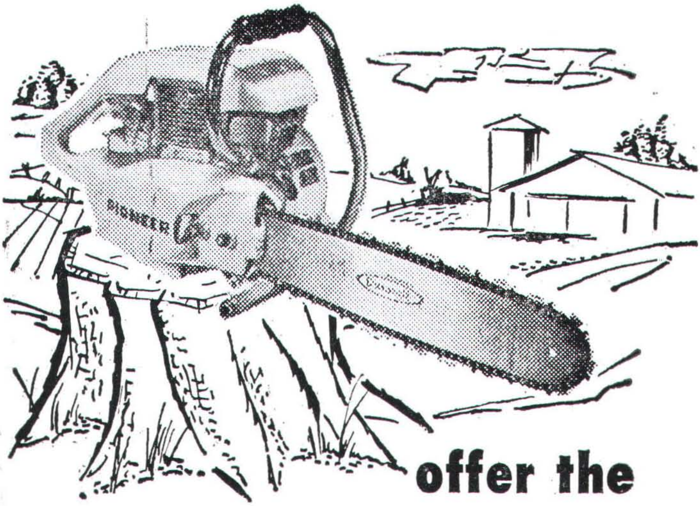

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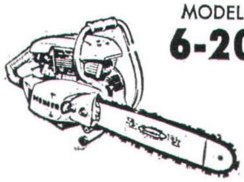

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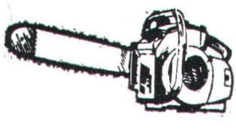

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IRISH FORESTRY

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IRISH FORESTRY

Volume XX Autumn 1963 Number 2

A Review of Twenty-One Years of Irish Forestry*

By T. CLEAR,
Professor of Forestry, University College, Dublin.

THE occasion of the twenty-first Annual General Meeting of the Society provides an opportunity to take a backward look over the years in which the Society grew up to full stature. While an account of the proceedings of the Society over the past twenty-one years would in itself be both interesting and revealing, I feel that it might be more useful to trace the growth and development of forestry, forest policy and forestry thought in Ireland as revealed in the papers of our Society's Journal—Irish Forestry.

The journal of the Society provides a ready source of information on forestry developments through the years, more particularly, the record of the President's Address to the Annual General Meeting of the Society, which reviews the advances in forestry or forestry knowledge during the year. I have relied largely on this source in compiling the review and I should like to commend these presidential addresses to anyone wishing to have a fuller account of recent Irish forest history.

The inaugural meeting of the Society was held in Dublin on the 21st September, 1942. The Society thus came into existence at a time when the country in general, and forestry in particular, was going through a rather testing period with the impact of shortages growing more pressing with every passing month.

Already by the Spring of 1943 there must have been some sign of a silver lining, because on the occasion of the first Annual General Meeting held in February of that year, the President looked forward to better days to come.

In his address, the President, Dr. M. L. Anderson, discussed the Emergency Powers Order which fixed maximum prices for timber. "This latter order", said the President, "gives the growers for the first time a suitable basis for securing a satisfactory price for their growing timber. The prices are adequate and growers should be securing a high enough return from timber sales to enable them to carry out satisfactory and ample replacements. They should also bring growers to realise more fully the value of their growing timber." It may be of interest to record here the maximum prices of some categories of standing timber as of January 1944.

* A paper read by Professor Clear at the Twenty-first Annual General Meeting, 1963.

Larch, 12 inches Q.G. Breast Height and over.	1/3d. per Hoppus ft. (less 10% bark allowance).
Conifers, other than larch, 8 inches to $11\frac{3}{4}''$.	8d. per Hoppus ft. (less 10% for bark).
Oak—well grown selected trees 20″ B.Ht. Q. Girth and over.	2/6d. per Hoppus ft. (less 10% bark allowance).
Oak, whole parcels, 14″ or over.	1/6d. per Hoppus ft.
Beech, selected trees, 14 inches or over.	10d. per Hoppus ft.

Practically the only source of supply of timber at the time was the private woodlands of Ireland of which it was said in 1943—"There is no doubt that generally private forestry is at a very low ebb." There was apparent satisfaction in official quarters that the private owner was enjoying, at long last, a reasonable, if strictly controlled, return from his woodlands and that these adequate prices would provide a very necessary shot in the arm for private forestry.

With regard to State Forestry, the President hoped "that during this difficult time the Government will find it possible to maintain its afforestation programme to the fullest extent possible and that steps will be taken to resume the process of expansion of the State forestry programme which was interrupted by the present emergency".

An event occurred at the First Annual General Meeting which deserves mention in any review of Irish Forestry. At this historic meeting, Mr. A. C. Forbes was elected first Honorary Member of the Society under Article IX of the Constitution of the Society which provides that "The Society shall have power . . . to elect as honorary members persons who have rendered notable services to the advancement of forestry knowledge". The President, Dr. M. L. Anderson, introducing Mr. Forbes, recalled how in 1906 he, Mr. Forbes, had to start single-handed to lay the foundation of the State forests, not alone by his afforestation work, but by forming the nucleus of the technical staff and organisation required for future development. "In fact," continued Dr. Anderson, "all of us who are now employed in the State Forest Service are in a sense heirs of Mr. Forbes and still work along the lines initiated by him".

Mr. Forbes, in his reply, expressed the opinion that the Society of Irish Foresters was the first Forestry Society ever established in Ireland which showed promise of a long and successful life. He was sure, in fact, that our Society would have a long and successful career.

The year 1943 was a notable one for post-war plans of various kinds. Forestry came in for more than its share of notice by the planners, and the first issue of *Irish Forestry* contains many reviews and notices of articles and proposals concerning post-war forestry policy, that appeared during that very lively year.

Notable among the forestry publications of that year reviewed in Irish Forestry Vol. I No. 2 was the Report of the Minister for Lands covering the period 1938 to 1943. The Report stated that the programme then envisaged aimed at the creation of a forest estate of 700,000 acres, of which, 600,000 would be productive and 100,000 acres protective. This figure of 700,000 acres was mentioned in several contributions in the Journal that year. One reviewer, dealing with a publication which called for large-scale afforestation among other things, comments "The Forestry Division seems to be encountering great difficulties in their attempts to achieve their annual planting programme of 10,000 acres". Indeed, the planting programme in that year was *4,022 acres*—a fine achievement considering the prevailing conditions.

In a further review in the same issue there is what appears to be official or professional comment on what was then considered to be a grossly exaggerated forecast of monetary returns from forestry plantations. "At present maximum prices, an annual yield of 100 cubic feet of timber (a yield possible only on the best hill sites) would bring a gross return of £2 per acre. When production costs are subtracted the best nett return one could expect is £1 per acre and the average from all land might be as low as 10/6d. A fully stocked 40 year old stand of spruce would carry 4,000 cubic feet to the acre, so that at the present maximum price of 10d. per cubic foot, the most one could legally get is £150 per acre." Now, twenty years later in 1963, we would expect to get at least £500 for the same acre.

Private planting costs in 1943 worked out at £16 per acre and the planting grant was £4 per acre for a block of 5 acres—according to a well-known expert on private forestry, writing in the Journal in that year.

A report that aroused much interest in late 1943 and early 1944 in forestry circles here and abroad was the White Paper on Post-War Forestry Policy by H.M. Forestry Commissioners for Great Britain, dated June 1943. The report was reviewed in Vol. 1 No. 2 of Irish Forestry. The reviewer took the opportunity to compare State forestry in Ireland with State forestry in Great Britain and we get a valuable commentary on many of the major issues of State forest policy raised by the British Forestry Commissioners.

On the technical side, the reviewer agrees with the authors of the White Paper that "It is better to wait a year or two than to plant the second best or wrong kind of tree on a given site", and adds by way of comment "Some of the enthusiastic amateur planners would do well to consider this point seriously".

"In most places it is still a waste of time to plant without netting", quotes the reviewer, and adds—"This needs no comment". The Myxomatosis disease which practically eliminated the rabbit in the next decade was still unheard of here in 1944. In 1963, however, the rabbit has once again become a factor to be reckoned with and there are signs that in the future it may again be "a waste of time to plant without netting".

Among policy issues raised by the Commissioners' Report and discussed by the reviewer in Irish Forestry, were the necessity for an *ad hoc* Forest Authority, the need for higher professional qualifications in the technical ranks of the State Forest Service and the need for an adequate provision for research, education and information. The reviewer challenges many of the recommendations made in the White Paper and expresses views that make interesting reading to-day. On the subject of research and education, for instance, we read—"In respect of this matter improvements are, doubtless, desirable, but that is a development which must be held over until the Forest Service begins to pay its way. It is possible to improve techniques considerably without indulging in heavy special expenditure which is not yet absolutely necessary"!

The President, in his review of the year 1945, complains—"I started to take notes on what was happening in the forestry world, but it soon became borne in on me that, though the year gave promise of many remarkable events, when the annals were to be written, forestry would receive scant attention". With the war reaching a crucial stage in Europe and with the pre-occupation with the pressing and immediate shortages of food and fuel, afforestation was understandably, not making headline news. A worthwhile 4,230 acres of new forest was, however, planted and an increase of £93,000 was secured for forestry purposes.

The year 1946 was reviewed by the President at the Annual General Meeting held early in 1947. He spoke of the new Forestry Act of 1946 which had just appeared in print and also reported that the Dail had voted a sum of £287,000 for the work of the State Forestry Department in 1946. The area planted in 1946 was *3,598 acres,* the lowest figures recorded since Forestry became the responsibility of the Minister for Lands in 1933.

No review of the Irish Forestry scene in 1946 would be complete without mention of the departure from the country of Dr. M. L. Anderson. Dr. Anderson, it will be remembered, was the principal founder of the Society, and held many offices during the formative years, notably President, Editor and Excursion Convenor. In his official capacity as Director of Forestry, he was responsible for many developments in the difficult war years when the activities of the Department were switched from afforestation to mainly utilization to meet the urgent demand for timber.

Two notable events destined to have a profound effect on Irish forestry were commented on at the Sixth Annual General Meeting held on March 16th, 1948. A new Government had come to power and delegates from Ireland had attended the Commonwealth Forestry Conference held in Britain. The delegates brought home news of great developments in technical forestry in Britain and elsewhere and saw first-hand evidence of the profound impact of research in British Forestry. It appeared that a major break-through in afforestation techniques on peatland had been achieved in Britain with the development of special ploughs and the application of phosphatic manures. "Much that has been done in Great Britain could be copied here with advantage", reported J. A. K. Meldrum—one of the delegates and then Director of Forestry— in his valedictory address as outgoing President.

That the delegates were very impressed by the work of the Research Branch of the Forestry Commission is evident from their recorded remarks. "The Cost of the Research Branch works out at about 2% of the Commission's expenditure and no outlay has produced more abundantly . . . No doctrine is so dangerous as that which says that forestry cannot afford research . . . An industry which has to do with factors of soil, climate and species which are as yet dimly perceived cannot afford to do without research."

Foreign influences were also beginning to affect forestry thinking here in 1948. This is revealed by the President's comments on his visit to the Commonwealth Forestry Conference. He was impressed by the South African delegate, Ian Craib, who had startled the Conference by describing how his country had, as a result of his researches in spacing and thinning, brought in a new and revolutionary method of raising Conifer Crops—"This," said the President, "seems to herald the advent of the mathematician into the realm of the silviculturist!"

It was noted, that imports of softwoods were (in 1948) being received in fair quantities, though not on the scale of pre-war years. "These imports," said the President in his review, "are most welcome as they relieve the strain on our sorely tried woods. It is a matter of satisfaction to see that our native softwoods which were being consumed at the rate of more than 250,000 cubic feet (sawn measure?) per month, are now being used at not more than 25,000 to 40,000 cubic feet per month."

The change in Government, mentioned in the 1948 review, was making itself felt in 1949. The President opened his address to the 7th Annual General Meeting, as follows: "Ladies and Gentlemen, the most remarkable development in Forestry circles during the year was the sensational announcement by the Minister for Lands that the annual planting programme was to be stepped up to a minimum of 25,000 acres."

The most outstanding event of 1949 was the Society's excursion to Wales. "There," said the President, Mr. M. O'Beirne, in his valedictory address to the 8th, and so far most successful, Annual General

Meeting, "the caterpillar tractors ploughing the hillsides and swamps, rendering waste ground fit for planting made a profound impression on our members. I hope that before the end of the year, we will have the pleasure of seeing our Forestry Division imitating this method."

The Director of Forestry, Mr. J. A. K. Meldrum, during the course of an address to the 1949 Meeting, announced the expansion of planting to reach a target of 25,000 acres per year by 1952. He did not expect a miracle but was confident that the target would be reached. Mr. Meldrum stressed the need for extending the scope of education in the National University and at the State Forestry School.

The year 1950 was reviewed by Mr. T. McEvoy, in his Presidential Address on the occasion of the Ninth Annual General Meeting. He told of sharply rising prices for imported forest products, especially pulp and paper occasioned by the outbreak of the Korean War.

A survey of plantable land in the country which had just been completed revealed some 1,200,000 acres of marginal and sub-marginal land capable of growing timber crops. Adding to this figure, an estimated 60,000 acres of stocked woodland in private hands and some 170,000 acres of productive State forest lands, the review concludes that in 1950 "the total potential forest area is close on a million and a half acres."

In 1950, 8,000 acres were planted by the Forestry Division, the Bowater Corporation commenced the production of hard-board from Irish timber in their factory at Athy, Co. Kildare, and the Society held a most successful study tour in Co. Wicklow. Over eighty home members and a party of Welsh Foresters combined to make this, the 7th Annual Study Tour, an outstanding event.

The big forestry event of 1951 was the publication of the eagerly awaited Report of the F.A.O. Forestry Mission to Ireland which appeared on the 15th February of that year.

A lengthy summary of this report (later known as the Cameron Report after its author, Mr. D. Roy Cameron), appeared in Vol. VIII No. 2 of Irish Forestry, issued December 1951.

This blue-print for Irish Forestry commissioned by the Government recommended among other things—

(a) A commercial programme of 500,000 acres to supply an estimated need of 100,000 standards of saw timber. Planting to proceed at 11,750 acres per annum.

(b) A social programme for soil conservation, stabilisation of employment in congested areas and the reclamation of idle lands. The report goes on to say—"It seems safe to assume that there are at least 500,000 acres which in the national interest require to be afforested as part of the Social Programme."

The year 1951 saw the planting figure pass 10,000 acres for the first time since State forestry began and also saw imported timber and pulp prices reach an all-time high. The Society toured Argyll in Scotland—a memorable visit.

In 1952 Dr. D. Roy Cameron came all the way from Rome to address the Society on the work of the F.A.O. Forestry Division. In the course of his address he referred to his report on Irish Forestry and dealt with criticisms that had appeared in the press and elsewhere. He stresed that the programme laid down in his report was the policy of the Irish Government of the day and not one that F.A.O. had wished on it. The request to F.A.O. was to review the programme. He concluded—"You in Ireland have it in your power to lay the foundations for a progressively increasing economic prosperity for this historic land. May you and those who follow you in the Society of Irish Foresters be worthy of your opportunity and of your destiny."

At the Eleventh Annual General Meeting of the Society, the retiring President, Mr. J. A. K. Meldrum, announced that State Afforestation was making spectacular progress, largely due to the innovation of mechanical preparation of land. During the season 1951-52 no less than 15,000 acres of new plantation were established. "Unless the problem of land acquisition is solved," said the President, "the ultimate establishment of 1,000,000 acres of forest cannot be translated from dreamland into reality."

The Society was also told of the devastation caused in Scotland by the "big wind" of January 31st, 1953, when over 40 million cubic feet of timber was blown. This was almost by way of advance notice of similar visitations here at home in later years.

At the International Peat Symposium held in Dublin in July 1954, papers on aspects of peat afforestation were read by experts from many countries. Mr. T. McEvoy dealt with progress of peat afforestation in the Forestry Division at home. In his most interesting contribution, which was published in Vol. XI No. 2 Irish Forestry, we read that in 1951 "when machinery became freely available, the Irish Forest Service purchased twenty-two tractor-and-plough units." In July 1954, Mr. McEvoy reported at the Symposium—"Ploughing is now accepted practice on peat soils," and "the use of phosphatic fertilizers has been adopted on poor sites and preliminary results are promising."

Mr. McEvoy's article mentions a figure of £20 as the all-in cost of establishing plantations on bogland in 1954, including fencing, draining, ploughing, plants, planting and fertilizing. An experiment using the newly developed planting technique was described in some detail and deserves recalling:—

> "Drains opened with single mould board draining plough. Ploughed 20″ deep with double mould-board planting plough—furrows opened at 10′ espacement—ribbons at 5′. Planted with 1 + 1 *Pinus contorta,* Lulu Island origin, at 4 ft. × 5 ft. with semicircular spades. Five acres were treated with 2 oz. basic slag

applied around each plant on surface of ribbon shortly after planting."

In his address to the 13th Annual General Meeting held in March 1955, the President, Mr. T. McEvoy, mentioned a developing export trade in Irish hardboard as significant since "surpluses beyond home requirements of low grade and small sized thinnings may become available and an export market for those in processed form may be very desirable." He forecasted that "the future will undoubtedly bring difficulties in equation of supply and industrial capacity."

The President stated also that in the season 1954-55 the State expected to plant 13,500 acres and that the estimates for forestry provided for a record outlay of £1½ million.

At this meeting members were privileged to hear an address by the famous forest economist, Mr. W. E. Hiley, on the economics of "thinning". Mr. Hiley's visit to the country did much to arouse interest in the economics of tree growing.

The year 1956 brought a new Forestry Act to facilitate land acquisition for forestry in cases where transfer was hindered by faulty title or where the sale of Commonages was held up by one or two unco-operative individuals. It also saw state planting rise again to over 15,000 acres. Expenditure at £1¾ million—income at £200,000 and employment at 5,000 were all new records.

That year the Society organised a study tour to Southern Germany. This tour, ably led by the President, Mr. O. V. Mooney, was the most ambitious and the most memorable to date. It set up standards in punctuality, good discipline, oratory and good relationships among hosts and guests. The tour is still spoken of by foresters in Germany, as one that left a lasting good impression of Irish people in general and Irish foresters in particular.

At the 15th Annual General Meeting of the Society held in March 1957, the President, Mr. Mooney, referred to the violent storms that occurred on Thursday, January 31st, 1957, and the following Monday, February 4th, 1957 which "must have equalled or exceeded the destructive effects of the famous big winds of 1903. Gusts of 84 m.p.h. were recorded at Dublin, 107 m.p.h. at Milan and 100 m.p.h. at Belmullet.

"This event will serve as a sharp and serious reminder," said the President.

Reviewing routine event in 1956, the President said that the total area then held by the Department was 320,998 acres—of which 269,442 was productive ground. It was expected that 20,000 acres would be acquired in 1957 compared with 17,358 in 1955/56; 17,513 in 1954/55 and 20,436 in 1953/54.

The total area planted to 31st March, 1956 was 208,481 acres and the planting programme for the year 1956/57 was 17,578 acres.

The Minister for Lands made a policy statement in the Dail on

April 24th, 1957, which was recorded in "Irish Forestry" Vol. XIV No. 1. He reviewed progress to date and in particular discussed the influence of forestry on the national economy. "It is unfortunate, but inescapable," said the Minister, Mr. Erskine Childers, "that the employment given in new planting gives no immediate return in terms of increased national production. In this respect, it is questionable whether this small country, with limited capital resources, with problems of considerable excess of imports over exports and a plethora of other economic difficulties can really justify a steadily increasing annual capital investment in afforestation which is already close to £2 million a year. The capital being devoted to afforestation could, if wisely spent in other spheres of national economic development, produce almost immediate results in productivity gains. Devoted to afforestation, its immediate economic effect is purely inflationary. Our inherited paucity of woodland had led us, however, to undertake afforestation on a scale which is quite phenomenal in relation to our resources and our needs."

In 1957 we had the formal opening of the Forestry School at Shelton Abbey, and a meeting of the British Association for the Advancement of Science in Dublin. This latter was a big occasion for forestry in Ireland—with an outstanding exhibition and papers, discussions and tours of forestry interest. The Society helped in many ways to make this meeting a success and "Irish Forestry" published many of the forestry papers read at this historic gathering of scientists.

The year 1958 heralded what promised to be a revival of private forestry. Mr. Erskine Childers, T.D., Minister for Lands, at Muintir na Tire Rural Week, Roscrea, August 1958, announced the Government's decision to increase the grant for private forestry from £10 to £20 per acre. The Minister asked the help of Muintir na Tire in securing a massive increase in the level of private planting. He said "For the first time the Department of Lands is being charged with the duty of promoting private forestry as being of equal importance to state afforestation."

Mr. D. Mangan, as President, reviewed the year 1958. The main item of news on the home front was the introduction in April 1958 of the Incentive Bonus Scheme for Forestry Workers.

The review recorded progress in afforestation for 1957/58 when 20,056 acres were planted and a total of 28 million trees used. Gross expenditure on Forestry had risen to £2,087,412 and income to £331,966 —a nett expenditure of £1,755,446.

A notable event also for the Society was the visit of Dr. Axel S. Sabroe from Denmark who was guest speaker at the Annual General Meeting 1958. This visit was followed by a visit of the Society to Denmark in May 1959—which Dr. Sabroe helped to make the great success it was.

In 1959 Dr. M. L. Anderson paid a return visit to Ireland at the invitation of the Society. We were reminded at the Meeting, the 17th

Annual General Meeting of the Society, that Professor Anderson had exerted an abiding and distinctive influence on Irish forestry and that our greatest debt to him was due to his initiative in establishing the Society of Irish Foresters as a forum for the independent development of Irish forest thought.

In 1959, the Society broke new ground—in every sense of the word —when it organised a demonstration of forest machinery at Kilruddery, Bray. The field-day, which was organised by Mr. M. Sharkey, was a marked success. Mr. Childers, Minister for Lands, who opened the proceedings, spoke of the remarkable progress that had been made in the development of new and better types of machinery capable of dealing with a very wide range of forest operation and of the enormous contribution which the use of suitable machinery could make to more economic and more efficient forestry.

In 1959, the Senate of the National University appointed the author of this review, Thomas Clear, to the newly established Chair of Forestry in University College, Dublin. It will be recalled that Professor A. H. Henry was Professor of Forestry in University College, Dublin, and that the Chair lapsed at his death in 1930.

The year 1960 was reviewed by the President, Mr. Maurice Swan. The year was notable for the achievement of the State planting target of 25,000—a target figure that was at one time hoped for by 1952.

While 1960 was a quietly successful year for Irish forestry at home, Seattle on the western seaboard of the United States of America, housed the greatest assembly of foresters the world has ever seen, on the occasion of the Fifth World Forestry Congress. The doings of that Congress made headlines in the World press and the published proceedings, which have been secured by the Society, run to three large volumes.

It was my duty as President to review the year 1961—the review noted that in 1960-61, 150,000 acres of new land was planted in Europe—in Common Market countries—with overall afforestation increasing to a peak of 875,000 acres.

In Britain, 1960-61 was a record year for afforestation—with a total of over 100,000 acres planted. Ireland too had a record planting programme in 1961. 26,060 acres was planted at the 169 forests throughout the country. Gross expenditure had reached £2¾ millions and income £460,000. The volume of industrial wood extracted from State forests was 4.3 million hoppus feet. The year saw the official opening of the Scarriff Chip-Board Mills, which had been in production for some time and also the building of a new chip-board factory at Waterford was announced. The year was one of the worst on record for storms with widespread and, in places, frightening devastation of advanced pole plantations, particularly in the western half of the country.

Perhaps I should conclude this review by a general survey of the changes that have come over the forestry scene in the last twenty-one years. The most remarkable feature of this period is the spectacular growth of State forestry, where the area under State forest has grown from some 135,000 acres to around 375,000 acres—an increase of a quarter of a million acres. In the period, gross State expenditure on forestry totalled around £25 million.

Nett annual expenditure on forestry has increased from £250,000 in 1943 to over £2.5 million in 1962/63. Income has increased from some £70,000 to around £700,000—a tenfold increase in both cases. Planting has increased from 4,000 acres in 1942/43 to 25,000 acres in 1962/63.

Private forestry on the other hand, which was bearing the major part of the burden of unprecedented wartime demands for home timber—amounting to 10 to 15 million cubic feet annually during the peak period—has suffered a total eclipse. Although planting rose from a wartime low of 300 acres to around 1,000 acres in 1962, it was apparent to all that this increase was not enough to arrest the rapid decline in woodland acreage in private hands and much of the new planting was in small patches on farms, unlike the earlier afforesation which was associated with the large wooded estates.

On the utilization side, while sawmilling of home-grown timber had declined from the highly artificial and forced wartime levels of around 8,000,000 cubic feet to less than half of that figure, there is evidence of a rapid build-up of interest in the conversion of home-grown timber in recent years. New, permanent, electrically driven band or gang mills of substantial size have been established in recent years and native saw timber is in keen demand in 1962-63. Here, too, the produce from State plantations now dominates the scene—with Sitka spruce bulking largely in the current saw log category. In 1942, private grown timber of Scot's pine, larch, spruce and oak with small portable steam or oil driven saw mills, were the main features of the home trade.

The big development in the pulp and board sector is something scarcely dreamt of in 1942. Now, four major plants are in operation, two chipboard mills, one hardboard and one integrated ground-wood mill—with a combined intake of some 4 million hoppus feet.

In the forest the period has seen great changes—most of all in the field of mechanisation. To-day over 70% of all ground is mechanically prepared—every production forest is buzzing with the noise of petrol-driven chain saws and giant bulldozers, graders and tracked tractors are commonplace on our hillsides cutting new roads at amazing speed and at less than 1942 prices per running yard. Extraction is now mainly by lorry—with 7 to 10 ton loads and the trailer and lorry combination with 15 to 20 ton loads is in increasing evidence. The planting spade, the crosscut, the axe, the horse and horse-drawn timber carriage, so much a feature of the 1942 scene, are now comparatively rare. Nurseries too have changed out of all knowing—with tractor-driven ploughs, rotovators and seed sowers and chemical sprayers and dusters—all new to the scene.

The Society has served its members well during those years of rapid change and development. It has by means of lectures, field trips and study tours kept members up-to-date with developments. The Society has welcomed and introduced new ideas and new techniques. The elected officers have given splendid service to the advancement of forestry in general and the Society in particular. As to the future, I hope and pray and confidently expect that the next twenty-one years will be at least as fruitful for our Society and for Irish forestry as the period under review.

The Soils of Ireland

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Soil Formation

SOIL formation is the process by which geological parent materials subjected to the action of natural forces and living organisms are transformed over time into soils. In the course of the transformation various chemical, physical and biological changes take place so that the end-product, the soil, is a completely different natural body from the parent material. The nature of the parent materials and the environmental conditions involved are largely responsible for the character of the resultant soil. Five major genetic factors namely, parent material, climate, relief, vegetation and time are usually associated with soil forming processes and man's influence in modifying these natural processes cannot be discounted. The interaction of these factors and the relative impact of each, determine the nature and intensity of the processes by which the inert parent material is developed into a dynamic soil and the character of that soil. A mature soil then possesses both inherited and acquired characteristics.

It may be accepted that the soils of Ireland are more variable than those of most other countries or regions of similar area. A number of factors have contributed to making the soil pattern so complex. The interaction of the major factors of soil formation discussed above are foremost in their influence in this respect. A relationship to the local geology is to be expected in our soils. This relationship is complicated, however, by the fact that most Irish soils have been derived, not from the local rock formations, but from the transported glacial drift which mantles them. Since it is now known that Ireland was subjected to two main glaciations and perhaps a previous one besides (Mitchell, 1957) and since each of these involved a number of advance and retreat stages of the ice sheet, it can be appreciated that the resultant drift deposits that form the parent materials of the majority of our soils are of very mixed origin and of complex geological and physical constitution. Such differences in the drift are reflected in our soils.

Even on a uniform and common parent geological material, our soils display wide variations amongst themselves, due to the other factors that influence them in their genesis, formation and development from the geological parent material. It is now recognised that our post-glacial climate showed distinct variations from time to time (Brooks, 1921) but current and recent-past climate has been operative also. The main climatic factor operative in this country is the rainfall-evaporation regime. With the ratio balance well in favour of rainfall most of our soils tend to occur in the leached to podzolised categories. Apart from those, with our humid climate we have extensive areas of gleyed soils where water movement is retarded in the profile giving surface-water gleys or where high water table gives ground-water gleys. The former may be a function of the physical constitution of the profile, inherited mainly from the parent material, as in our "Drumlin" soils. The latter is most often a function of relief or position of the soil relative to the landscape topography where the relief factor asserts its influence over all others in characterizing the soil profile. Such soils occur in low relief or depressed sites in association with the leached and podzolised groups on the slopes and higher ground. The relief factor toward the opposite extreme is apparent where the tendency toward more severe leaching and podzolisation is increased with elevation.

The vegetation factor has influenced the situation considerably. For instance, on similar parent materials with all other factors being equal, two soils may show variable profile character as a result of vegetation history. Apart from the broad distinctive influence of forest versus grassland on soil profile character, there is the general difference between coniferous and deciduous species in this respect. It is now apparent that the majority of Irish soils were formed initially under a forest cover (Erdtman (1927), Mitchell (1951), Mitchell (1956), Murray (1957)) which in most areas was superseded by a gramineous cover with the usual modification of soil profile.

The influence of time or age is not so apparent in our soils, except in extreme cases of young alluvium in comparison with more mature soils, but nevertheless it has played its part too. The greater portion of Irish soils however, are relatively young. Finally, in thinking of variable soils, we can never discount man's interference over the years with the "natural" trends of soil development which was more pronounced probably from the early clearance of the virgin forests by Neolithic farmers commencing about 3,000 B.C.

Classification of Irish Soils

Prior to the establishment of the National Soil Survey by the Agricultural Institute in 1959, little attempt had been made to survey, classify and map the soils of Ireland in a systematic manner. However, as early as 1848 Sir Robert Kane, a pioneer in this field, described to the Royal Irish Academy a system of classification of land, based on detailed physical and chemical analyses and the agricultural capabilities of the soils, whereby he divided land into types ranging from "waste" land to "superior" land (Simington and Wheeler, 1945). Through some misadventure Kane's maps and reports were unfortunately lost. The work of Gallagher and Walsh (1942) set the basis for the overall classification of the soils of the country. A number of surveys of a more local and specific character (Brickley (1941), Walsh & Clarke (1943), Spain (1948) Walsh et al. (1953), Walsh & Ryan (1954)) were carried out but nothing in the way of a systematic and comprehensive classification and mapping of Irish soils in the modern concept (Ryan, 1962) was embarked upon prior to 1959.

As a result of the prevailing humid temperate climate the soils of Ireland, like those of North West Europe in general, have been subjected to a leaching process, leading to different degrees of podzolisation, depending on parent material and other modifying factors. For the most part then, in terms of soils on a world scale, our soils fall into the broad division of Pedalfers or more specifically into the zone of light-coloured podzolised soils of the cool-temperate, humid regions. As is to be expected extensive areas of so-called intrazonal soils may be interspersed with the above zonal group. Zonal soils are those with well-developed profile characteristics that reflect the dominating influence of climate and vegetation in the course of their development, whereas the intrazonal groups comprise for most part, soils that reflect the dominating, direct, or indirect influence of some *local factors,* usually topography or parent material, over the normal influence of climate and vegetation. Into these intrazonal groups fall our extensive poorly-drained or *gley* soils, the result of impeded drainage due to impermeability within the soil or high water-table. Our soils, at least our mineral soils, then can be considered to fall into two broad groups —the zonal podzolised soils and the intrazonal gleyed soils. We must also consider our organic soils or peats both zonal and intrazonal and our azonal alluvial soils.

The dominant process taking place more particularly in our better drained soils is one of leaching or downward removal of constituents both chemical and physical from upper to lower soil horizons. As one would expect then, most of our free draining soils have A/B/C/ profiles where the constitutents leached from the surface A horizons become deposited in the underlying B horizons. In all cases C refers to the underlying parent material of the soil.

The present systematic survey, classification and mapping of Irish soils is being done on a county by county basis and with three counties completed to date, it is not possible at present to provide a detailed overall picture, say at *soil series* level, of the soil pattern for the entire country. The present contribution therefore, will attempt to provide a more general picture by outlining the *Great Soil Groups* or major soils that we possess. These major groups are comprised of soils that have many important properties in common and that therefore, tend to behave in similar manner when subjected to defined cultural and management practices. In general terms also soils within a major group should have similar use range or use suitability. This level of classification however, is not sufficient to take account of differences at a local level which are significant in determining a soil's best use and true potential. The *soil series* is used for more detailed definition at a local level and conists of soils with similar profile characteristics and derived from a single parent material. A *Great Soil Group* may comprise several series of closely similar character.

The Great Soil Groups of most common occurrence in Ireland are briefly described in the following paragraphs. Others occur less extensively or in more scattered areas. Also within these major groups there is a considerable number of related sub-groups.

Alluvial Soils.

Sometimes referred to as Regosols these are immature soils with weakly developed(A/C) soil profiles. In texture and drainage they vary considerably even within one location. Being associated with river and estuarine basins mostly, these are naturally quite a scattered group. These and the soils from lacustrine, marine and raised beach deposits are potentially productive but in many cases poor drainage and temporary annual inundation create serious problems.

Brown Earths.

These well drained soils of medium textures known as *braunerden* or *sols bruns* in Continental Europe were also known as "brown forest soils" to distinguish their comparatively uniform, brownish profile with absence of a bleached sub-surface horizon, depleted of iron, from the podzolised soils associated with coniferous forests and heaths. The brown earths then are essentially soils of relative maturity but with uniform profiles where weathering has more or less kept pace with leaching. A limited degree of leaching however, is allowable within the group. The B horizon is not too pronounced in these soils and usually if present, takes the form of a structure or colour B so that the profile may be designated an A/(B)/C profile. The humus layer is normally of the mull type except in the more sandy types or where the soils tend toward the podzol group when a moder type humus occurs.

Recent evidence suggests that the brown earths may represent the natural soil climax under deciduous forest, on lighter textured materials in the lowland areas especially, with the podzols forming where the forest was removed and reversion to heath took place (Dimbleby and Gill, 1955). Unlimed soils have a moderately acid to neutral reaction coupled with a range in base saturation from low to moderately high and it is on this basis that two sub-groups of the brown earths are distinguished in this country viz. (a) acid brown earth or brown earths of low base status (b) brown earths of medium-high base status.

The former occur predominantly on the more acid parent materials such as non-calcareous shales sandstones, granites, mica-schists and glacial drift derived from these sources but may also be found on glacial drift, originally base-rich and of dominantly limestone composition, that has been decalcified and base depleted through weathering and leaching. The latter subgroup is associated with base-rich parent materials such as limestone and limestone-dominant glacial drift that has undergone less leaching.

The brown earths are amongst the most extensively cultivated soils in the country due to their desirable drainage conditions and their well-developed structure and although of relatively low natural fertility they are responsive to manurial treatments. These in their natural state are excellent forest soils also for hardwoods, Douglas fir and a wide range of conifers.

Rendzina-like Soils.

An important group of soils agriculturally and occurring in scattered relatively extensive areas forms a notable exception amongst our free-draining "Pedalfer" soils. These soils resemble the Continental Rendzina soils and even under our climate possess but an A/C profile or in other words have a rather shallow surface soil resting on the parent material—mostly a Carboniferous limestone or limestone glacial drift. These soils under our climatic conditions have been decalcified to the extent that in many cases they no longer retain any free carbonates in the profile. However, their base status and pH is mostly high. The organic matter content in the surface is high relative to other mineral soils and the humus is a mull type. The surface soil in particular, is dark coloured (dark brown to black). Where more excessive base depletion has occurred, soils with A/(B)/C profiles are found. These rendzina-like soils have many features in common with the shallower members of the brown earths of high base status.

Under the rainfall conditions prevailing these free-draining shallow soils are productive especially under grassland. In certain areas the parent rock comes too close to the surface to allow cultivation and in places too, extensive rock outcrop occurs. Hazel scrub is common on these soils which are suitable for *Pinus radiata,* Silver fir, ash, beech and sycamore.

With the widespread distribution of Carboniferous limestone formations and predominantly limestone drifts in Ireland one might expect more of these rendzina-like soils but this is not so. Our climate is not typical of that associated with the true Rendzina so only where the parent material has a sufficiently strong modifying influence do we find our Rendzina-like soils.

Grey-Brown Podzolics.

Associated with the Pedalfers in that there is a leaching process operative in the profile are those soils in which the main constituent shifted downward is the finely divided clay fraction. Where a defiinite B horizon occurs with significantly greater clay content than in the A or C horizons then these are known as Grey-Brown Podzolics. In Ireland on our vast areas of deep limestone or mixed limestone drift the most common soil at normal elevations in a deep, arable soil of grey-brown colour. This soil, depending on the degree of leaching, resembles in some cases the Continental brown earth already discussed where the profile is relatively uniform in character and in others the Grey Brown Podzolics mentioned above.

The latter group usually possess a heavier texture generally than the brown earths and are characterised by the distinct clay increase (with associated clay-skins) in the textural B horizon (Bt). Thus these profiles are designated A/Bt/C profiles. They are well to moderately well-drained soils of medium base status and moderate to neutral reaction. The organic matter content in the surface is moderate to high and the humus a mull-type.

The lighter-textured members are good all-purpose agricultural soils when adequately manured and well-managed but the heavier textured members do not compare favourably in this regard with the brown earths but make more desirable grassland soils where under proper manurial and management practices they can be highly productive. Very little of these soils are available to forestry but they should constitute highly productive forest soils.

Modified Grey-Brown Podzolics.

This peculiar group occurs on the dominantly limestone fluvio-glacial eskers and glacial outwash materials of Weichsel Age across the Midlands. These in many cases display well expressed podzol characters but under rather unconventional conditions for podzolisation. (See Gallagher and Walsh (1942)—Athy Series). It is now considered, as a result of more recent investigations, that these soils are polygenetic soils where due to vegetational change from a forest to a heath or gramineous cover the original profiles have been modified. In the case of heath, podzol development has proceeded within an original grey-brown podzolic profile and in the case of gramineous cover the surface horizons of the original profile have been homogenized.

These are a very mixed group of soils in terms of profile depth, degree of development and extent of modification. In general they still retain a high base status and reaction is about neutral to slightly alkaline, although numerous exceptions occur where both pH and base status are both in the moderate to low category. In the latter instance the surface organic matter content may be above normal levels and approaching a moder-mor type but about normal or sometimes low organic matter levels with a mull-type humus are most common.

The soils being well-drained, relatively light-textured and of favourable structure are extensively cultivated. The land form in certain cases however, makes cultural practices difficult. Pasture adequately manured and well managed can be very productive on these soils but water deficit in drier seasons, in particular on the lighter-textured and more shallow members, can be a distinct problem.

Brown Podzolics.

These soils are more intensely leached than the acid brown earths as a result of which they have been more depleted of bases and other constituents in the upper horizons. A characteristic feature of these soils is the presence of a subsurface horizon of strong red-brown or yellowish-brown colour due to enrichment principally by iron leached from the upper horizons. These soils therefore, with A/B/C profiles are more degraded generally and of more acid nature than the brown earths. However, they still retain an acid mull or in more degraded forms a moder-type humus.

The brown podzolics occur in many areas in close association with the acid brown earths where local conditions of parent material, topography or past vegetation cover have been more conducive to their formation. They are the dominant soil of medium elevations on acid parent materials such as non-calcareous shales, sandstones, granites, mica-schists and glacial drift of such sources. In such instances they usually occur as an intergrade group from the acid brown earths of the lowlands to the podzols which occupy the higher elevations.

The brown podzolics have usually a somewhat lower level of natural fertility than the brown earths. However, as well-drained soils of favourable structure, they are useful tillage and all-purpose farming soils, provided they are adequately limed and manured and well managed when they resemble the brown earths in behaviour. In their natural state these soils carried the primeval oak forests of Counties Wicklow, Wexford and Waterford, some of which were planted with larch and Douglas fir on private estates. These are considered excellent forest soils.

Podzols.

These soils are still more intensely leached than any of the foregoing, and as such they may be considered as degraded soils. They are usually developed on parent materials of very low base reserves or under conditions that tend to deplete the base reserves to this low level. The hills and mountains of acid geological materials—acid shales, sandstones, quartzites, granites, mica-schists—provide situations where both these factors are operative in soil development. The acid nature of the parent materials and high rainfall with low evapotranspiration losses in these areas, combine to allow a considerable downward leaching of soil constituents foremost amongst which are bases, iron and aluminium oxides and humus. In cases of further deterioration the surface becomes very acid, conditions for decomposition by micro-organisms become unfavourable, with the result that a peat-like, raw humus layer accumulates in the surface, on which a characteristic heath vegetation is found. These soils then, have very distinct profile differentiation or A/B/C profiles. In the more extreme forms the B horizon contains a thin iron-pan rather than a diffuse B as in the less extreme forms.

These are poor soils with high lime and nutrient requirements. Where they occur in lowland areas they have been successfully reclaimed for cultivation and other purposes in many cases. The more extreme forms that occupy extensive areas of hill and mountain throughout the country have not been ameliorated to any extent. In most cases the land forms and nature of the terrain associated with these soils are such that mechanical means of reclamation and cultivation are not feasible but considerable improvement in productivity is possible by surface regeneration including manurial amendments. The presence of iron-pan is a hindrance to root penetration (important in forestry as well as in the agricultural use of these soils) and to water percolation. For the latter reason the surface horizons of these podzols may develop very poorly drained conditions—a further drawback. Besides the low level of major nutrients in these soils they are generally very deficient also in trace elements vital in the nutrition of plants and animals.

These are the principal mineral soils available for afforestation and are usually planted with pines but with deep ploughing and phosphorus application they are suitable for Sitka spruce.

Skeletal Soils.

Throughout the hill and mountain regions in particular, thin, skeletal soils (comprising Rankers and Lithosols) occur intermixed with extensive areas of outcropping rock. The ranker group are composed of a thin moder-mor type humus layer overlying unweathered stones and shattered rock of an acid nature. The lithosols are stony soils with little of finer materials within the profile. These are very poor soils, of very low base reserves and natural fertility and with physical characteristics that strictly limit their development. Some surface treatment can improve their productive capacity for extensive grazing.

Gleys.

Gleys are those soils, of extensive occurrence in Ireland, in which the effects of drainage impedance dominate. These have developed under conditions of intermittent or permanent waterlogging. The impeded condition in these soils may be due to high watertable level or to perched watertable as a result of the relatively impervious nature of the soils or their parent materials or in certain cases to a combination of both factors. Gley soils therefore, can occur in depressions or on elevated sites on the landscape. Run-off of surface water from higher ground is also a major contributing factor.

The mineral soil horizons of gley profiles usually display distinct features associated with the drainage-aeration conditions prevailing such as drab grey colours with prominent ochreous mottling much in evidence. In cases of extreme conditions of waterlogging the greater part of the profile is characterised by grey and blue-grey colours with little or no mottling. Texture in general in these soils is heavy, especially in the surface-water gleys but gleying is not by any means confined to heavy textured soils. Relative to the foregoing soils depletion of bases and other constituents in general is not so pronounced in these soils. However, rooting area in them is limited, structure is very weak, aeration is poor, decomposition rate of organic matter is slow, leading to undesirable surface accumulations of a raw humus in more extreme cases, and they possess many other unfavourable features (Quinn and Ryan, 1962).

The majority of gleys are not very friable and when wet become very sticky. Due to their poor physical conditions, these soils, except in very favourable seasons, present difficulties in cultivation especially in the development of a desirable tilth. Besides, due to their poor drainage, growth is slow early in the season and this factor together with their weak structure, render these soils very susceptible to poaching damage by grazing stock. Consequently the grazing season on them is short. Nevertheless the potential of these soils for pasture production is very high in many cases, provided manurial and management practices are at an adequate level. They can be quite productive under trees also especially for Sitka spruce which however is liable to windthrow due to shallow rooting.

Peats.

Peats or organic soils are widespread in Ireland. These can on a broad basis be divided into two subgroups (a) Basin Peats (b) Climatic or Blanket Peats.

The basin peats were formed by the long-term accumulation of plant remains in post-glacial lake areas due to conditions for decomposition being unfavourable. The lower peat layers are composed of the remains of swamp species principally and are soligenous whilst the uppermost layers are associated more with ombrogenous *Sphagnum* species mostly. Whereas the underlying deposits in these lake beds are predominantly calcareous and of limestone origin the surface layers of the bogs are very acid.

The climatic peats are associated principally with the hill and mountain areas in the country where they form a surface blanket or mantle over the landscape. As such they are not confined to basin areas. Associated factors are chiefly the acid nature of the geological parent materials of low base and nutrient supplying power and the cool-temperate, humid climate.

The high organic content gives peat some unique chemical and physical properties and makes reclamation and cultivation difficult. Virgin peat has an exceptionally high moisture content, low ash in the dry matter and a massive structure with poor aggregate formation. As a result peat has low hydraulic conductivity, poor porosity and unfavourable aeration conditions. Other problems are inherent in the drainage and amelioration of peat and in the manurial and management practices required in attaining optimum output. (Burke and O'Hare, 1962). Nevertheless success has been attained in the reclamation of peats and in the production of pasture, arable crops and forestry on them at both a local individual level and on a more extensive scale in certain cases. The vast majority of peats in the country however, are still unreclaimed.

Distribution of the Soils

With the present state of knowledge and until such time as the survey, classification and mapping of our soils is more advanced it is not possible to delineate accurately the distribution of our very complex soil pattern. The geographic distribution of our soils is associated with climatic, relief and biotic factors as well as with the nature of the parent materials and these factors are in themselves very variable.

In a generalized manner the dominant great soil groups (already discussed) occurring in different areas or regions are outlined on the accompanying schematic soil map. The delineation of the different soil areas, and the composition of these areas in terms of the most commonly occurring great soil groups within them, are based mostly on spot checks and not complete surveys and the map must be interpreted as such. Likewise the soil boundaries shown are not by any means absolute in most cases. In reality what are shown are associations of dominant great soil groups but no account is taken of more minor inclusions or sub-groups that are interspersed with the dominant major groups.

The legend accompanying the map (Appendix) gives the great soil groups that are dominant in each area and the most commonly occurring geological parent materials associated with these soils. More detail is available in certain regions than in others as a result of more precise observations in these areas. A much more complete picture of the distribution of our soils will become available with the progress of soil survey in the immediate years ahead.

Acknowledgement.

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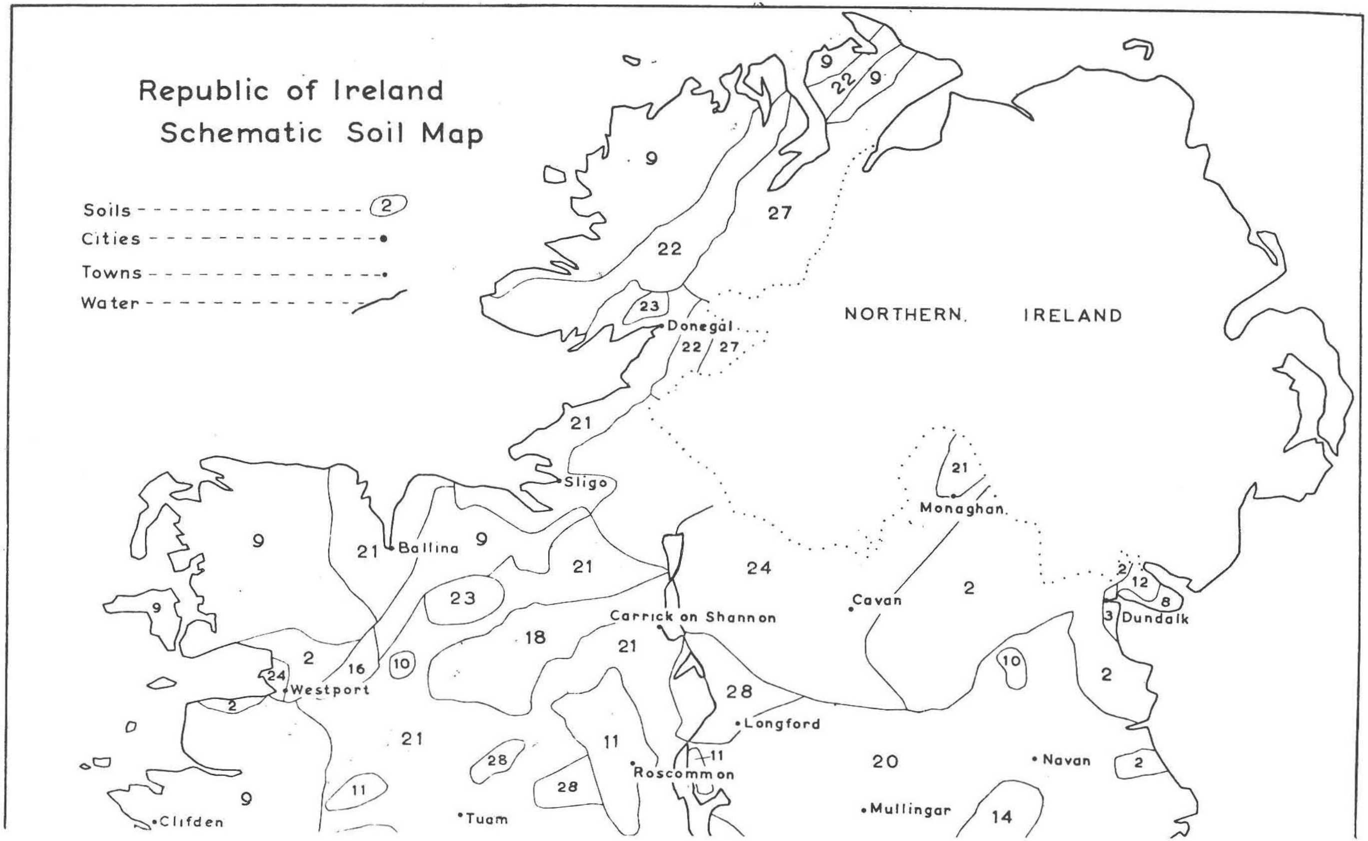
Appendix.

Legend.

1. Acid Brown Earths and Grey Brown Podzolics with some Gleys derived from Ordovician—Cambrian—Quartzite parent materials, mostly as glacial drift cover.

1a. Surface-water Gleys and slightly gleyed Acid Brown Earths derived from Cambrian-Ordovician-Quartzite parent materials mainly as a dense glacial drift cover.

2. Acid Brown Earths and related Brown Podzolics derived from Ordovician and Cambrian shales (igneous intrusions in places) or from Silurian or Avonian shales, with thin mixed glacial drift cover.
3. Deep ground water Gleys of alluvial origin.
4. Acid Brown Earths and Brown Podzolics and some Podzols derived from coarse-textured glacial morainic deposits.
5. Deep surface-water Gleys with some slightly gleyed Brown Earths derived from dense, mixed glacial drift of marine origin.
6. Grey Brown Podzolics and mixed Brown Earths derived from mixed coarse-textured glacial drift.
7. Acid Brown Earths and Brown Podzolics derived from Granite and granitic glacial drift.
8. Mixed Brown Earths and Grey-Brown Podzolics derived from a mixed Limestone—Dolerite—Diorite glacial drift.
9. Climatic Peats, Podzols, Skeletal Soils and Brown Podzolics, on acid igneous and metamorphic formations with mixed glacial drift cover in places.
10. Acid Brown Earths (many with gleying), Gleys, podzolised Gleys and Climatic Peats on Coal Measure and Yoredale shale formations with mixed glacial drift cover in most places.
11. Rendzina-like soils and Brown Earths of high base status derived from Carboniferous Limestone with dominantly limestone glacial drift cover (usually thin). Also some Basin Peats.
12. Grey-Brown Podzolics, Acid Brown Earths and surface-water Gleys derived from glacial drift mainly of Silurian—Felsite—Dolerite —Granite source.
13. Brown Earths (mostly medium base status) and Grey-Brown Podzolics derived from Limestone—Old Red Sandstone glacial drift with igneous influence in parts. Also some Gleys and Basin Peats.
14. Podzolised Grey-Brown Podzolics, Brown Earths of high base status and Grey-Brown Podzolics derived from mixed coarse, fluvio-glacial drift mostly of Limestone origin. Extensive Basin Peats also.
15. Brown Earths (medum-high base status) and Grey Brown Podzolics derived from mixed, mostly Limestone, glacial drift. Some Basin Peats and Gleys also.
16. Climatic Peats, Podzols, Skeletal soils, Gley-Podzols and Brown Podzolics mostly on Old Red Sandstone rock and glacial drift.
17. Acid Brown Earths, Brown Podzolics and some Gley-Podzols derived from mixed, mostly Old Red Sandstone, glacial drift.
18. Acid Brown Earths, Brown Podzolics, Podzols, Gley-Podzols,


Republic of Ireland
Schematic Soil Map
Soils 2
Cities
Towns
Water
NORTHERN IRELAND
Donegal
Sligo
Ballina
Carrick on Shannon
Monaghan
Cavan
Dundalk
Westport
Longford
Roscommon
Navan
Mullingar
Tuam
Clifden
9
22
27
23
21
24
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12
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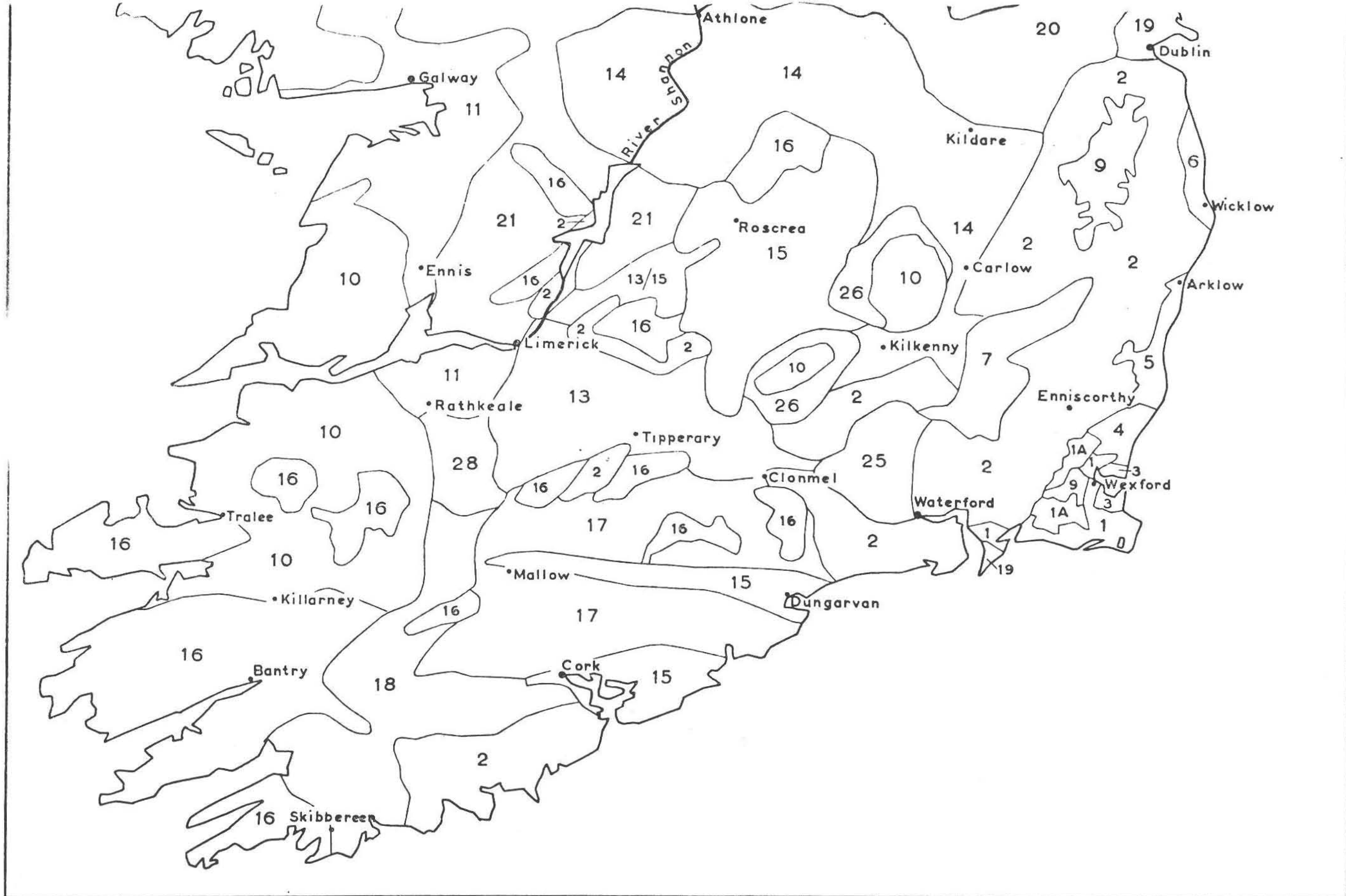

Prepared by National Soil Survey, Soils Division, An Foras Talúntais

Based on the Ordnance Survey by permission of the Government

Gleys and mixed Peats mostly on Old Red Sandstone and Avonian Shale rock and glacial drift.

19. Very deep black and brown calcareous soils derived from Limestone glacial drift.
20. Deep Brown Earths (medium and high base status) and Grey Brown Podzolics derived from mixed, mostly Limestone glacial drift. Also extensive areas of Basin Peats and Gleys.
21. Brown Earths (medium-high base status), Grey-Brown Podzolics and some Peats on impure Limestone and mixed, mostly Limestone, glacial drift.
22. Brown Podzolics, Podzols and Climatic Peats with some Gley-podzols on Mica-Schist and Gneiss materials.
23. Gleys and mixed Peats on mixed glacial drift.
24. Extensive areas of Gleys with Acid Brown Earths and Grey-Brown Podzolics (with and without gleying) and some Basin Peats on mixed glacial drift (mostly dense boulder-clay) associated with the Drumlins.
25. Grey-Brown Podzolics and Brown Earths (medium base status) on Limestone—Old Red Sandstone—Silurian glacial drift with some igneous influence.
26. Acid Brown Earths, Brown Podzolics and Gleys on mixed shales and glacial drift of similar origin.
27. Brown Podzolics and Acid Brown Earths on mixed predominantly Mica-schist and Gneiss materials.
28. Grey-Brown Podzolics, Gleys and some Basin Peats on mixed sandstone limestone drift and on glacial lake deposits.

The Improvement of Forest Trees by Selection and Breeding

By A. F. MITCHELL,
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THE first step in establishing a plantation is to select the species which is most suitable for the site and the future requirements of produce. Until recently selection ended at this stage.

Seed of the species decided upon was obtained from wherever it was cheapest or most convenient. Exotic species with very wide geographical and altitudinal ranges were planted on a large scale during the eighteenth and nineteenth centuries, but it was only towards the end of the nineteenth century that the importance of the actual area of origin began to be realised. For example European larch from high altitudes was recommended because of the northern latitude of Scotland where it was to be planted. Later still it was found that trees raised from these areas failed badly due to the late spring frosts, and lowland larch from farther east was found to grow better. Similarly the inland provenances of Douglas fir, the Blue or Colorado Douglas, were clearly inferior to the green or Coastal Douglas fir. It was realised that choice of species alone was insufficient; there must be a choice also of provenance of the species for the conditions where it was to be planted.

Within areas of similar climate there are tree populations which differ in quality and vigour. This is most marked where the trees occur in scattered groups too far apart to interbreed. A noted example is the Polish larch. The choice of provenance must then be narrowed down to the best stands within the chosen climatic or altitudinal zone, and the survey of populations to assess their quality is the first step in tree-breeding. This can be taken a stage further in certain cases, by removing all the inferior trees from the selected areas when the remaining high quality trees interpollinate. They also then have room to develop bigger crowns and carry more flowers, male and female, and so produce more and better seed.

The stage beyond that of selecting and thinning seed-sources is the selection of the finest individual trees, wherever they may be, and breeding from these alone. This requires the special techniques of vegetative propagation and the formation of seed-orchards.

Natural Selection.

The species and individual trees now growing in natural forests are the survivors of very long periods of natural selection. Any tree possessing an heritable difference rendering it capable of producing more offspring than the others will be represented in the succeeding generations by a greater number of offspring, until this favourable character is to be found throughout the population. Conversely an heritable disability to produce offspring is progressively swamped and disappears—in one generation, in the extreme case of sterility. Hence natural populations are composed of individuals inheriting primarily the ability to survive and flower in their environment. The features most important in a timber-tree may have been selected incidentally —a single straight stem is the most efficient way of carrying a crown high among other trees, for example—or they may, in other circumstances, have been selected against. For example, in an open stand, more flowers can be carried early in life on a low, spreading crown with strongly developed branches.

Artificial Selection.

The breeding of many plants and animals has been carried on almost unconsciously since man settled into pastoral ways. Cattle, dogs and horses were bred for different uses and conditions. Food crops have been gradually selected for increased production of the edible parts. The effects of selection are very powerful and even this unplanned selection has changed the food plants until they bear small resemblance to their wild ancestors. The same changes could have been made in very much fewer generations had they been planned. The first requirement is to decide the aim of the breeding programme. In each generation only the plants which are nearest the ideal are used to raise the next generation. Each generation is thus one step nearer the ideal. Carefully planned selection can have rapid and startling results as is shown for example, in Russell lupins, Excelsior foxgloves and Ballard Michaelmas daisies.

The response to selection depends on the amount of variation occurring in the original population and on the intensity of selection. Most forest tree species are very variable and cross-pollinate freely which maintains this variability. Thus selection can be an effective method of producing improved varieties.

Selection may be operating in undesired directions. One example is the way pests subjected to poisonous sprays produce varieties which are resistant to the poison, by the intense selection against susceptible individuals and in favour of any degree of resistance. A more subtle example is provided by the accidental production of Flax Darnel in the Netherlands. Darnel is a weed-grass growing in the flax fields. When the flax is cut for seed the flower-heads of darnel are normally below the level of the flax and unripe. An early individual plant occurred once, however, and at the flax harvesting time, its seeds were ripe and high enough to be cut. The seeds were mixed with the flax seed and were sown with it, and the process was repeated until this new variety of darnel became a regular contaminant of flax over a wide area.

It is evident that if the best individuals of any crop are removed before they have produced as many offspring as those left behind, a selection will operate in favour of the less desirable types. This is what happens in forests which are exploited in a primitive manner and it has degraded the natural forests of large parts of the world. In the course of time the better inherent factors or genes have been lost and such stands can no longer produce trees of good quality. Tree-breeding aims to reverse this process and raise stands possessing only the best factors.

The Objects of Tree-Breeding.

Broadly, the object of tree-breeding is to produce varieties of trees which are the most desirable for both grower and user. Fortunately the qualities required by silviculturists and timber-merchants are largely compatible.

The silviculturist or forester requires rapid germination and growth in the nursery; rapid establishment of a crop of disease-free trees and rapid growth to timber-size. The trees should also have compact crowns with dense foliage and small, nearly horizontal branches which prune easily or fall naturally.

The timber users require a straight, nearly cylindrical stem, free from fluting and spiral grain, and wood of uniform quality and of the necessary density, fibre-dimensions and so on, with few or small knots, perpendicular to the grain.

The two qualities of rate of growth and size of branches can be altered by silvicultural practice, but only within the limits inherent in the population. If the crop is inherently very vigorous, growth can be retarded if necessary by close spacing or delayed thinning but if the population is not inherently vigorous, no silvicultural treatment can make it grow very fast should this be required. Hence selection of the parents should be in favour of maximum vigour. Again, it is difficult to foresee the requirements of the timber-trade sixty years ahead of the date of planting so the safest plan is the production of the maximum possible yield of wood per unit area of land.

Thus the aim is to produce trees of great potential vigour, healthy, with straight, persistent stems which are as nearly cylindrical as possible and possess regular, numerous, small and level branches cleanly set in the stem.

The Selection of Parent Trees.

It will be evident that only those characters which are inherited can be improved by breeding. It is fortunate that the greater number of the important characteristics of trees have been found to be heritable in varying degrees. It would seem simple, therefore, to find trees in the forest which approach the ideal and breed from these. This is the general plan, but there are complications in assessing the trees for use. No characteristics are inherited in the manner of goods—the same entities belonging to successive generations. The most that can be inherited is the ability to show a character given the required environment. For example, although gorse plants are said to inherit spiny leaves, a gorse seedling grown in high humidity will develop trifoliate leaves and not spines. Trees are long-lived and may be conditioned to their environment to a greater degree than other organisms. The tree in the forest is the result of the interaction between the potentials inherited and the effects of the environment. This important concept is expressed in the terms *genotype,* or inherent make up of the tree and the *phenotype,* the actual appearance of the tree modified by its environment. The selection of trees for breeding is dependent on the estimation of the relative importance of genotype and environment in forming the tree. Three methods are used in selecting trees by which this is done. These are:—

(1) For single trees, straightforward assessment of the environmental effects from topography and soil and the condition of other trees and plants in the area.

(2) In plantations the potential plus trees are surrounded by other trees in very nearly the same environment and their relative performance can be seen. If conditions were completely uniform the differences among trees would be solely those due to their genotypes.

(3) On very favourable sites every tree will be almost as good as its genotype is capable of making it i.e. genotype almost equals phenotype. Such sites do in fact produce a great variation among trees of the same species and the outstanding trees can be selected and the rest safely ignored.

Further difficulties arise from trees which would be selected but have some defect which may be due to damage of a random nature i.e. loss of the leader some years previously. This could have been caused by wind, snow, another tree blowing against it or by birds. Sometimes many trees in one area show such damage at similar heights and from the date when it occurred it can be attributed to an ice-storm known to have happened at that time. This kind of defect might occur in any tree, but on the other hand, there may be trees which are more susceptible to it than others and these would not be desirable. The safest course is to discard such trees unless certain desired characteristics are really exceptionally well developed.

Selection of trees in very unfavourable conditions, as for example at high altitudes or severe exposure is a special case. It may be that the best trees selected on favourable sites would produce the best plants for extreme sites too, but this hypothesis needs testing. Meantime trees are selected on such sites and should be used separately because their use may be limited. For example in severe exposure the only trees which can show good stem form and crown-shape are those able to withstand the wind. Any other trees which might on a favourable site, have been of excellent form, will be mis-shapen on the site where it is growing. Plants raised from trees selected on these sites may be the best for growing on such sites but not on others.

The selection of broadleaved trees raises the problem of the lack of persistence of the main stem, which even in the best oak for example is seldom longer than fifty feet. This is so even in plantations, whereas open grown oak frequently fork much lower. Nearly all the value of an oak stem lies in the bottom thirty feet and it might be thought sufficient to select trees which fork at or above this height. But there is no guarantee that progenies of such oak will not fork below thirty feet whereas this is less likely if all the parent trees have grown fifty feet with a single stem. In beech it is possible to select trees with stems persistent through the crown to the top at over 100 feet, although this is rare. Good boles of seventy feet are, however, found less rarely.

Some defects debar a tree from selection completely. These are susceptibility to disease, possession of spiral grain and excessive fluting or bending.

Selection of plus trees along the lines outlined above does, in fact, produce progenies much superior to the normal seed. In Australia, trees raised from normal and selected Loblolly pines have been compared, also those raised by controlled pollination of selected trees as would occur in a seed-orchard. The results, with the trees at 800 to the acre are tabulated below:—

	Good trees/acre	Plus trees/acre
Average seed (normal collection) ...	112	1
Selected parents (open pollination) ...	200	10
Three best selected parents	277	47
Controlled pollination	412	80

Controlled pollination of larches in Britain has shown that at four years of age the progenies are outstanding. At two years assessments showed that vigour is heritable to a small degree and only the most vigorous trees produced progenies significantly more vigorous than normal. Later assessments may well show a greater inheritance of vigour but selection should be very rigorous and only outstanding trees should be selected.

Once sufficient plus trees have been selected to make graphs of the height and girth reached at different ages by this kind of tree, the figures can be used as a basis for selection as far as vigour is concerned. The fastest growing plus trees of larch at various ages lie on curves up to three quality classes above Quality Class I in the Yield Tables.

The Use of Hybrids.

Progress in breeding by selection depends on the natural variation available. One way to increase variation is to cross trees of different species and select among the hybrids. Only species which are closely related will cross, but even so their genotypes are usually very different and the second generation of their hybrids (i.e. F_2 plants raised by crossing the first generation, F_1) will segregate to produce new variants. In other branches of plant-breeding it is possible to work through generations rapidly and great progress is made by this method. In forest trees the time needed for raising and seeding a generation makes it desirable in practice to use the first generation hybrids for planting in the forest. But while these are being raised in quantity, a few of the most desirable are selected and planted together for raising an improved second generation. Selection here must be rigorous, for in raising a second generation from hybrids, there is normally a loss of a phenomenon known as hybrid vigour, or heterosis. Heterosis occurs where plants raised from dissimilar parents are superior for any characteristic to either parent, and is therefore confined to the F_1 cross. Heterosis in some qualities—for example vigour in some western American pines—has been shown to occur only in climates intermediate between those of the parent species. It may have a number of genetic causes but in some cases a simple explanation may be sufficient. For example, natural crosses between Nootka cypress, *Chamaecyparis nootkatensis* and the Monterey Cypress, *Cupressus macrocarpa* arose in Wales in 1888 and 1911. The Nootka cypress inhabits the cool moist regions of western North America and the Monterey Cypress comes from a hotter, drier peninsula in California. The former is of slow growth and the latter is fast. The hybrid, known as Leyland's cypress *x Cupressocyparis leylandii,* on all sites so far used, easily outgrows the Nootka cypress, and on many sites outgrows the Monterey cypress as well. This could be due to inherited ability to grow well in both the cool moist periods in which the Monterey does not do so well, and in hot dry periods, in which the Nootka is slow, so that in our climate with both kinds of weather, the hybrid can grow well at all times.

Species which have a wide natural distribution may consist of a number of geographic races or even subspecies. Crosses between the geographic races are intra-specific but since their parents are of different non-interbreeding populations, these crosses may show hybrid vigour. Crosses between the Blue or Colorado Douglas fir and the Green or coastal Douglas fir; and between the Polish European larch and Western alpine European larch are such intra-specific hybrids and may prove to be of value.

Tree Seed-Orchards.

The seed-orchard is the means of selective breeding and cross-breeding in trees. The selected "plus" parent trees are propagated by grafting and clones of these grafts are planted in balanced mixtures in such a way that the female flowers of a given clone can be pollinated equally by all the other clones in the orchard. The individual grafts of each clone are separated from each other to prevent self-pollination for this inbreeding causes a loss of vigour and the production of many aberrant forms. The minimum number of clones in any one seed-orchard is usually 20, and 30 is better but a few small orchards of 10 clones are made for special purposes. The higher numbers are preferable for large scale forest use, to avoid the harmful effects of inbreeding among progenies from the stands which will be raised from seed-orchard seed, where natural regeneration may be required.

The seed-orchard is planted on a site isolated by distance from other trees of the same or related species to avoid contamination from unselected trees. The minimum distance from a stand of other related trees is a quarter of a mile. Scattered individual trees at half this distance will have a negligible effect. The best areas are those of a good but light soil of high nutrient status, preferably with a southward slope and in a part of the country receiving much sunlight and high June and July temperatures. These factors increase the flowering and hasten the first crops of seed. Air-drainage is of great importance to minimise damage from late frosts.

Seed-orchards intended for the production of inter-specific hybrids are planted with the grafts of the two species alternately in the column and the rows. Thus each graft of one species has four plants of the other species adjacent to it. Conifers are wind-pollinated and it has been found that all but a small fraction of the pollen comes from adjacent trees. The proportion of hybrid seed produced, however, depends also on the relative flowering times at each orchard of the two species and of the clones of those species being used. The parent trees may be growing in any area of Britain or abroad and their times of flowering observed where they are growing does not show their relative times of flowering when all are in one area in an orchard. These can be found only from the seed-orchards themselves or from the collection of grafts, called "tree-banks" which are built up by the breeder. Tree banks are discussed below.

From observations on flowering times in tree banks, of all plus trees, early and late clones may be used to exercise some control over the output of seed and in hybrid larch orchards the outgoing seed can be sorted at picking, if the right trees are used. The Japanese larch sheds pollen two weeks before most European larch but the cones of the European are receptive when the Japanese pollen is shed. Hence by ensuring that the orchard does not contain any unusually early pollinating or late coning European larches, all the cones collected from the European larch clones will contain hybrid larch seed and the cones from the Japanese larch will produce pure Japanese larch seed. To produce pure European larch from a hybrid orchard, late coning European larches could be used with early pollinating Japanese but in practice it is better to have pure European larch orchards separately. Pure Japanese larch orchards will be unnecessary as this seed will be produced by the Japanese larch cones in a hybrid orchard if there are no early pollinating European larch. From these findings it is also apparent that the output of hybrid larch seed is proportional to the number of European larch grafts. Since the Japanese larch cones used have mostly proved copious pollinators, hybrid larch orchards can now be made with only one Japanese larch graft to every four European larch grafts.

The onset of flowering in grafted plants is usually earlier than in trees of seedling origin, especially in pines, spruces and beech. The flowers are first borne within easy reach of the ground making controlled crossing work easy. The trees may be pruned to increase or encourage early flowering—the shapes of the grafts cannot affect the genotype of the seed they produce. If the grafts are allowed to grow tall, climbing for seed-collection is concentrated and special methods may be developed to make cone-collection easier.

The Tree-Bank.

As has been said above, for observation small numbers of grafts of every plus tree selected are put in tree-banks. These are also used to build up supplies of grafting material. Ideally seed-orchards would be made after these observations in tree-banks had been made, but in order to save time and to have seed-orchards from the earliest possible time, so that their management can be learned, the best of the first plus trees found are put straight into seed-orchards. The grafts in the tree-bank ensure that if the parent tree is blown, or felled, or dies, there is still material available from it to make more grafts. It enables scion-collection to be done rapidly from the ground within a few acres, from parent trees which may be scattered all over the country. The grafting material taken from grafts is frequently much superior to that from the parent tree and makes better grafts.

Botanical and cytological work and small scale experimental crosses can also be carried out in tree-banks and to some extent the forms of growth of the parent trees can be compared under the same conditions of soil and climate etc.

General Conclusions.

Although at first sight, the long time-gap between generations might make tree-breeding seem impracticable, there are now techniques which make possible the production of improved cultivars within a few years. Eight years after establishment, the first larch seed-orchard has produced two crops totalling about ten pounds of seed. More recent seed-orchards are getting established more quickly and have been planted at twice the density. The estimated annual production after ten years should be 10 lbs. of seed per acre and at twenty years perhaps 50 lbs. per acre. Thus 20 acres of larch seed-orchard can contribute substantially to national requirements. Seed-orchards are expensive to establish but even if their products give only a one per cent. increase in the crop value, the outlay yields a big return, for it must be noted that one pound of larch seed for example, of normal germination, provides plants for 15 acres of forest. With the improved germination a good seed-orchard should provide and the wider spacing which may be adopted with high quality plants, one pound of seed may plant 30 acres. A small increase in value of timber on 30 acres of land would allow a very great increase in the economic price of a pound of seed needed to plant it.

The establishment of seed-orchards enables the few really outstanding trees growing in any country to be used as the progenitors of all the crops planted, and provides the material for raising a succession of improved cultivars.

The Resin Canals of Pinus Contorta Loudon *

By T. M. Black

Summary.

THE purpose of the investigation was to attempt to (1) clarify the position regarding the number of resin canals found in the leaves of *P. contorta* Loudon and var. *latifolia* Engelm., and (2) find some feature of the resin canals which may be used to distinguish different provenances of the species. Examination of the needles of nine provenances growing at Millbuie Forest, Easter Ross, Scotland, revealed the existence of primary and secondary resin canals which have not been previously observed in the species. These two main types may be further subdivided according to the length and position of the resin canals in the needles. The occurrence of some of the different types of resin canals in the provenances indicates that there are large areas within the natural distribution of *P. contorta* Loudon in which many resin canal characteristics are uniform. It also appears to be the case that it is possible to distinguish individual provenances within these areas by the occurrence of other resin canal characteristics, although further work is required before a satisfactory key can be devised.

Introduction.

In recent years it has become apparent that *Pinus contorta* Loudon has an important part to play in afforestation. Considerable attention has been paid to the question of selecting suitable provenances, and to the more striking differences between these provenances. Vigour, form, needle colour, and other characteristics have been studied fairly intensively with a view to (a) assessing the probable value of provenances for planting, and (b) distinguishing coastal and inland forms of the species, as well as different provenances. Little detailed anatomical work, however, has been performed.

The principal objective of the present study is to investigate one aspect, resin canals, of the anatomy of the species and determine its usefulness in distinguishing different provenances. An examination of the literature indicates that it may be possible to distingush the coastal form of the species, *P. contorta* Loudon, from the inland one, var. *latifolia* Engelm., by the number of resin canals. Most of the recorded details of the resin canal number are, however, rather contradictory and it is intended that the present investigation will clarify this situation, at least, to some extent.

The specimens examined in the course of the investigation were obtained from trees growing in a provenance trial at Millbuie Forest, Easter Ross. In all, ten needles from each of two-hundred-and-fifty

* This article is based on part of a thesis submitted for the degree of Ph.D. at the University of Aberdeen.

trees, belonging to nine different provenances, were sectioned and examined. Four of the provenances were of coastal origin, and the remainder originated from inland areas in the natural distribution of the species.

Literature.

One feature of the literature dealing with the species is the lack of agreement on the number of resin canals occurring in the needles. Britton and Shafer (2) state that *P. contorta* Loudon has two median resin canals, and Martinez (9) reports the same number for var. *latifolia* Engelm., the inland form. Harlow (6) records that the former usually has two resin ducts, occasionally one or three, and that they are rarely absent. However, other authorities, while agreeing that one or two resin canals may be present, state that they may be frequently absent (3, 5). Beissner (1), in fact, uses this feature as one point to distinguish *P. contorta* Loudon and var. *latifolia* Engelm. According to him resin ducts are often absent in the former, and normally present in the latter. It has been noticed, however, that resin canals are often absent from var. *latifolia* Engelm. (7) and, indeed, Sutherland (11) could not find any at all. From the foregoing it is apparent that a considerable amount of confusion exists as regards the number of resin canals.

One article dealing with samples taken from many points in the species natural range, has clarified the position to some extent. Critchfield (4) found that the great majority of needles have 0, 1, or 2 resin canals but the number may range from 0 to 7. He also found that the mean number of resin canals per needle in individual trees ranged from 0 to 3.9, and that the sample mean for groups of trees varied from 0 to 2.1 resin canals per needle. However, he summarised his results in the statement that:

". . . . . the frequency of resin canals shows much greater differences within geographic provinces than between them".

The only exception to this was in the Mendocino white plains area where resin canals were found to be totally absent. He also studied some specimens from plantations grown at Placerville in California, New Zealand, and Yorkshire, and concluded that:

". . . . . geographic variation in resin canal number is principally controlled by genetic differences between local populations".

Resin canal types.

In studying the resin canals, sections were usually cut at (1) the base, (2) the mid-point, and (3) the middle of the top third of the needle's length. Sections were frequently cut at other points but the three enumerated above were those adhered to in most of the work. The basal section was cut at the point where the two needles of a single fascicle separate and was, therefore, situated just above the apex of the dwarf shoot from which the needles arise.

The resin canals can be divided into two distinct types :—

Primary: resin canals which arise at the extreme base of the needle, and thus can be seen in sections cut at this point.

Secondary: those which arise at a point situated above the base of the needle and thus cannot be seen in the basal section, although sections cut elsewhere in the needle may have resin canals present.

The primary resin canals can, on the basis of length, be sub-divided as follows :—

(a) the primary resin canal runs, more or less, the entire length of the needle.

(b) the resin canal is shorter, and is evident for about half the length of the needle. It is present at the mid-point but absent from the section cut at the middle of the top third of the needle's length.

(c) the resin canal is very short and is confined to the region just above the base of the needle.

Type (c) is generally up to 1 cm. long and, as in (a) and (b), a central cavity is normally present. Sometimes it is represented only by a small bundle of sclerosed cells, usually less than five in number. In this case it is the continuation of a resin canal which has, below the apex of the dwarf shoot, a central cavity. On the other hand, primary resin canals of types (a), (b), and the normal variety of (c) may, or may not, have a central cavity present below the apex of the dwarf shoot.

Secondary resin canals begin, and like primary resin canals, end, as a small bundle of sclerosed cells. The central cavity disappears first, then the secreting epithelium, and finally the sclerosed cells. This type, like the primary resin canals, can be sub-divided on the basis of length and position in the needle :—

(a) starts below the mid-point of the needle and finishes near its tip.

(b) found only in the middle third of the needle's length, being absent from the section cut at the mid-point of the top third of the needle.

(c) situated in the top third of the needle's length, and absent at the needle's mid-point.

A minor variant of type (c) is where the resin canal is found only at the extreme tip of the needle. In this event the resin canal begins above the point situated one sixth of the needle's length below the tip, and thus is generally found in the top 5-7 mm. of the needle. Its occurrence is rare.

The occurrence of resin canals within individual needles.

Generally, the needles have 0, 1, or 2 resin canals present. In the case of needles having 2 resin canals, both are usually of the same type i.e. either primary or secondary. However, some needles have 1 primary and 1 secondary resin canal.

The resin canals are normally median in position and are situated at the corners of the needles. If the needle has 3 resin canals, as is occasionally the case, the third resin canal is usually situated in a median position in the middle of the abaxial side of the needle. In this case the third resin canal is often secondary and the two normal resin canals primary, but all three canals may be primary. Needles having 4 resin canals have been found, in which event three of them are usually primary and one secondary. The primary ducts are situated at the corners and in the middle of the abaxial side, the secondary resin canal being situated between one of the corner resin canals and the one on the abaxial side.

Material and method.

Nine provenances growing in an experiment at Millbuie Forest on the Black Isle, Easter Ross, were selected for examination. (Table I). Thirty trees were chosen at random from each provenance, with the exception of Shuswap Lake from which only ten were taken. Shuswap Lake and Salmon Arm are practically similar as regards position, the main difference being in altitude (Table I), and it was considered that ten trees would be sufficient to indicate any possible difference between them.

Needles were collected from vigorous vegetative shoots of the current year situated in the top third of the crowns of the trees, the leaders being excluded. The shoots were from all aspects. Only needles from the upper exposed side of the shoot, about its middle point, were collected. Fifty needles from each tree were measured, one needle being taken from each of fifty fascicles. The average needle length per tree was then calculated. The ten needles nearest the average, and situated on either side of it, were chosen for further examination. These needles were sectioned as described in that part dealing with resin canal types.

Results.

The results are summarised in Tables I-V. The figures for Shuswap Lake have been multiplied by 3, whenever necessary, to make them directly comparable with those given for the other provenances.

(a) The total number of resin canals present at three levels in the needles of the provenances. (Table II).

Six of the provenances examined show a decrease from base to top in the total number of resin canals counted at each of the three levels investigated. This feature is most marked in the two southern coastal provenances, Olympic Peninsula and Grays Harbour, in which the total number of resin canals present in the sections cut at the middle of the top third of the needles' length is only about half the number present in the sections cut at the base of the needles. Three provenances exhibit a totally different trend in which the total number of resin canals increases from the base to the top of the needles. The prominence of secondary resin canals in these provenances is, of course, the reason for this trend.

It may be stated that Table II indicates that there are three distinct trends exhibited by the provenances examined :—

(1) Queen Charlotte Islands, and Sonora Island–New Westminster.
These two northern coastal provenances have a high number of resin canals and the bulk of them run the entire length of the needle.

(2) Shuswap Lake, Salmon Arm and Priest River Valley.
These three inland provenances show a marked departure from the normal in that the total number of resin canals increases from the base to the tip of the needles. This feature is very marked in the Priest River valley provenance which is the most southern of the three. In this case, however, the maximum is reached, not at the top of the needles, but in the middle. It is also more outstanding in the Salmon Arm provenance than in one from Shuswap Lake, and in this connection it is an interesting point that the Salmon Arm provenance comes from a lower altitude than the Shuswap Lake provenance.

(3) Olympic Peninsula, Grays Harbour, Prince George, Williamson River.
The remainder of the provenances are characterised by a distinctly lower number of resin canals than are present in the two northern coastal provenances, and by the same decrease in number from base to top. As has already been stated this decrease is most marked in the two southern coastal provenances, Olympic Peninsula and Grays Harbour.

(b) The distribution of needles having no resin canals, or resin canals of different types, in the provenances examined (Table III).

An examination of the number of needles having no resin canals indicates that the provenances may be grouped as follows :

(1) Queen Charlotte Islands and Sonora Island–New Westminster.
These two northern coastal provenances are characterised by the low number of needles having no resin canals.

(2) Grays Harbour, Shuswap Lake and Williamson River.
In these three provenances approximately one-third of the needles examined had no resin canals.

(3) Olympic Peninsula, Prince George, Salmon Arm and Priest River valley.
The other provenances are distinguished by the fact that about half of the examined needles exhibited no resin canals.

However, although these groups are distinct it should not be construed that statistically significant differences are absent within each group. For example, the first group obviously has far fewer needles with no resin canals than the provenance with the next lowest number, Williamson River, but the difference between Queen Charlotte Islands and Sonora Island—New Westminster is still of such an order as to be statistically significant at the 1% level. Similarly, in the second group mentioned in the preceding section, there are significant differences at the 1% level in the proportions of resin canals at the base, middle, and top of the needles.

Critchfield (4) in his study of the species found that:

". . . . . a needle is more likely to have either two or no resin canals than to have only one".

Table III indicates that this is true of most of the provenances. If primary resin canals only are considered then the exceptions are Salmon Arm and Priest River valley: if secondary resin canals are considered the exceptions also include Shuswap Lake. Addition of the number of needles having both types of resin canals shows that all three provenances have more needles with one resin canal than with two, the feature being most marked in Salmon Arm.

	Needles having:—		
	No resin canals	1 resin canal	2 resin canals
Shuswap Lake	105	99	93 (96)
Salmon Arm	154	88	49 (58)
Priest River valley	164	65	51 (71)

If the number of needles having one primary and one secondary resin canal are added the values given for the number of needles having two resin canals are altered to those given in brackets. In this light it appears that the only exceptions to Critchfield's statement are Shuswap Lake and Salmon Arm, and the difference in the number of needles having either one or two resin canals is small in the case of Shuswap Lake.

One of the most outstanding features of Table III is the large proportion of needles having secondary resin canals in three of the inland provenances. It is evident that this is a character peculiar to Shuswap Lake, Salmon Arm, and Priest River.

Table IV gives some indication of the distribution of these needles in relation to the trees sampled in each provenance. It should be emphasised that the classification employed is arbitrary. For example, in a particular tree only one of the ten needles examined may exhibit resin canals, if these resin canals are primary the tree is classified as having only primary resin canals. Similarly, if only one secondary resin canal was found in the ten needles examined the tree would be classified as exhibiting only secondary resin canals.

(c) The variation in the number of primary and secondary resin canals of different types in the provenances examined. (Table V).

An examination of the distribution of primary resin canals by type in the coastal provenances shows that there are two distinct groups. The two southern coastal provenances exhibit a smaller number of type

(a) and a larger number of type (c) when compared with the two northern ones. Statistically significant differences in the distribution of primary resin canals by type are absent within each of the two groups. This is also true of a group of the inland provenances consisting of Shuswap Lake, Salmon Arm, and Priest River valley. Comparison of the two remaining provenances, Prince George and Williamson River, revealed the existence of a significant difference at the 1% level as regards the distribution of primary resin canals by type.

The three types of secondary resin canals are common in only three inland provenances, Shuswap Lake, Salmon Arm, and Priest River valley. It is obvious from Table V that there are large differences in the distribution by type between the three provenances. This is in complete contrast with the position as regards the distribution of primary resin canals by type within the same three provenances.

Discussion.

It is evident from the details given in the previous sections that the provenances examined may be divided into groups, and that the composition of the groups will vary with the feature under consideration. However, it would also seem to be the case that some divisions of the provenances cover several features and, thus, appear to be more natural, or generally applicable. In the coastal provenances the most suitable grouping appears to be (1) Queen Charlotte Islands and Sonora Island—New Westminster, and (2) Olympic Peninsula and Grays Harbour. Within each of these groups statistically significant differences are absent in respect of many features e.g. the proportions of resin canals at the base, middle, and top of the needles; the average number of resin canals per needle; and in the distribution of primary resin canals by type. Similarly, the inland provenances may be divided into two groups: (1) Prince George and Williamson River, and (2) Shuswap Lake, Salmon Arm, and Priest River. Again, statistically significant differences are absent in respect of numerous features e.g. the average number of secondary resin canals per needle and the division of needles with resin canals between those having primary or secondary resin canals.

Some features obviously follow the pattern described above and, yet, may exhibit significant differences within the groups. The proportions of needles with no resin canals in the coastal provenances indicate that Queen Charlotte Islands should be grouped with Sonora Island—New Westminster, and Olympic Peninsula with Grays Harbour. Significant differences at the 1% level are present within both groups, but the difference between the groups is much greater than that within the groups. In the inland provenances the distribution of primary resin canals by type also indicates that the division of provenances given previously is satisfactory. There are no significant differences within the second inland group, but a significant difference at the 1% level between Prince George and Williamson River. Table V, however, shows that Prince George and Williamson River are the only inland provenances to exhibit primary resin canal types (b) and (c) in any quantity. The proportions of resin canals at the base, middle, and top of the needles in the inland provenances also confirm the given grouping. In this case there is no significant difference between Prince George and Williamson River, and the significant difference at the 1% level within the second group is due to the Priest River provenance. Inspection of Table II shows that Priest River has a greater affinity with Shuswap Lake and Salmon Arm than with any other provenance, or group of provenances. Secondary resin canals occur in quantity only in the second group of inland provenances and, hence, though there are significant differences between the provenances they are not of the same magnitude as the difference between the group as a whole and the rest of the provenances. In summary, it can be stated that although significant differences may be present within the described groups the differences between the groups are generally of a larger order.

It may be contended that the first inland and second coastal groups of provenances appear to have much in common and, thus, these two groups should be amalgamated. However, the differences in the distribution of primary resin canals by type, and the effect of this on the numbers of resin canals found at the three investigated levels in the needles, would appear to be sufficiently large to warrant the two groups being kept separate.

Critchfield (4) found that resin canal frequency showed much greater differences within geographic provinces than between them. This would appear to be contrary to the present results. However, he was concerned only with the number of resin canals per needle as counted in sections cut at the middle of the needles. It is clear from the data given that this method will give, in many cases, an underestimate of the number of resin canals per needle. For example, Grays Harbour exhibits an average of 0.73 resin canals per needle when only those situated in the middle of the needle are considered (Table II). In fact the average number of resin canals per needle for this provenance is 1.107 (Table V). Another point which is of much greater importance is that his geographic provinces were extremely large e.g. one covered the Rocky Mountains, another the Sierra-Cascade mountain chain. Hence, it is clear that although Critchfield is correct in his findings there are still large areas within the geographic provinces, as defined by him, which exhibit a high degree of uniformity in respect of, at least, some of the features examined.

Four subspecies of *Pinus contorta* Douglas ex Loudon were distinguished by Critchfield (4). They were :—

Subspecies		Geographic province or group
contorta	...	Coastal.
bolanderi	...	Mendocino white plains.
murrayana	...	Sierra Nevada, Oregon Cascades.
latifolia	...	Rocky Mountains.

The four coastal provenances examined, naturally, can be classified as ssp. *contorta.* All the inland provenances investigated, with the exception of Williamson River, belong to ssp. *latifolia.* The Williamson River provenance originates from the natural range of ssp. *murrayana.* On this basis Williamson River might be expected to exhibit some features, concerning the resin canals, which would enable it to be easily separated from the other inland provenances. It may be distinguished from the three eastern inland provenances e.g. by the small number of secondary resin canals, but, it has already been shown that Williamson River is very similar to Prince George. Williamson River has fewer needles and trees with no resin canals than Prince George. These are outstanding distinctions between them, but it should be noted that Williamson River and Shuswap Lake have comparable numbers of needles with no resin canals, and Salmon Arm and Williamson River have similar numbers of trees with no resin canals. The distribution of the primary resin canals by type (Table V), however, reveals a significant difference at the 1% level between Williamson River and Prince George. It is interesting to note that this feature does not show the presence of significant differences within the other groups i.e. the two northern and the two southern coastal provenances, and the three eastern inland provenances.

Examination of characters, other than the resin canals, indicates that Williamson River is distinct from the other provenances. Table I shows that it has the shortest needles of the inland provenances. It also has, by far, the broadest needles of all the provenances examined. The mean values for the coastal provenances range from 1.43 to 1.50 mm., the mean of the other inland provenances vary from 1.51 to 1.61 mm. and that for Williamson River is 1.85 mm. In this connection it is interesting to note that Critchfield (4) describes ssp. *contorta* and ssp. *latifolia* as having leaves of medium width, while ssp. *murrayana* has wide leaves.

Critchfield (4) found that both leaf width and resin canal number increased regularly with increasing altitude. The main difference between the origins of Shuswap Lake and Salmon Arm is probably in altitude and Shuswap Lake has wider needles, 1.59 mm. as opposed to 1.51 mm., and a higher average number of resin canals per needle. In view of Critchfield's results this is not surprising. The total numbers of primary and secondary resin canals evidently increase with altitude, the former exhibiting a much larger increase than the latter. This is only to be expected in view of the fact that no evidence was found of the existence of a correlation between the presence of secondary or primary resin canals. Table V shows the distribution of secondary resin canals by type is also liable to be changed. Secondary resin canal type (c) increases with altitude, but type (a) decreases with altitude. Table III indicates that an increase in the altitude of the origin of the provenance results in an increase in the number of needles having one secondary resin canal, while the number of needles having one primary resin canal drops. The table also shows that there is a sharp rise in the needles with two primary resin canals.

Although the position is undoubtedly complicated there is some evidence of the existence of latitudinal, altitudinal, and longitudinal clines. Critchfield's (4) results suggested a latitudinal cline in resin canal number in his coastal samples, but he concluded that the existence of a general association between latitude and resin canal number within the species was doubtful. In this case it would appear more reasonable to look for existing clines within divisions of the species rather than within the species as a whole. Primary resin canal type (c) becomes more frequent in the southern coastal provenances, and secondary resin canal type (a) evidently becomes increasingly frequent to the east in the inland provenances. As regards altitude, Salmon Arm and Shuswap Lake give some indication of the relationship between this factor and the behaviour of the resin canals. Finally, it should be pointed out that it may be too much to expect a clear cut relationship between the resin canals and the origins of the provenances as expressed in terms of latitude, longitude, and altitude. The climate at the origin of a provenance is not solely determined by its absolute position as given by these three factors, and climate may be connected with the resin canal characteristics of a population. It is known, for example, that the resin content of *Euphorbia biglandulosa* is increased by growing it under conditions of lower average and absolute minimum temperatures (10).

It was emphasised by Critchfield (4) that there was no over-all coincidence in the variation patterns of any two characters within the species. Critchfield found that although leaf width was more or less constant in all coastal samples, the average number of resin canals per needle increased from about 0.2 in the south to over 2 in the north. Similarly, if the relationship between leaf width and resin canal number had been absolute, Williamson River would have exhibited the highest number of resin canals in the present study. The present study, however, showed that there was a negative correlation significant at the 5% level between the average number of resin canals per needle and the needle length.

It is clear from the data given in the tables that it is possible to distinguish groups, and individual provenances within these groups. This being the case it is possible to devise a botanical key to assist the tracking down of the provenances studied; such a key could, for example, be based on the distribution of primary resin canals by type. This would enable a provenance to be placed within its correct group, and then named. A slightly different type of key is given in Appendix I. The usefulness of a key of this type is indicated by evidence given in literature which states that frequently there is no record of the origin of well formed stands (8). There are numerous difficulties connected with the formulation and use of a key of this type but the example given is, at least, a step in the right direction. Some of the difficulties are summarised as follows:—

(1) The key is based on the characteristics exhibited by a population, and to attempt to find the origin of a plantation random samples have to be taken from the whole plantation. It is impossible to tell the origin of a single tree by its resin canal characteristics alone, although it is possible to do this in some cases if other features of the tree are considered. In some cases, however, it may be comparatively easy to place an individual tree within a group of provenances. For example, if a tree has numerous secondary resin canals and no primary resin canals then it may be placed within the group comprised of the three eastern inland provenances.

(2) The samples examined in the present study were taken from unthinned plantations and it may be assumed that they are representative of the natural populations at the origins of the provenances. If a plantation has been heavily thinned the samples taken may not be wholly representative of the natural population. One comparatively minor point is that the present samples are taken from populations which probably differ considerably in size.

(3) Only a small number of provenances were studied and this may well lead to difficulty in placing provenances which have not been examined. More information is also required concerning any possible effects of different site conditions. However, it would appear to be the case that there is, at least, a reasonable chance of placing a provenance in its correct group.

Critchfield (4) examined material from plantations grown at Placerville and in Yorkshire and found that the variation pattern of resin canal frequency, of the seed sources represented in these plantations was almost identical to that of the natural populations. Hence, it may be concluded from the present results that within the natural distribution of *Pinus contorta* Loudon there are large areas in which many resin canal characteristics are uniform. Within the coastal provenances examined there are two distinct groups, one being situated to the north of the other. In the inland provenances there are again two groups, but in this case one is situated to the east of the other. The results also show that it is possible to distinguish individual provenances within these groups by the examination of other resin canal characteristics.

Acknowledgements.

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TABLE I.

Details of the provenances.

Origin	Latitude (north)	Longitude (west)	Altitude (ft.)	Year of seed collection	Mean needle length (cms.)
Queen Charlotte Islands, B.C.	52°–54°	131°–133°	0–150	1935	4.95
Sonora Island	50° 25′	125° 25′	0	1933	4.90
and New Westminster, B.C.	49° 12′	122° 56′	0		
Olympic Peninsula, Washington	47°–48°	123°–125°	300–400	1933	5.10
Grays Harbour, Washington	47° 5′	124° 0′	?	1936	5.29
Prince George, B.C.	53° 56′	122° 43′	1,867	1933	7.15
Shuswap Lake, B.C.	51° 0′	119° 0′	2,100–2,700	1933	6.76
Shuswap, Salmon Arm, B.C.	50° 42′	119° 18′	1,200	1934	6.32
Priest River valley, Idaho	48° 20′	116° 15′	2,380	1933	6.31
Williamson River, Klamath, Oregon	42° 30′	122° 0′	3,400–5,000	1934	5.69

The first four provenances are from coastal regions; the others are from inland areas and, hence, are examples of var. *latifolia* Engelm.

TABLE II.

Variation in the number of resin canals as counted from sections cut at the base, middle and top of the needles.

Origin	Total number of resin canals at:— Base	Middle	Top
Queen Charlotte Islands	592	584	551
Sonora Island and New Westminster ...	543	529	493
Olympic Peninsula	225	182	123
Grays Harbour	332	219	149
Prince George	242	221	179
Shuswap Lake	132	192	285
Shuswap, Salmon Arm	77	150	196
Priest River valley	58	189	179
Williamson River, Klamath	329	272	214

TABLE IV.

The number of trees in each provenance having primary, secondary, or no resin canals.

	Primary resin canals only	Primary and Secondary resin canals	Secondary resin canals only	No. resin canals
Queen Charlotte Islands ...	27	3		
Sonora Island and New Westminster ...	28	2		
Olympic Peninsula	21	3	1	5
Grays Harbour	29			1
Prince George	17	3	1	9
Shuswap Lake	3	9	15	3
Shuswap, Salmon Arm ...	2	11	10	7
Priest River valley		14	10	6
Williamson River, Klamath	24	3	2	1

TABLE III.

The distribution of needles having no resin canals, or resin canals of different types.

Origin	Needles having no resin canals	Needles having resin canals which are :— Primary: Number of resin canals 1	2	Total number of needles	Secondary: Number of resin canals 1	2	Total number of needles	Number of needles having 1 primary resin canal and 1 secondary resin canal
Queen Charlotte Islands	0	6	291	297	0	0	0	2
Sonora Island and New Westminster	24	11	257	268	0	0	0	0
Olympic Peninsula	140	57	99	156	4	0	4	0
Grays Harbour	101	67	132	199	0	0	0	0
Prince George	158	33	104	137	4	0	4	1
Shuswap Lake	105	9	60	69	90	33	123	3
Shuswap, Salmon Arm	154	28	20	48	60	29	89	9
Priest River valley	164	16	11	27	49	40	89	20
Williamson River, Klamath	90	59	134	193	8	7	15	2

The number of needles examined in each provenance, with the exception of Shuswap Lake, was 300. However, the numbers shown for the two northern coastal provenances do not add up to 300. This is due to the presence of one and six needles, each having 2 primary resin canals and 1 secondary resin canal, in the Queen Charlotte Islands and Sonora Island—New Westminster provenances respectively. One needle having 3 primary resin canals and another having 3 primary and 1 secondary resin canal were also found in the Sonora Island—New Westminster provenance.

TABLE V.

Variation in the number of primary and secondary resin canals of different types in the provenances examined.

	Primary resin canals Types			Secondary resin canals Types			Total number of primary resin canals	Total number of secondary resin canals	Total number of resin canals
	a	b	c	a	b	c			
Queen Charlotte Islands	549	33	10	1	1	1	592	3	595
Sonora Island and New Westminster	491	31	21	2	5	0	543	7	550
Olympic Peninsula	121	57	77	2	2	0	255	4	259
Grays Harbour	149	70	113	0	0	0	332	0	332
Prince George	174	46	22	1	0	4	242	5	247
Shuswap Lake	126	6	0	60	0	99	132	159	291
Shuswap, Salmon Arm	72	3	2	71	4	53	77	128	205
Priest River valley	51	7	0	110	21	18	58	149	207
Williamson River, Klamath	191	69	69	11	1	12	329	24	353

APPENDIX I.

1. Total number of resin canals greater at base than top of needles 2
Total number of resin canals less at base than top of needles: secondary resin canals common 6

2. Few needles with no resin canals: bulk of needles (i.e. about 85%) have 2 resin canals which run entire length of needle. Queen Charlotte Islands and Sonora Island—New Westminster.
Fairly high number of needles (i.e. above 30%) with no resin canals 3

3. Approximately $\frac{1}{3}$ of needles with no resin canals 4
Approximately $\frac{1}{2}$ of needles with no resin canals 5

4. Proportion of total resin canal number at base to resin canal number at top of needles more than $\frac{2}{1}$: primary resin canal type (c) more common than type (b) .... Grays Harbour.
Proportion of total resin canal number at base to resin canal number at top of needles about $\frac{1.5}{1}$: primary resin canal type (c) as common as type (b) .... Williamson River.

5. Primary resin canal type (c) half as common as type (b) .... Prince George.
Primary resin canal type (c) more common than type (b) .... Olympic Peninsula.

6. Needles having 1 primary resin canal 1/6th as frequent as those having 2 primary resin canals .... Shuswap Lake.
Number of needles having 1 primary resin canal greater than number having 2 primary resin canals 7

7. Needles having 2 secondary resin canals only half as common as those having 1 secondary resin canal: secondary resin canal type (c) more than ten times as frequent as secondary resin canal type (b) .... Salmon Arm.
Number of needles having 2 secondary resin canals nearly as large as number having 1 secondary resin canal: secondary resin canal type (c) nearly as common as secondary resin canal type (b) .... Priest River Valley.

Society's Activities

Twenty-First Annual General Meeting

THE Twenty-first Annual General Meeting of the Society was held in the Shelbourne Hotel, Dublin, on Saturday, 16th March, 1963. The outgoing President, Professor T. Clear, was in the chair. He opened the private meeting.

Minutes.

The minutes of the Twentieth Annual General Meeting which had been published in the Journal were taken as read and were approved and signed.

Council's Report.

There were five meetings of the Council during 1962 with attendances as follows:—

5 attendances each: Miss Cahill, Miss Furlong, Mr. McNamara, and Mr. O'Carroll.

4 attendances each: Messrs. Sharkey, Luddy, Cosgrove, FitzPatrick, Hanan, and Swan.

3 attendances each: Messrs. Gallagher and McCarthy.

2 attendances: Professor Clear.

The activities of the Society in the field have been fully reported in our journal and need not be repeated here. They indicate a successful year. In respect of membership also we have had a successful year. Since 1960, when we fell on rather lean times, our paid up membership has just doubled. At the end of 1960 we had only 136 paid up members, in 1961 the number increased to 187 and at the end of 1962 the figure was 258. This has been due to the vigorous policy pursued by the Treasurer who over his two years in office has also succeeded in collecting a large amount of arrears.

However, membership alone does not make a Society healthy and active and the Council regrets to report a certain reluctance on the part of its members to join fully in the running of the Society. The numbers who completed nomination forms for the Council and who voted in our elections show no change on previous years, about 20 nomination forms and 110 voting papers were received. There is also a marked reluctance to accept nomination for posts of responsibility requiring some effort and time on the holder's part and as a result there was again no contest for the posts of Secretary and Treasurer, there being only one acceptor in each case, and nobody at all willing to act as Editor or Business Editor.

Some years ago a sub-committee of the Council reported on education within the Society and it was felt that the best way of inducing members to persevere in their studies was to offer recognition for knowledge gained, and the possibility of our Society sponsoring Foresters' Certificates on similar lines to those obtainable through the British Societies was mooted. The Council also felt that it would be desirable if our certificate could open the way to higher qualifications. With this object in view negotiations were opened with the Central Examination Board of Great Britain to have our certificate accepted as qualifying for entry to the examination for the National Diploma in Forestry. In July last a meeting was arranged in Edinburgh at which we were given the opportunity of putting our case to the Central Examination Board who are responsible for the N.D.F. examinations. Our representatives at that meeting were our President, Professor Clear, Vice-President, Mr. McNamara and the Secretary. At this meeting it was agreed, subject to ratification by the Councils of the constituent Societies of the Board that:—

(1) Forester Certificates awarded by the Society of Irish Foresters would be recognised for entry to the Diploma examination.

(2) That the written examination for the Diploma could be held in Ireland under the supervision of the Society of Irish Foresters but that for the first three years we should accept an invigilator from the British Societies.

(3) The Central Examination Board would recognise the Certificates of the Society of Irish Foresters based on examinations by that Society only and they would not accept certificates or documents from any other body.

(4) That after three years of operation the question of representation on the Central Examination Board by the Society of Irish Foresters would be considered.

To date the Council of the Royal Forestry Society of England, Wales, and Northern Ireland have accepted these suggestions but the Council of the Royal Scottish Forestry Society have not yet reached a decision.

The Committee set up to publish a book on Irish Forestry as agreed at the last Annual General Meeting has made good progress under its Convenor, Mr. FitzPatrick. Much of the copy is in hands but much work, particularly editing, has yet to be done. The Joint-Editors appointed are Mr. FitzPatrick and Professor Clear. At a meeting with contributors they have been given very full powers to edit, rearrange and co-ordinate the material supplied.

As illustrated lectures are now a regular feature of our winter activities the Council has purchased a 500 watt 35 mm. projector and screen.

The proceedings of the Fifth World Forestry Conference in Seattle have been published in three volumes and the Society has secured a copy. In addition Dr. H. Mooney has kindly donated another copy of these proceedings to the Society. The Council wish to express to Dr. Mooney their thanks for his generous gift.

The Council also wish to thank the Minister for Lands for facilities granted during the year and the Officers of his Department for the courtesy, help and co-operation which they have always so willingly extended to our Society.

Treasurer's Report.

The Statement of Accounts which had been circulated with the notice of the meeting to all members, appears in this issue.

In discussion on the Council's and Treasurer's reports it was asked if copies of the proceedings of the 5th World Forestry Conference would be available to members. The President said they would, but he pointed out that we had two copies and that they were quite bulky and expensive; he asked that members should be specific in stating their interests and that they should return the volume promptly at the time promised.

It was asked if the 35 mm. projector would be available for hire. The meeting agreed that hiring, if at all, should be at the discretion of the Council.

Mr. McNamara explained in detail the scheme for the Woodman's and Forester's Certificates and for the Diploma in Forestry. The Woodman's and Forester's Certificates were the responsibility of the Society and no other body would have any say in their issue. The Diploma, however, was the responsibility of the Central Examination Board and we would have no say in it unless and until we got representation on that Board.

The adoption of the Council's and Treasurer's reports was proposed by Mr. McEvoy, seconded by Mr. Cosgrave and passed unanimously.

Motions.

(1) To amend Article *VIII* as follows :—

Delete from

"Technical Members Grade I ... ... 15s. 0d."

and substitute :—

Technical Members Grade I shall pay ...	£1	10s.	0d.
Technical Members Grade II shall pay ...	£1	0s.	0d.
Associate Members shall pay	£1	0s.	0d.

(2) To amend Article *XI* by the insertion of the words "Secretary and Treasurer", after "Vice-President" and before "Editor".

First Motion: Proposed by Mr. Hanan, seconded by Mr. Sharkey. Mr. Hanan said that our build up of capital had been over the 21 years of our existence. We had at the last Annual General Meeting decided to spend our surplus moneys in producing a book on Irish Forestry. A careful analysis of income and expenditure showed that one almost balanced the other when reviewed over several years. We have our ups and downs; last year showed a loss of £170 odd but included, were several non-recurring items of expenditure and two journals which were larger and more expensive than usual. Without some moneys in hands we would have been in difficulties and now that surplus moneys are to go on our book, and our N.D.F. scheme may yet bear fruit, we would be very much in a hand to mouth position.

Mr. Durand said that with stock on hands we had a reserve of some £740 and we had agreed to spend £500 only on the book. He felt there was no reason to hurry and that we should wait and review the position in a few years time.

Mr. T. McCarthy supported Mr. Durand's view. The Secretary said that £500 was voted for the book last year but that printers had increased their rates considerably during the year and it was possible the Council would have to approach a General Meeting before the book could be published. Also we had made good progress in persuading the Central Examination Board to accept our suggestions on our inclusion in the N.D.F. examinations and this would involve us in the expenses of setting up our own examinations for Woodman's and Forester's Certificates. Lastly the new subscription rates could not come into operation until 1964. We would always have this time lag whenever we agreed to the increase.

Mr. Galvin supported the motion : He felt that we should not run too close and find ourselves embarrassed for lack of funds. If we did accumulate, we could spend it on another book or other good work. It had taken 20 years to accumulate our present funds.

Mr. McEvoy said we should have an income from the books and this might recoup most of our expenses on it.

Mr. McGuire said that instead of increasing subscriptions we should get more new members.

Mr. Sharkey and Professor Clear both agreed that on careful analysis our accounts showed the need for this increase. The subscriptions now being charged were the same as when the Society was founded 20 years ago.

Mr. Mooney also spoke in favour of this motion. The chairman then put the motion to the meeting and it was carried by 27 votes to 6.

Second Motion: The purpose of this motion was to include the Secretary and Treasurer as members of the Council from which our constitution at present excluded them. It was passed unanimously.

Proposed Activities for the year.

Mr. Morris, meetings' convenor, outlined the proposed activities for the year. The Annual Study Tour would be longer than usual. It was proposed to have five days' touring beginning and ending in Dublin. The route would take the Society through Wicklow, Carlow and Slieve na mBan to Cahir; from there by way of Bansha, Limerick and Tulla to Galway; thence to Sligo via Cong, Castlebar, Foxford and Lough Talt. From Sligo we would go into Northern Ireland visiting some of the forests there and spending the night at Omagh, where we would have our annual dinner. From Omagh we would return to Dublin visiting Cootehill Forest on the way.

During the year it was proposed to hold afternoon excursions to:

(1) Killakee Forest where the theme would be site assessment, choice of species and development of management plans.

(2) Ossory Forest on problems associated with felling and regeneration.

(3) Gougane Barra on recreational facilties and multiple forest use.

(4) Clonsast Bog on pollen analysis and the history of our bogs.

(5) Johnstown Castle of the Agricultural Institute had agreed to act as host for a day excursion.

This concluded the Private Business of the Society.

President's Valedictory Address.

Since I am the main speaker at the public session of this Annual General Meeting and since I am then reviewing forestry progress in Ireland up to the present time, I will be forgiven, I know, and I am sure you will be relieved, if I shorten my valedictory address to a few remarks.

As you are all aware, very rapid progress has been achieved in State Afforestation in recent years and planting has now levelled off at the desired planting rate of 25,000 acres per year. Current gross expenditure on State Forestry is running at about £3¼ million a year. With the achievement of the planting target, so long the main purpose of State forest policy here, and with the very high level of current State investment in Forestry, there is every likelihood that the purpose of our afforestation programme will come more closely under review in the future.

What has been accomplished is no mean achievement. It is however, as if a climber has climbed a very steep and stiff ascent to arrive at a plateau and pauses to draw his breath and to congratulate himself on the magnitude of his achievement. He looks round and up to the peak that he set out to scale. There is still a long way to go with ups-and-downs but no really spectacular cliff to scale: a long steady grind with no thrills or surprises. This he realises is the toughest level to have reached, with nothing but a steady grind ahead and no laurels to be won except the final one, achievement of the final goal.

It is interesting, therefore, to see that foresters overseas are becoming more and more concerned with the long-term economic aims in the working of a State forestry authority. At the Eighth British Commonwealth Forestry Conference held in East Africa in 1962, there were several contributions on this topic. The contributions by delegates from

Britain and especially from the British Forestry Commission are notable indeed in so far as they are more applicable to conditions here at home. It is apparent that it is more and more being recognised by foresters that forestry has no prior or overriding claim on the available resources of the economy and that the claims of forestry are likely to be increasingly considered jointly with other industries.

Foresters and forest economists are now more than ever, seeking criteria by which the value or profitability of forestry may be fairly assessed. The Faustmann formula is being taken out and dusted and put to increasing use to find the answers and to illustrate the economic factors which influence the type of timber grown and the methods of growing it. It is recognised that there can be no justification for the devotion of pounds worth of labour and materials to large acreages of land if the resources involved could have yielded higher revenues when allocated amongst labour, plants, material and land in some other way. Investment policy in forestry has not always followed the calculated best results. "Why has this been so?" asks the economist. "Is it that forestry has different objectives, social, aesthetic, strategic, to other forms of enterprise and that decisions on resource allocation to forestry are influenced by this to a major extent?"

Other issues that are being discussed at forestry conferences and symposia at the present time include the utilization of small-sized thinnings, inferior grades of wood and sawmilling and other forest waste. Costs of manual work in forestry are rising; the extent to which rising wage costs can be offset by greater mechanisation and the use of better working methods varies greatly with circumstances but in general, it is true to say that it is when dealing with small diameter wood that those labour costs are more difficult to overcome.

Do our present silvicultural methods lead to increased yields of small produce which are expensive to handle, transport and process? Can we have wider planting without losing in productivity or affecting timber quality? Does the answer lie in thinning skilfully, using crown thinning or eclectic thinning which provide larger and more profitable assortments from the first thinnings? Or should thinning be avoided altogether especially in remote areas and clear felling by machine harvester visualized? Such questions are being posed by foresters everywhere to-day, in Britain, in Europe, in America and in the Southern Hemisphere as well. It is evident that rapidly changing circumstances and conditions are particularly hard on a forestry enterprise and that a great volume of research, both economic and silvicultural, is required so that forestry objectives can be fully understood by all concerned. We have skilled men here at home who are ready and able to evolve a system of forestry appropriate to our country if only the objectives can be fixed, economic, social, industrial, strategic or a combination of all. The main risk that one can sense from current discussions abroad is that afforestation will be pursued on lines that are traditional and conditioned by out-of-date concepts, that policies will be pursued long after the original objectives have changed or disappeared. To avoid the apparent risks associated with those changes in objectives is one of the main tasks of forestry research to-day.

Public Business

After a short interval the meeting began its Public Business with an address by Professor Clear on "Twenty-one Years of Irish Forestry." This address appears as the first article in this issue.

Mr. C. S. Kilpatrick, Deputy Chief Forest Officer, Forestry Division, Ministry of Agriculture, Northern Ireland, then reviewed progress and achievements in Forestry in Northern Ireland. He was followed by Richard Delahunty, a student in Shelton Abbey, who in representing the future hope of Irish forest manhood, in a rallying speech, left us in no doubt that the tomorrow for Irish Forestry was one that held every promise for those who were prepared to work for it.

Mr. J. Galvin, nurseryman, one of the Society's oldest friends, then spoke on behalf of the Private Forestry interests and Associate Members.

Our President, Mr. McNamara, commented on the past 21 years and spoke optimistically for the future. He then thanked the speakers and closed the meeting.

SOCIETY OF IRISH FORESTERS

Statement of Accounts for Year ended 31st December, 1962.

1961.	Income	£ s. d.	£ s. d.
£256 2 8	To Balance from last account		471 17 11
	,, **Subscriptions received :—**		
	9 Technical Grade 1. 1960	9 0 0	
	14 ,, ,, ,, 1961	14 0 0	
	64 ,, ,, ,, 1962	64 0 0	
	1 ,, ,, ,, 1963	1 0 0	
	1 ,, ,, ,, 1964	1 0 0	
	1 ,, ,, ,, 1965	1 0 0	
	17 ,, Grade 2. 1960	8 10 0	
	29 ,, ,, ,, 1961	14 10 0	
	101 ,, ,, ,, 1962	50 10 0	
	2 ,, ,, ,, 1963	1 0 0	
	4 Associates 1960	3 0 0	
	8 ,, ,, ,, 1961	6 0 0	
	93 ,, ,, ,, 1962	69 15 0	
	6 ,, ,, ,, 1963	4 10 0	
£296 5 0			247 15 0
£6 13 4	,, **Interest on Investments**		6 16 8
£273 6 4	,, **Journals and Advertisements**		306 6 10
£3 13 6	,, **Donations**		—
£836 0 10			£1,032 16 5

1961.	Expenditure	£ s. d.	£ s. d.
£62 4 11	By Stationery and Printing ...		71 17 7
£196 12 6	,, Printing of Journal and reprints of articles		475 4 0
£45 7 7	,, Postages		48 18 8
£25 11 4	,, Expenses re meetings ...		39 18 4
£1 5 2	,, Bank Charges		1 17 9
£15 0 0	,, Honorariums : Secretary ...	12 10 0	
	Treasurer ...	12 10 0	
			25 0 0
£2 0 0	,, Excursion Expenses ...		—
	,, Trees for Ireland—		
£7 0 0	Affiliation Fee and Dinner		3 2 6
	,, Expenses—Diploma Conference,		
—	Edinburgh		40 19 6
—	,, Purchase of Projector ...		25 0 0
£9 1 5	,, 5th World Forestry Congress Book		—
£471 17 11	,, Balance in Bank		300 18 1
£836 0 10			£1,032 16 5

CERTIFICATE : I have examined the above account have compared it with vouchers and certify it to be correct, the balance to credit being £300 18s. 1d. which is on current account at the Ulster Bank Ltd. There is also a holding of £200 Dublin Corporation 5% Redeemable Stock 1968/73 and a holding of £200 Prize Bonds. Credit has not been taken for Subscriptions due for 1960 £1 15s. 0d., 1961 £15, and for 1962 £61 5s. 0d. which were outstanding at 31st December, 1962.

22nd January, 1963. D. M. CRAIG, Hon. Auditor.

85 Harcourt Street, Dublin.

Annual Study Tour

First Day.

THE calm cloudless skies of the morning of Monday, 27th May, augured well for the 21st Annual Study Tour of the Society of Irish Foresters, and, as our bus hurried from the hustle and bustle of a busy Dublin and headed for the peaceful tree covered slopes of Wicklow, the wish common to all present was that this historic tour would not be marred by any inclement weather. As it turned out our wish was fully granted and we enjoyed five days of glorious sunshine.

Arriving at the home of Mr. J. Murphy, Forester-in-Charge, Glen Imaal Forest, we discovered that a Telefís Éireann camera crew were there ready to attempt to capture a brief glimpse of the atmosphere and enthusiasm of an Irish Forestry Study Tour. Alongside the forester's picturesque dwelling, the members grouped as Mr. Michael McNamara, President of the Society, extended a welcome to all present. In particular he welcomed us to Co. Wicklow, which had a forest coverage of 10%, the highest in the country. He then introduced Mr. D. McGlynn, Divisional Inspector for the area, who, in turn, also extended a céad míle fáilte to those gathered there, and he hoped that both the staff in charge of the forest and the members would benefit from the visit.

Mr. Niall Morris, Convenor, then mentioned that the main block of the forest was a few miles further on and the formalities having been completed we drove to see the first of the many sample plots chosen for inspection during the tour. The figures listed in the handout for this plot are as follows :—

Property : *Glen Imaal* Compartment : *21*
Species : *Sitka Spruce* Age : *34* (*P/29*).

	Plot	*B.F.C.*
No. of Stems per Acre	260	255
Mean Qr. Girth	9″	9″
Mean Tree Height	74′	74′
Mean Tree Volume	19.4 H. ft.	18.8 H. ft.
Volume per Acre	5,044 H. ft.	4,800 H. ft.
Top Height	76.5′	78′
Quality Class	II	II
Total Basal Area/Acre	146 sq. ft.	136 sq. ft.

Increment Estimate
Schneider Increment % (S) ... 4.8.
C.A.I. per acre/annum (modified in accordance with formula
C.A.I. = 0.9S + 1.8) ... 308 300 B.F.C.

Soil Analysis	*Ph*	*Ca*	*P*	*K*
0 — 1″ in depth	4.7	1	4	1
1 — 4″ „ „	4.3	1	4	2
4 — 9″ „ „	4.1	1	4	2

Before discussion was opened, it was stated by Mr. Mooney that this 34 year old stand of Sitka spruce was one of the oldest and best stands of Sitka spruce that would be seen on our five day tour.

The question was asked as to the length of rotation or ultimate size of log envisaged for this crop. In answer it was stated that while no well defined plan had as yet been drawn up, the possibility of clear felling, when the 10″ to 11″ B.H.Q.G. stage had been reached, was under consideration. It was recognised that the stand was still putting on valuable increment and that it would continue to do so for another 10 years or so. An alternative to clear felling, if a steady supply of marketable saw log had to be maintained, was the suggestion that approximately 50 of the larger stems (1,500 cu. ft.) be removed. This treatment of the stand was received with mixed reactions as some thought that the removal of a number of the larger poles would affect the wind stability of the crop. While the timber merchant would welcome the appearance on the market of logs of such dimensions it was pointed out that 11¾′ B.H.Q.G. was recognised as being the ideal size of tree.

Before leaving this stand of Sitka spruce Mr. Morris focused the attention of the members on a tree tightly girdled with a small aluminium band. By means of a vernier scale incorporated in the band it was possible over a period of time to measure the increase in circumference of a particular tree. A number of these instruments were in use throughout the country with readings taken every week by the local forester. Thus, with the data gathered over a period of about 10 years at hand, it should be possible to determine when growth commences and ends, and also when growth is at a maximum. The 1961 readings indicated that growth was slow in May, that it reached a peak in July, dropped somewhat in August and dropped further in October. Growth it appears generally ceases about the 3rd week of October. As might be expected, temperature and rainfall influence growth considerably, and the sharp frost experienced in June 1962 was recorded on the bands by a fall off in growth.

Leaving the Sitka spruce, we walked a short distance to a stand of Douglas fir which had a scattering of Japanese larch and the data for this crop reads as follows:—

Property: *Glen Imaal* Compartment: *20*
Species: *Douglas Fir* Age: *34* (*P/29*).

	Plot	*B.F.C.*
No. of Stems per Acre	350	365
Mean Qr. Girth	6¾″	6½″
Mean Tree Height	53′	56.5′
Mean Tree Volume	7.0 H. ft.	7.6 H. ft.
Volume per Acre	2,457 H. ft.	2,790 H. ft.
Top Height	62′	60′
Quality Class	IV	IV
Total Basal Area/Acre	112 sq. ft.	109 sq. ft.

Increment Estimate

Schneider Increment % (S) 7.0.
C.A.I. per acre/annum (modified in accordance with formula
C.A.I. = 0.9S + 1.8) ... 197 214 B.F.C.

Soil Analysis		*Ph*	*Ca*	*P*	*K*
0 — 1″ in depth	... ...	5.0	1	2	1
1 — 4″ „ „	... ...	4.7	1	2	2
4 — 9″ „ „	... ...	4.6	1	3	3

Japanese Larch: Dominants which occur, have an average height of 67 ft., and correspond with quality class II crops of B.F.C.

These figures do not speak very highly for this plantation and in seeking possible reasons for its general backwardness and unsatisfactory growth the members came up with some interesting observations. In 1932, following the damage to a large group of Douglas fir, Japanese larch was introduced and it was thought that this latter species had interfered considerably with the normal well being of the original species. It was also pointed out that the low phosphate content of the soil was a factor which could not be overlooked in seeking an answer to the question. With an elevation of just slightly under the 700′ contour line the site was considered too exposed for Douglas fir and this theory was borne out by the fact that there was evidence of wind blast.

Before boarding the bus for Carlow our President thanked those of the Bray Division who had contributed to get the Study Tour of 1963 off to such a fine start.

Following an excellent lunch at Carlow we travelled in brilliant sunshine south-westwards through the historic city of Kilkenny and on towards our next rendezvous at Boherboy Property of Anner Forest. Here Mr. McNamara again performed the necessary introductions as we met Mr. McCarthy, Divisional Inspector of the area, and Mr. Larkin, Forester-in-Charge. Mr. McCarthy extended a hearty welcome to the members of the Society and then Mr. Morris led the whole party to visit a plot marked out in a Douglas fir stand. The data given for this plot is summarised as follows :—

Property: *Boherboy* Compartment: 12
Species: *Douglas Fir* Age: *33* (*P/30*).

		Plot	*B.F.C.*
No. of Stems per Acre	... ...	300	310
Mean Qr. Girth ...	... ...	7¼″	7¼″
Mean Tree Height ...	... ...	63′	62.5′
Mean Tree Volume	... ...	9.94 H. ft.	10.5 H. ft.
Volume per Acre ...	... ...	2,982 H. ft.	3,256 H. ft.
Top Height ...	... ...	70′	66′
Quality Class ...	... ...	III	III
Total Basal Area/Acre	... ...	112 sq. ft.	115 sq. ft.

Increment Estimate

Schneider Increment % (S) ... 5.0.
C.A.I. per acre/annum (modified in accordance with formula
C.A.I. = 0.9S + 1.8) ... 188 250 B.F.C.

Soil Analysis		*Ph*	*Ca*	*P*	*K*
0 — 1″ in depth	... ...	4.8	1	2	4
1 — 4″ „ „	... ...	4.8	3	2	6
4 — 9″ „ „	... ...	4.9	1	1	2

The difference in size between the various trees was noticed and it was the general concensus of opinion, that a selective thinning should be carried out. It was also learned that 10 to 15 years ago the crop had passed through a check phase, an occurrence apparently common to Douglas fir. However, it now appeared to be thriving and the site was recognised as being more suited to Douglas fir than the previous ground visited at the Glen Imaal Forest. Still, the presence of lichens growing on the bark caused one member to voice his doubt that all was not well with a crop which displayed this phenomenon.

The wisdom of growing Douglas fir when Sitka spruce generally gave a higher yield was questioned, and in answer it was mentioned that it might prove more economic to plant Douglas fir if 5/- to 15/- per cu. ft. could be obtained from the transmission pole trade. Another factor in favour of Douglas fir was that, as a crop, it culminated much later than Sitka spruce which tended to fall off after approximately 50 years. Again Douglas fir was a tree which could be geared to meet the demand of the veneering trade. In view, therefore, of the apparent versatility of Douglas fir the question was then raised as to the reasons, or lack of reasons, for its doubtful popularity among the timber people. One of these causes was attributed to the fact that in the earlier timber trials carried out on Douglas fir the material used had been of a coarse and brittle nature and the memory of the poor results still lingered on in the minds of many. The unfair practice of comparing say 50 year old European with 200 year old U.S. Douglas fir also tends to detract from the true worth of the former. Another relevant point in the Douglas fir versus Sitka spruce controversy is, that Sitka, because it is a spruce, is more closely associated with white deal, a timber which in Europe enjoys unrivalled popularity.

The last stop of the day was at Ballynockan Property of Slievenamon Forest and close to the place which inspired the composition of the poem Cill Cais. Here we visited a sample plot in the midst of a Sitka spruce plantation. The statistics for this plot were:

Property: *Ballyknockane* Compartment: *30*
Species: *Sitka Spruce* Age: *28* (*P/35*).

	Plot	B.F.C.
No. of Stems per Acre	490	550
Mean Qr. Girth	5¾″	5¾″
Mean Tree Height	55′	49′
Mean Tree Volume	6.28 H. ft.	5.1 H. ft.
Volume per Acre	3,077 H. ft.	2,800 H. ft.
Top Height	56′	53′
Quality Class	III	III
Total Basal Area/Acre	113 sq. ft.	124 sq. ft.

Increment Estimate

Schneider Increment % (S) ... 5.9.
C.A.I. per acre/annum (modified in accordance with formula C.A.I. = 0.9S + 1.8) ... 217 305 B.F.C.

Soil Analysis	*Ph*	*Ca*	*P*	*K*
0 — 1″ in depth	4.6	1	1	1
1 — 4″ „ „	4.5	1	2	3
4 — 9″ „ „	4.5	4	4	5

The fact that some of the original oak stems had been retained when the Sitka spruce was introduced and that an attack of honey fungus (*Armillaria Mellea*) had killed off some of the younger stems did not help the well being of this stand. Still, although the soil showed a tendency towards gleying, it was generally considered that quality class III was low for the site. It was pointed out, however, that the crop need not necessarily remain in this particular class. Reference to quality class immediately gave rise to the perennial argument of how much reliance may be placed on a criterion which uses height as its basis and some thought that the Scandanavian method based on vegetation was a better method of determining quality class.

The suggestion was put forward that a 25 year rotation be employed here, and that all the produce should be channelled in to the pulpwood industry. However, it was considered that the site was capable of meeting both pulpwood and saw log demands, and that a heavier thinning would help to set the crop along such a path. Displeasure was voiced at the thought of utilising relatively good land solely for pulpwood production when there was an abundance of inferior land on hands.

That the pulp mills in this country showed a marked preference for spruce was then mentioned, and in the discussion that followed it was learned that while the mills were inclined to favour spruce, it was really the available quantity of a particular species which was the overriding factor in this question. In the U.S. 30% of the timber used for pulpwood was *Pinus contorta* while in New Zealand *Pinus radiata* formed the bulk of the pulpwood material.

It was on this note that the first day of the tour terminated and after extending our thanks through our President to Mr. McCarthy and his staff we boarded the bus which carried us on to Cahir, to a first class meal, and to a night's relaxation.

T.McG.

The Second Day.

On entering Cahir Forest we were welcomed by Mr. C. A. McCormack, the Divisional Inspector. Cahir district has long been noted for its Scots pine and larch plantations, and our particular interest to-day was with a stand of European larch on the recent 4½ thousand area acquisition from the Charteris Estate. The party heard with regret that the District Inspector, Mr. Munnelly, was ill and unable to attend. His assistant, Mr. O'Connell, and the Forester, Mr. Collins, were both present.

Our Convenor, Mr. Morris, supplied data of the plot under discussion. It was mainly European larch but with an occasional Scots pine. The crop had received no systematic treatment at least, no records or evidence had been found and neither was there any record of its early life. As it now stood there were 400 stems per acre with a mean height of 68 ft. and a mean B.H.Q.G. of 7¼″. Volume per acre was 4,790 Hoppus ft. The increment % was estimated at 3.3 but it was admitted that the method of estimation—an adaption of the Schneider formula—was open to doubt.

A surprising feature of this crop was that while the number of stems per acre, the volume and the basal area were all double the figures of the B.F.C. yield table the mean B.H.Q.G. was only slightly less than the yield table figure. In value it was in the pole stage and while silviculturally it might be said to have been mistreated, its value now was very much higher than if it had received the orthodox treatment. The pole market was at a peak and there was a grave danger that if we based our treatment on the economics of this peak price we could run into trouble later. Farmers no longer had an appreciation of the value of good larch for carts, gates, and other farm uses, at least not enough to pay an enhanced price for it. First quality class larch was not common and indeed we seemed to have given up the struggle to grow larch or Scots pine; Sitka spruce and *Pinus contorta* bid fair to replace all species, larch included.

From Cahir the party travelled to the beautiful Glen-of-Aherlow and to the chargeship of Mr. Boyce. The crop to be discussed here was Scots pine planted on the south face of the Slievenamuck mountains. The age was 34 years, number of stems per acre 640, mean height 37 ft., B.H.Q.G. $5\frac{1}{2}''$. Volume 2,065 Hoppus ft. The current increment per cent. was estimated at 5.5 and the crop was quality class II by B.F.C. yield tables.

There was originally a European larch/Scots pine mixture, the larch giving the volume in the early years and being removed in thinnings with Scots pine carrying on the rotation.

The feeling was that for its age this crop did seem poor, but the question was asked could this be due to a phase through which Scots pine passed up to middle age and out of which it would later grow. The stumps showed slow growth in the early years and an increase in later years, and it was generally accepted that Scots pine is a slow starter. Possibly this slow start was an inherent characteristic of the particular provenance we used, as this was one species in which we paid very little, indeed no attention at all, to provenance in the early years of planting.

The soil analysis figures tended to indicate a rich soil, but the soil pit showed the converse. The importance of correct interpretation of soil analysis was illustrated and stressed.

After lunch in the Lake Hotel, Killaloe, the party visited the Chipboard factory at Scarriff, and were shown the manufacture of this popular product from the raw timber to the finished article.

An interesting feature of chipboard is that it consists of an upper and lower layer of spruce chippings with a centre of pine. Chips used in the manufacture are dried to 2% moisture content before being mixed with the glue and it was stated that three tons of wet timber were used in producing one ton of chipboard.

From Scarriff the party went to Maghera Property, Tulla forest, and were met by Mr. Haas, Divisional Inspector, Mr. Gibbons the District Inspector and Mr. Conway the Forester-in-charge.

The Society had visited this area in 1957 following the large blow of February of that year. The visit of "Debbie" in 1961 completed the damage. It was pointed out that this area was planted in the pre-plough era and drainage was probably not sufficient for the type of ground. A soil pit showed a high water table despite a reasonable slope, and the crop Sitka spruce, would have rated above country average for the species.

It was pointed out that "Debbie" was no ordinary visitor and if the crop had not blown down it would have been damaged by cracking and breaking as we saw had happened in Mount Bellew last year and this might prove an even greater loss. The Convenor suggested that form factor could have an influence on stability and suggested that in danger areas sylviculture might be directed to giving a tree of low form factor, deep crown, and plenty of rooting space. There was some criticism of the slowness in clearing up after windblow which resulted in the second blow coming on top of the first. It was also suggested that planting of large areas in the one year and with a single species was conducive to windblow. It would be better to distribute one planting in smaller areas over the forest and never attempt a large area of even age monoculture. Blocks of 25 acres are economic to the timber merchant and there is no need for the large 100 acre blocks we now take as common.

After our discussion in the woods we continued up the new road to the television station on Maghera. Here we were received by Mr. O'Connor, Mr. Dempsey and staff and spent a very pleasant time being instructed in the mysteries of how our television works. Our best thanks are due to Mr. O'Connor and his staff for their patient understanding in replying to our many questions.

M.S.

Third Day.

On Wednesday the 29th May in glorious sunshine the Society visited Cong Forest where we were met by Divisional Inspector, Mr. O'Carroll, District Inspector, Mr. Mac Meanman, Forester-in-Charge, Mr. Leonard and his assistants, Mr. Lonergan and Mr. Kelly. We were welcomed on behalf of the Minister of Lands by Mr. O'Carroll and Mr. Mac Meanman.

Our first stop was in a stand of 45 year old Norway spruce for which the convenor gave us the following details:—

	Plot	*B.F.C.*
No. of Stems per Acre	260	285
Mean Qr. Girth	$10\frac{3}{4}''$	9″
Mean Tree Height	72′	70.5′
Mean Tree Volume	25.4 H. ft.	19.1 H. ft.
Volume per Acre	6,600 H. ft.	5,454 H. ft.
Top Height	73.5′	74.5′
Quality Class	I	I
Total Basal Area/Acre	210 sq. ft.	161 sq. ft.

Increment Estimate

Schneider Increment % (S) ... 3.8.
C.A.I. per acre/annum (modified in accordance with formula
C.A.I. = 0.9S + 1.8) ... 343 280 B.F.C.

Soil Analysis	*Ph*	*Ca*	*P*	*K*
0 — 1″ in depth	5.3	4	2	1

The Convenor explained that this increment was exceptionally high and the sample plot taken might not be truly representative of the crop. Professor Clear commented on the peculiarity of the fact that the most commonly occurring quality class for Norway spruce in Ireland was quality class II, while in the case of Sitka spruce quality class IV was the average. This might be due to the fact that Norway spruce was usually planted on old estate woodland where land was good.

Norway spruce had its limitations, we were told, but on suitable ground it should be chosen in preference to Sitka spruce because (i) it was more frost hardy (ii) it was usually a more stable crop (iii) it was less susceptible to *Fomes annosus* (iv) it could be run to a longer rotation. Mr. Morris mentioned that the amount of good ground being acquired by the Forestry Division was diminishing and so it was essential to plant Norway spruce where ground was suitable. Professor Clear informed us that in Denmark Norway spruce was planted on poor podsols and he felt that its range might be extended in this country. Mr. Mooney explained that the research section of the Forestry Division were fully aware of the importance of this species and have included Norway spruce in species trials on a wide variety of soils. Commenting on the annual growth pattern of our major species, Mr. Morris mentioned that, as a result of trials carried out, it has been demonstrated that curve of growth for Norway spruce was more uniform than either Sitka spruce or *Pinus contorta.*

The party then proceeded to Cong sawmills where we were introduced to Mr. Fahy, Forester-in-Charge. This mill was designed by forestry personnel and built by direct labour. Timber for the building and furniture trades was the main line of production. Fifteen men were initially employed and this number increased to the present level of twenty-two men. The present annual output is 62,000 cu. ft. of sawn timber which was comprised as follows: oak 1%, ash 3%, other hardwoods 3%, larch 20% and other conifers 73%. The round timber used in conversion was obtained entirely from the home forest. The quality of this timber was generally rough as the woods in the Cong Estate were mainly planted and maintained as game coverts. The party saw the following machinery in use: two break-down benches (vertical log handmill and friction-feed rack bench), two re-saw self-feed benches, a cross-cut saw, a planer and thicknessing machine, a tenoning machine, a morticing machine, a five-cutter and a spindle moulder. A double kiln with a capacity of 1,000 cu. ft. was also in use. Mainly softwood for flooring with a small percentage of hardwoods for the furniture trade was dried in the kilns. Demand for softwood, particularly building timbers, was very high we learnt and there was a preference for the spruces owing to the existence of decayed knots in the pine here and the roughness and wide grain of the silver fir. A very attractive display of our most common conifer timbers was also on view. Before proceeding to the next stop the president proposed a vote of thanks to Mr. Fahy and his staff for a very interesting visit.

The next stop was in the grounds of Ashford Castle, Cong beside one of the large trees believed to be *Pinus contorta* ssp. *bolanderi.* This group of trees is the subject of an article written by Mr. Hanan in *Irish Forestry,* Vol. XIX. No. 3. Mr. Mooney stated that these trees were believed to have been planted in 1884 and were of obvious interest as they were the largest known specimens of *Pinus contorta* in Ireland. From measurements taken in March 1961, the largest surviving tree was 97′, while eight of the specimens were over 80′. Seeds collected from these trees have been sown. Some of the trees were sawn in Cong sawmills and the timber turned out quite satisfactory. At this stage the Convenor presented each member of the party with a souvenir sample of this famous contorta pine timber. This souvenir was in the form of a very pretty tray which contained in the centre the badge of the Society of Irish Foresters. The President on behalf of the Society thanked the Convenor for this very attractive gift and explained to the members that Mr. Morris had put a lot of thought and effort into the production of the souvenir.

The next point of interest was Foxford Forest where we were met by District Inspector, Mr. Allman, Forester-in-Charge, Mr. Crowley and Assistant Forester, Mr. Hanly. Mr. Crowley stated that Drummin wood was originally owned by Lord Arran. He sold this property to the Sisters of Charity in 1910, who, in turn, sold it to the Forestry Division in 1928. It was mainly old oak woodland with Scots pine, silver fir and some spruce. From 1933-36 the area was cleared and planted at the rate of 60 acres per year. In the period 1936-43 no work was carried out here and the property was in the hands of a caretaker. Then from 1944-50 weeding and pruning operations took place. The first thinning was in 1951, while subsequent thinnings took place in 1957 and 1960.

The first stop in Drummin wood was in a 30 year old Japanese larch stand for which the Convenor gave the following data :—

	Plot	*B.F.C.*
No. of Stems per Acre	290	195
Mean Qr. Girth	$8\frac{1}{4}''$	$7\frac{1}{2}''$
Mean Tree Height	65′	64′
Mean Tree Volume	14.6 H. ft.	12 H. ft.
Volume per Acre	4,234 H. ft.	2,340 H. ft.
Top Height	66′	66′
Quality Class	I	I
Total Basal Area/Acre	136.0 sq. ft.	74 sq. ft.

Increment Estimate

Schneider Increment % (S) ... 3.5.

C.A.I. per acre/annum (modified in accordance with formula

C.A.I. = 0.9S + 1.8) ... 207 180 B.F.C.

Soil Analysis	*Ph*	*Ca*	*P*	*K*
0 — 1″ in depth	5.4	4	2	1
1 — 4″ „ „	5.3	4	2	2
4 — 9″ „ „	5.3	3	1	2

Mr. Morris was of the opinion that this crop was overstocked. A discussion arose here on the advisability of growing Japanese larch on a site like this. Mr. Allman stated that if a price of 3/- per cubic ft. was obtained it would be economic to grow Japanese larch, but it was doubtful if 2/- per cube would be procured. Mr. Mangan informed us that the E.S.B. will purchase larch for poles provided it is straight and of good quality. Professor Clear suggested underplanting here with *Tsuga heterophylla*. The tsuga by suppressing vegetation would give easy access for thinning and pruning operations and a pulpwood crop could be obtained from the tsuga poles.

From here the party moved a short distance to the next point of interest which was a 30 year old *Sitka spruce* stand. The convenor gave us the following information:—

	Plot	*B.F.C.*
No. of Stems per Acre	280	310
Mean Qr. Girth	8″	8″
Mean Tree Height	66′	66.5′
Mean Tree Volume	14.0 H. ft.	13.5 H. ft.
Volume per Acre	3,920 H. ft.	4,180 H. ft.
Top Height	69′	70.5′
Quality Class	II	II
Total Basal Area/Acre	122.0 sq. ft.	134 sq. ft.

Increment Estimate

Schneider Increment % (S) ... 5.3.
C.A.I. per Acre/Annum (modified in accordance with formula C.A.I. = 0.9 + 1.8) ... 255 332 B.F.C.

Soil Analysis: As for last plot visited.

Time did not permit a discussion to take place here and so the day's proceedings concluded with the President thanking Mr. Allman, Mr. Crowley and their associates for a very enjoyable and instructive afternoon.

P.H.

Fourth Day.

The sun still shone as we departed from the beautiful Yeats country and headed northwards for Co. Tyrone, where on arrival at Castlecaldwell Forest, we were warmly greeted by members of the Northern Ireland Forest Service.

Mr. Parkin, Chief Forest Officer, welcomed us on behalf of the Minister for Agriculture and went on to say, they in Northern Ireland felt honoured that the Society of Irish Foresters had decided to include some northern forests in this year's "Coming of Age" Study Tour. He expressed the hope that the visit would prove interesting and enjoyable and having mentioned that as a member of our Society, he himself was looking forward to an exchange of views, introduced Mr. Kilpatrick, Deputy Chief, Mr. Phillips, Divisional Officer, Dr. Jack, Convener and Research Officer, Mr. Woolfenden, District Officer, Mr. Montgomery, Head Forester and Mr. Cunningham, Forester.

Dr. Jack outlined progress to date at Legges Wood property of Castlecaldwell Forest, where Sitka spruce was planted on a 1st class site in 1919. Thinnings to date have yielded 6,125 H. ft. per acre and standing volume at present amounts to 6,247 H. ft. making a total crop yield of 12,372 H. ft. per acre. Periodic annual increment, October 1958/December 1962 was 400 H. ft. per annum.

A sawmill 20 miles away facilitated disposal of heavier thinnings and no difficulty had been experienced in disposing of pulpwood at remunerative prices. Mr. Morris, stating that less than 5% of our Sitka spruce stands in the south were of quality class I standard, expressed pleasure at seeing a fine stand above Q.C. I to which Dr. Jack replied that 3% to 4% only of Northern Ireland Sitka spruce fell into Q.C. I. In reply to a query from Mr. Mooney, who commented on the vigour of the plantation and enquired if it was to be retained, Dr. Jack replied that the stand was being retained and went on to refer to the very considerable damage caused by the 1961 gales. He favoured crown thinning from an early age as a counter measure to storm damage e.g. from 25′ upwards. Mr. Parkin favoured more attention to drainage and mentioned that more intensive drainage was being undertaken since 'Debbie's' visit in September 1961.

The second stop at the same forest proved to be a P.08 Sitka spruce and other conifer stand at Stone Park which had been acquired in 1960 and never thinned. Sitka spruce volume was now 12,500 H. ft. per acre and M.A.I. 230 H. ft. per annum indicating no loss of production as a result of no thinning. Mr. Morris was of the opinion that had thinning been carried out, there would have been even a greater volume than 12,500 H. ft. per acre and Professor Clear assessed the possible gain at 200 to 300 H. ft. per acre, which he pointed out would not have been marketable due to location. Mr. Busby pointed to the slow dying of the repressed trees as a safeguard against windthrow and Mr. Morris drew attention to the compound interest problem in unthinned stands.

As time marched on, our President, Mr. McNamara, thanked Mr. Cunningham and we boarded our coach for Ballintempo Forest where, on arrival, a sumptious *al fresco* meal, prepared by Mrs. Stinson and Mrs. Thompson, awaited us on an elevated site which commanded a magnificent view of the entire countryside. The President really spoke for the entire party when he thanked the talented ladies and their helpers who provided such an appetising meal.

Well sustained, we entered Ballintempo Forest where we were introduced to Mr. Stinson, Forester. This forest extended to 4,000 acres, 1,600 acres of which had been planted and was a deep peat area of low productivity. The forest workers' houses (for key workers) at the entrance to the forest, rent of which with water laid on, was 4/- per week, aroused comment as we travelled to our first stop where some very interesting experiments in drainage and manurial treatment were outlined by the District Inspector, Mr. Woolfenden.

A plot was drained with a single furrow Cuthbertson at 30′ apart in July 1955, but in 1957, it was noted that there had been little or no change in the vegetation as a result of the pre-drainage work.

Plots ploughed in late 1955 and planted in March, 1956 with Sitka spruce and *Pinus contorta* showed *Pinus contorta* growth to be considerably better than Sitka spruce to date; but in the case of both species, application of basic slag has proved more beneficial at time of planting than 1 year later with difference more marked in Sitka spruce. Ploughing methods, utilising Beggs and Cuthbertson's single and double mould board, do not appear to have had any marked effect but it was noticeable six years later, in 1962, that Sitka spruce growth tended to fall off on the areas that were least intensively ploughed.

Mr. Parkin referred to the importance of attention to deepening of main drains, the beneficial effect of the tree crop in changing the peat structure and lowering water table and mentioned that the action of the trees was more pronounced than the deepening of the drains in lowering of the water table. He considered that a good pulpwood crop was a reasonable expectation.

Prepapration for 1964 planting at the forest introduced a Type P. Cuthbertson with a system of racks left every 14 planting rows at right angles to road system in order to facilitate extraction later.

Mr. Stinson explained a modification which he himself designed for the single Cuthbertson plough for the stepping down of the ribbon, the advantages of which he stated were suppression of vegetation, early access to emulsion, more shelter for young plants and reduction in costs. Mr. Woolfenden informed us that the previous manuring at 2 ozs. per plant at time of planting, mostly basic slag, was now being superseded by 3-4 cwt. of ground rock phosphate per acre broadcast, prior to ploughing, using a Muskeg Tractor mounted on rubber and aluminium tracks which are capable of traversing swamps.

Time continued to march on and reluctantly we left this very interesting forest, our President thanked all the officers concerned for the painstaking reviews of their work.

Final stop for the day was Pubbles Nursery near Enniskillen where our party were welcomed by Mr. Coates, Nursery Officer, who introduced Mr. Parker, District Inspector, Mr. McSorley, Head Forester and Mr. Bell, Forester.

The advantages of the nursery, we were informed by Mr. Coates, were soil texture, natural drainage and proximity to planted areas of 320 acres but the disadavantages were many e.g. aspect, frost, exposure, slope, stones, scattered blocks and waste ground.

In 1953, the Ph. was 5.1 but by the end of 1955 it was down to 4.7. Ground limestone was applied in 1956 and 1957 and the Ph. is now fairly steady at 5.2 to 5.4. Consideration is being given to the use of peat instead of farmyard manure as the soil is generally lacking in humus.

Nursery costs in the first years were very high and the need for mechanisation became an urgent concern. Mr. Bell outlined the forms of mechanisation introduced which included a seedbed-ridger in 1955/56, an imported stone-picker and a tractor-drawn imported sand and grit spreader in 1959 and a home designed tractor-drawn seedbed roller in 1960.

Reduction in cost per acre of seedbed sown was quite spectacular when 1955 costs of £103 per acre with a basic wage of 120/- per week were compared with 1962 figures of £65 per acre when basic wage had risen to 168/- per week. Apart from this drastic reduction in costs, these changes between them resulted in a marked increase in the quality and quantity of seedlings produced.

Introduction of a small plough in 1959, followed by replacement of the Northern Ireland type lining out board by the Ben Reid type in 1961, increased the number of plants lined out, per man day, from 2,600 in 1958 to 5,000 in 1963.

Simazine, introduced for the first time on a small scale in 1960, was used on all transplant lines in 1961, resulting in a saving in that year of over £400 in weeding costs. In 1961, Paraquat was tested as a pre-emergence weed killer and proved so much more effective than T.V.O. that nothing else is being used now.

As time was pressing, owing to our Annual Dinner engagement in Omagh, we bade farewell to Pubbles much earlier than we would have wished. Mr. McNamara thanked Mr. Coates and his staff and, in particular, the ingenious Mr. Bell for a most informative sojourn at the Nursery and we then boarded our coach for Omagh.

On arrival back in Omagh, the party were the guests of the Minister of Agriculture, Mr. H. W. West, at a cocktail reception in the Royal Arms Hotel, Omagh. The Minister was unfortunately unable to attend having been called on urgent Cabinet business and was represented by Mr. H. Elliot, M.B.E., who is responsible for the Forestry Division of the Ministry. He was accompanied by senior technical officers of the Division, and also present was the Duke of Abercorn, representing the Royal Forestry Society of England, Wales and Northern Ireland, accompanied by the Duchess.

Following the cocktail reception, the Society held its Annual Dinner. The guests included the Duke and Duchess of Abercorn, Mr. and Mrs. Elliot and Mr. Parker, Chief Forest Officer for Northern Ireland, and Mrs. Parker.

A pleasant surprise was the presentation by the local officers of a cake in the form of a log ringed with twenty-one candles. "The log" was duly cut by our President who was assisted by the Duchess.

J.R.

Fifth Day.

The party arrived at Cootehill Forest on the final stage of the tour with most of them suffering from the effects of the night before.

Mr. Breslin, the District Inspector, extended a welcome on behalf of the Minister for Lands and introduced Mr. Mulloy, Assistant District Inspector and Mr. Dalton, the Forester-in-charge.

Mr. Morris pointed out a stand of Sitka spruce and Norway spruce mixed. Figures, as per data supplied, were read out and a lively discussion was centred on the performance of Sitka spruce and Norway spruce growing on the same site. Sitka spruce, in this stand, showed quality class III while Norway spruce was quality class I. Mr. Mooney pointed out that Norway spruce should be favoured on sites suited to it, while Sitka spruce would show more production on the poorer types. It was noted that variation of stem sizes was due to group planting of hardwoods throughout the area. Mr. Mooney also pointed out that frost was a major factor to be considered on such sites and this was a pointer to plant Norway spruce, the more frost resistant of the two. The most striking point about the stand was the selection felling of commercial trees, approximately 20 to the acre and 15-20 H. ft. each. The wind blow danger resulting from this treatment was discussed. Professor Clear pointed out that dominants were usually blown by the wind and always caused further damage. Past experience with Douglas fir proved this point. Mr. Morris said that the relationship of form factor and rooting system had an important bearing on this matter. Trees of low form factor have better rooting systems making them more wind firm. Professor Clear indicated that the reduction of over all top height reduces the danger of wind blow and favoured the removal of dominants from the economic and sylvicultural point of view—sub-dominants usually pick up after removal of dominants. Mr. Loughrey pointed out that as vigorous dominants appeared to be favoured in early thinnings, felling should be carried out by forest labour as private companys tended to do damage while dealing with these. It was indicated that Norway spruce on such sites was of good quality class but produced poor quality timber. Mr. Morris pointed out that Sitka spruce might not be as vigorous if planted pure. Professor Clear favoured the adoption of Sitka spruce and Norway spruce mixture in order to cash in on the vigorous dominant Sitka spruce that would be taken out in the first selection thinning.

The party then proceeded to the second stop where a comparison of pure blocks of Scots pine and Norway spruce, side by side, growing on the same soil type was made.

The Scots pine showed less stems per acre and a lower annual increment when compared with B.F.C. tables. The Norway spruce adjoining was much superior. Mr. Galvin pointed out that the Scots pine was probably in its slow stage as was noted at Cahir forest and would possibly catch up on the Norway spruce. Professor Clear said that the poor quality of Scots pine stems and the low yield was an example of the loss that can be experienced on those sites. Quality class III or IV Scots pine on such sites could be clear cut.

The aspect of breaking up large blocks by planting such strips of Scots pine through them as a precaution against wind-blow was discussed. It was generally agreed that it would be a good security scheme. Mr. Morris indicated that the tendency to open up Scots pine too quickly resulted in the invasion of briar and undergrowth, causing a loss in annual increment up to as much as 50%. Mr. McNamara thought that *Ulex* invasion would result in loss of annual increment but briar etc. would suppress undesirable grass and in itself would not retard growth. The Norway spruce stand soil profile showed gleying tendencies. C.A.I. of 247 H. ft. at 28 years compared favourably with B.F.C. yield tables.

The party proceeded to the third stop where the finest oak to be seen in the country was viewed. It was 130 years old and had a 20½" mean quarter girth and 34 ft. to the nearest branch. This quality II stand produced an estimated 57 cu. ft. per acre per annum.

It was mentioned that the price for poor quality oak was 3/- per cu. ft., but quality oak for veneer fetched up to 15/-. It was pointed out however that the demand for oak was declining, fetching only 4/- and 5/- per cu. ft. for furniture.

A selection felling was recommended for this stand removing the poorer quality stems and retaining the better ones pending a good market. The understorey of rhododendron should be retained to keep the stems clean of epicormic branches—potential veneer oak might revert to inferior oak by development of epicormic branches. Professor Clear agreed that the undergrowth should be retained and suggested that spraying of epicormic branches to keep stems clean might be considered. It was also indicated that the retention of the whole stand as a national monument might be a good idea.

Mr. McNamara at the closing stages thanked the local officers who co-operated so willingly in making the stay at Cootehill such a success. The officers in the north were highly complimented on their co-operation, kindness and efficiency. Members were thanked for co-operating with the convenor, Mr. Morris.

Mr. Morris received hearty applause from the members in appreciation of his efficiency and his unsparing efforts in making the tour a success. He expressed pleasure in the co-operation he received from everyone.

The bus driver was not forgotten, receiving a round of applause for his effort in carrying out all requests effectively.

Mr. Mooney stated that the tour was the most successful and enjoyable in his experience and attributed this to Mr. Morris's co-ordinated effort and willingness to bear the weight of responsibility in the organisation of the tour.

B.O'R.

Excursion to Glennasmole

BECAUSE of the heavy rain and high winds the first outdoor meeting of the year, organised for 21st April, was postponed to Sunday, 12th May. The subject for consideration was Land Assessment and Classification.

The area visited, a commonage in the upper reaches of Glennasmole, Co. Wicklow, had not actually been offered for sale for afforestation but served as a good example of the kind of land considered suitable for tree planting.

Mr. Martin Sheridan, who was introduced by Mr. Michael McNamara, President of the Society, said that while the work involved in carrying out the annual planting programme of 25,000 acres was recognised and widely appreciated, the task of acquiring the land for such a programme was less well understood.

It was appropriate that on this, the first outing of the year, the procedures and problems involved in land purchase be discussed. Mr. Sheridan then detailed the normal acquisition procedure. The precise location on the ground and on the acquisition map of the boundaries of the area for sale was most important and was sometimes more difficult than it might seem. It was also necessary to ascertain full information as to rights-of-way providing access to the area and rights-of-way or other rights, such as rights to grazing, turbary, sporting rights, etc. against the area.

The classification of the land into site types was of critical importance. Using the commonage in which the party stood, as an example Mr. Sheridan dealt with the significant factors of soil origin, site elevation, aspect and exposure. He pointed out that vegetation was particularly valuable in assessing site quality. The commonage ranged in elevation from 900-1,650 ft. The underlying rock was granite. Quoting Moore he mentioned that the agricultural land of the valley was continuous with the calcareous drift of the lower ground.

The vegetation was divisible into three broad types—(I) the grass heath areas at the lower levels which carried *Ulex gallii,* some *Ulex europaeus* and fine grasses as *Agrostis tenuis, Festuca ovina* and *Nardus stricta,* (II) interspersed flush areas of limited extent with a cover of *Juncus* species, *Juncus effusus* particularly, and with grasses, and *Polytrichum* and *Sphagnum* mosses, (III) the more high-lying *Calluna* dominated moor, which included such species as *Eriophorum angustifolium* and *vaginatum, Nardus stricta* and *Juncus squarrosus,* with *Scirpus* and *Rhacommitrium* coming in on the more elevated ground.

The question as to which species should be planted on the various site types and sub-types gave rise to considerable discussion and difference of viewpoint and the value of the ecological approach to site classification was raised. While many would like to have more definite means of assessing the value or potential of particular sites for tree-growing, it was considered that, when properly understood and applied, the ecological method was satisfactory. In any event it was the only inexpensive method which was readily available for large-scale use. The alternative would involve the conducting of a series of detailed and expensive studies of the separate factors of environment. It was however suggested that as a long-term measure, aimed at improving our site assessments, a certain proportion of the areas acquired each year should be subjected to such direct scientific appraisal, as well as by the less direct ecological method. Dealing with the economic considerations involved in land purchase, Professor Clear mentioned that in Great Britain it had been estimated that it was not an economic proposition to invest money in areas which had a mean annual increment potential of less than 80 cu. ft. per acre per annum.

In land acquisition for forestry the paying of improved prices with a view to obtaining better quality land would be a worth while investment. It would in fact be more economic to pay £30 per acre for good forest land than to plant poor ground which had no market value.

The possibility or otherwise of ploughing was discussed and was considered to be a factor involved in assessing a fair purchase price.

Mr. D. McGuire said that the estimated preparation costs should also be taken into the reckoning. Mr. McGlynn felt that while it was acceptable to acquire poor quality ground, when it represented but a proportion of the offer as a whole, it was a different matter when areas purchased were largely comprised of such. In his opinion there was a risk that too much lower quality ground might be acquired.

The problem of exposure and the methods—or lack of methods—available in its assessment was raised. Mr. T. McEvoy suggested that some of the opinions expressed in regard to conditions on this commonage might have been biased in consequence of the prevailing high winds on that particular day. Professor Clear stated that while generally speaking bracken (*Pteridium aquilinum*) is not regarded as an indicator plant, it is useful as a guide to exposure.

Notwithstanding an apparent enthusiasm for further discussion on the problems and implications of this highly important facet of the national programme of afforestation, the onset of a downpour of driving rain forced the party from the mountain side, to the shelter of a local forestry hut, where individual arguments and discussions were continued and a welcome cup of tea was served.

N.M.

Excursion to Ossory Forest

MEMBERS assembled on Sunday, 14th July, 1963, at Glendine Property, Ossory Forest. The convenor, Mr. N. Morris, introduced the subject for the day—the comparison of two good quality stands of Norway and Sitka spruce.

The party proceeded to the first stop, the Norway spruce stand. The stand stood at 7,800 ft. altitude. Slope was 15°. A 1/10 acre plot, representing the stand, which we were told was due for felling, had been measured.

Crop particulars were as follows:—

P/yr.	S.P.A.	B.A. Sq. ft.	Mean tree Q.G. ins.	Top Ht. ft.	Mean Ht. ft.	Vol. H. ft.	C.A.I. H. ft.
1919	380	146	7½	73	63	4,520	217

These figures were compared with the figures for a B.F.C. yield table quality class I.

	285	161	9	74½	70½	5,450	280

The difference from the B.F.C. quality class I stand, in the larger number of stems per acre and smaller standing volume was mentioned, as was the 10 ft. drop in mean height.

A discussion on C.A.I. and M.A.I. arose, and on the optimum length of retaining a stand on the ground. It was noted that C.A.I. and M.A.I. crossed, in the case in question, at about 50 years. This indicated the advisability of early clear felling.

Professor Clear referred to the necessity of early felling due to windblow danger.

The potentialities of Sitka spruce on the same site was mentioned.

The aspect of different rotation types was also brought up by Professor Clear.

(1) Financial rotation
(2) Rotation of maximum production
(3) Technical rotation
(4) Silvicultural rotation

—and their applicability to stands such as we were viewing.

Various factors involved in the manipulation of rotation for the maximum benefit were broached on. The land expectation value, the indicating % for thinnings, the financial yield graph were all mentioned as important considerations. The Professor did a rapid calculation to determine the interest at present being earned by the spruce in which we were standing based on figures for land, timber and increment and an expected price of 2/6 per cu. ft. for the final crop. The crop was earning about 5%.

Other points concerned the critical stage at which the crop now was by Mr. Morris; the financial cost of windblow mentioned by Mr. O'Carroll. Mr. Sharkey mentioned two conflicting aspects from the timber trade point of view: the necessity of getting certain size categories of timber—and at the same time the greater necessity of having timber constantly available.

A discussion on the merits and demerits of the 40% rule, the 16% rules and the mean basal area tree method of timber sampling arose.

The prices for saw timber versus pulpwood were discussed by Messrs. Stagg and Sharkey and the possibilities of growing timber to certain price and size categories.

The necessity of an integrated timber industry was stressed—for the smoother and more efficient working of all sectors.

The party then proceeded to the second stop. A 35 year old stand of Sitka spruce which according to British Forestry Commission yield tables was quality class II. Crop data were:—

Age	S.P.A.	B.A. Sq. ft.	M. Girth in. Q.G.	M. Vol. H. ft.	M. Ht. ft.	Vol. H. ft.	C.A.I. H. ft.
Stand 35	240	126	$8\frac{3}{4}$	18.8	75	4,570	460
B.F.C.							
Q.C. *II*. 35	255	136	9	18	74	4,800	300

Size of average tree removed in stand ... ... 0.7 H. ft.

B.F.C. Q.C. *II* ... ... 1.4 H. ft.

The C.A.I. — M.A.I. graphs for quality class *II* Sitka spruce, we were told, crossed at 40-45 years. It was mentioned that a heavy thinning early on, reducing the capital of the crop somewhat, could prove economic.

Using the same technique as in the case of the Norway spruce crop, the interest % of the Sitka crop showed to be 6%. It was generally considered that the crop should be kept at least to 40-45 years.

Again wind problems and allied dangers were brought forward, but remedies by various thinning treatments were considered practical—for example, a lowering of form factor by substantial opening of the crown.

The feasibility of different initial espacements, and the possible advantage of wider initial planting with corresponding lower costs, and perhaps subsequent protection from a more stable crop were discussed.

The progressive deterioration of the weather rather dampened a very stimulating discussion which otherwise would have gone on considerably longer and members reluctantly, withdrew from the ground to more sheltered surroundings and tea. A vote of thanks was proposed to the District Officer, Mr. Prior, and to the Forester, Mr. Maguire, for their co-operation and interest and to Mr. Morris for the choice and comprehensive coverage of an interesting subject.

G.J.G.

Excursion to Clonsast Bog

ON Sunday, July the 14th, the Society visited Clonsast Bog where we were introduced to the interesting subject of peat-structure and pollen analysis by Dr. Neil Murray.

Pollen analysis he told us formed the backbone of his investigations. For those not already acquainted with it he outlined the principles of this study. It was well known that the remains of former vegetation were preserved in peat. It must also be long observed that all peat was not the same, varying from place to place and also at different depths. The first methods of investigating late quaternary changes of vegetation made use of larger fossils e.g. timber, leaves, seeds, etc. Positive identification of much of this material required the use of magnification with the resultant discovery of smaller fossils, inter-alia pollen grains. It appeared that the first pollen grains observed were found in pre-quaternary deposits about 1836, but, as far as known, the first to use systematically the occurrence of pollen grains in post-glacial deposits was a German called Weber in 1893. The first percentage calculations were made it seems in 1905 by a man called Lagerheim but the first to realise the full potentialities of the method was the Swedish geologist, Lennart von Post, who presented the first modern percentage pollen analyses in 1916. From the middle twenties pollen analysis had been the dominant method for investigating late quaternary vegetational and climatic development but it was also used in the investigation of older deposits and had even figured in modern legal cases in the courts of law. Pollen analysis was not used alone—the macrofossils and condition of the peat in which they were embedded were also taken into account. Archaeological finds in peat were also made use of as a means of dating the level at which they were found and, when sufficient pollen diagrams were available throughout a region, the reverse process could be carried out, namely, the archaeological objects may be dated by their position in the pollen diagram. Material for pollen investigation is best obtained from lake bottoms but as most of our lakes have been affected by drainage operations at one time or another, with consequent re-deposition of material bearing fossil pollen, they were unsuitable for the pollen analytical method, therefore we made use of the peat deposits. The pollen grain was formed in the male part of the flower and the portion which remains preserved in bogs or lakes was formed of one of the most extraordinary resistant materials in the organic world. Recent pollen grains would be heated to nearly 300 degrees centigrade or be treated with concentrated acids or bases with little effect. The form of pollen grains varied greatly with the subsequent possibility of identification, even as far as species in most cases. Pollen dispersal could take place in water or on insects or by wind. The latter was the most important for pollen analysis. Only a small percentage of the pollen produced ever reaches its goal, the balance falling as the so-called "pollen rain". It was these enormous quantities of pollen which become very evenly distributed by the wind over large areas of land and water with which we were here concerned.

Dr. Murray quoted the following figures from a text book by two well-known pollen analysts, Messrs. Faegri and Iversen. A ten year old branch of beech shed 28 million pollen grains. Spruce and oak (a ten year old branch) 100 million pollen grains. Pine (a ten year old branch) 350 million pollen grains. One male plant of *Rumex acetosa* 400 million pollen grains. The spruce forests of south and mid Sweden produce ca. 75,000 tons per annum when flowering freely. The general distance which pollen was carried was from 50-100 kilometres, though distances of 1,700 kilometeres had been recorded and pollen had been trapped from the air the whole way across the Atlantic.

We were then shown the sites where two borings in peat had been made. The first referred to on a map of the bog and was called Clansast D. This boring was made in deep peat. The point was situated in Trench 2. The depth of this boring was 370 cm.

On a complicated pollen diagram Dr. Murray explained the following facts. In the basal sample, just above the grey sandy clay, were found numerous traces of *Pinus* grains with small amounts of *Corylus, Quercus* and *Ulmus.* At 360 cm. level *Pinus* decreases but *Corylus, Quercus* and *Ulmus* had increased. At 350 cm., where *Ulmus* had decreased in value, we found the first trace of *Plantago lanceolata,* showing for the first time some form of agricultural interference. According to Van Zeist's dating, this 350 cm. depth dated to approximately 3,000 B.C. At the 300 cm. level there was more evidence of man.

From 270-260 cm. the value for *Quercus* fell then rose to a maximum. *P. lanceolata* appeared at 280 cm. and was then present throughout the remainder of the diagram indicating greater or lesser intensity by man right up to modern times.

From 270 to 210 cm. we passed through a period where wetter weather conditions prevailed and *Sphagnum* pollen grains became more numerous. Two more agricultural horizons appeared at 240 cm. and 210 cm. The Ericaceous pollen curve reached a peak at 130 cm. At 145 cm. *Ulmus* fell and *Corylus* was at a minimum and *Alnus* and *Quercus* started to rise from low values.

The *Taxus* peak at 100 cm. coincided, more or less, with the drier period when pine colonized the bog. It was interesting to note that *Pinus,* though low in value, was present right to the top of the diagram.

The party then moved on to another site. This was an incomplete profile situated in the face of a truncated peat bank on the east side of Drainage Trench 2; the profile was referred to as Clonsast G.

This profile was situated on higher ground which had long remained above the influence of the enlarging bog. At the base of the profile, *Taxus* and *Quercus* were growing on a dry soil as was shown by the extensive root systems of the oak in the boulder clay. Some time later peat covered the rise and conditions became increasingly difficult for trees, though *Taxus* and *Quercus* survived the change over for some time. A gradual change from an alkaline to acid condition took place. During the period a fen community with *Phragmites, Carex* and *Juncus* flourished.

The most striking feature of the pollen diagram we were told was the high value of 37% for *Taxus* pollen found at the base.

With the increasing acidity of the bog *Rumex* left the area and a layer of *Oxycoccus palustris* spread itself extensively. The fast rise in the Ericaceous pollen curves were doubtless due to this species.

The advent of *Calluna,* shown by the presence of its seeds, indicated a progressive drying of the bog surface. The Ericaceous curve at this period rose to a maximum. It was during, and as a result of this drying out that *Pinus* started to colonize the bog. The layer of pine remains resulting from this colonization can be traced over a large area of the bog and is contemporaneous with carbon—14 dated wood from a pine tree growing about A.D. 365.

Dr. Murray concluded by thanking Bórd na Móna and Mr. Finnegan for their permission in letting the Society visit the bog.

After tea we visited Trench 14 where Mr. O. V. Mooney and Mr. N. O'Carroll brought us up to date on their latest research work here.

Mr. McNamara, the President, thanked the speakers for what he described as one of the most interesting day excursions he had been on. He felt that those present would all agree with this.

M.J.S.

Excursion to Gougane Barra

"There is a green island in lone Gougane Barra,
Where Allua of songs rushes forth as an arrow,
In deep-valley'd Desmond—a thousand wild fountains,
Come down to that lake, from their home in the mountains."

Jeremiah Joseph Callanan.

THIS beautiful secluded West Cork valley is the location of Ireland's first national forest park and the twenty members and friends who braved the elements on an excursion here in August had a most interesting and informative afternoon.

The party was welcomed by Mr. N. Morris on behalf of the Society who intrdouced Mr. William Shine, District Inspector, representing the Minister for Lands on this occasion and who was to be our leader for the day. Mr. Shine at the outset stated that he would refrain from technical details and went on to give a brief history of the valley.

He stated that in the 4th century St. Finbarr established a monastery on the "Green Island" the ruins, in fact, even the cells used by the monks, are still to be seen and the "Island" which is now linked to the mainland by a narrow path draws crowds of pilgrims annually.

After the battle of Kinsale, O'Sullivan Beara on his march to Leitrim passed through Gougane. In more recent times, the famous Tom Barry, O/C. of the West Cork Flying Column, sought refuge and hospitality here in his many exploits. Gougane Barra in those days was a haven for the "boys on the run" in both Cork and Kerry who were all treated with typical West Cork hospitality by the Cronin family who now own Gougane Barra Hotel.

The area now forming the Department Forest property was acquired 23 years ago and from the outset great emphasis was laid on the value of the scenic amenities, but it is only recently that the actual development work started. The total area is 340 acres of which 238 acres are classed plantable and now carry crops of Norway spruce, *Pinus contorta,* Sitka spruce, European larch and *Abies grandis.* A stand of *Pinus contorta* and Sitka spruce mixture, although still in the early stages of development, aroused some interest. Mr. Shine pointed out that, due to early failures in the original Sitka spruce crop, the area was subsequently beaten up with *Pinus contorta* which nursed the spruce to what is now, a very interesting mixture in the thicket stage. The stands of Norway spruce and Sitka spruce at the mouth of the valley have done very well and have succeeded in reaching and maintaining a quality class II development stage (B.F.C. yield table standards). In the eastern end of the valley on a steep rocky incline a stand of very promising European larch now exists, although some slight damage has been caused to the perimeter by blasting during road construction.

The development of this area as a National Forest Park presented problems, especially in road construction. A ring road 1⅔ miles long was constructed round the upper perimeter of the valley. This road is still unfinished but when one contemplated the immensity of the task of blasting a road through solid rock for this distance one realises the tremendous work done in the past few years. It is intended to have this road tarred and open to tourists. In our walk round the "Ring" a number of the famous "thousand wild fountains" were encountered where bridge and culvert construction was necessary. A good example of a Mud Sill bridge exists here and Mr. Shine in pointing it out stated that it is the first traffic carrying bridge across the river Lee which rises in these mountains.

The excursion was marred by heavy rains for the most part but the sun broke through the clouds shortly before our arrival back at the mouth of the valley where Mr. Morris thanked the gathering for braving the elements and for showing great enthusiasm under such adverse conditions. He also thanked Mr. Shine for the excellent leadership which made the afternoon such a success.

E.S.F.

Excursion to Johnstown Castle

THE Society's excursion of September 8th to Johnstown Castle, Co. Wexford was attended by members as far afield as Derry, Clare and Cork. Fine weather, an unusual phenomenon of the 1963 outings, and the sheer beauty of Johnstown Castle, helped to make this outing one of the most enjoyable of the season.

Mr. Le Clerc, our leader of the day, was introduced to us by our President, Mr. McNamara. Mr. Le Clerc welcomed us on behalf of the Agricultural Institute. Johnstown Castle he said is the present headquarters of both the soils division of the Institute and the soil survey for Ireland. The estate has approximately 1,000 acres of which 350 acres is woodland and 30 acres amenity. The woodlands themselves are mostly conifers particularly Scots pine and were all planted circa 1890. He outlined the particular problems of management laying special emphasis on timber sales.

Our first stop was made in a mixed conifer wood where we came face to face with the problems Mr. Le Clerc outlined earlier. The crop, a mixture of Scots pine and Corsican pine, was recognised by all present as being of rather poor quality. 11½d. per cubic foot standing was the highest price offered. Mr. McNamara favoured the gradual conversion of the existing woodland to hardwoods particularly oak. The ability of the ground in question to grow quality oak was proved he said by the many fine specimens he had seen on our walk from the castle. Messrs. Morris and Galligan favoured a clear felling and replanting with Sitka spruce. Many feared that the amenity of the castle and environs would be spoilt by clear-felling and favoured a scrub clearance plan and a removal of poorer stems together with underplanting of say silver fir.

Leaving this stand we were introduced to another stand of similar material. Being slightly more exposed the volume per acre did not compare favourably with the previous stand. This lead to a discussion about the quality of slow grown timber and many thought that the increased cost of waiting for quality material to mature was not reflected by the price eventually obtained. Mr. Morris outlined the imperative need to high prune Scots pine when it became ready to do so. While other timbers, he said, could hold their dead knots when planked; Scots pine, because of the inherent quality of its sapwood to deteriorate more quickly than its heartwood, dead knots were more likely to fall out.

Our next stop was at an 8 year old Sitka spruce plantation which was showing good progress and which would in time produce not only quality timber but also considerable shelter for the surrounding agricultural land. Mr. Butler said that the woodlands at Johnstown were in effect shelter belts, contributing little in monetary terms but much to the creation of a favourable micro-climate in the estate. A spontaneous discussion arose from Mr. Butler's point in which Dr. McCracken and Mr. McNamara put forward many interesting views.

Before leaving the spruce Mr. Le Clerc drew our attention to an area under bamboo laid down some years ago on an experimental basis. A discussion arose about the utilization of this novel species. One member talked of the cellulose content and fibre length of bamboo, and thought of its possibilities as a processed material. The species he thought might have a place in forestry in the not too distant future if research proved it a profitable short rotation crop.

The tour concluded at the castle where we were entertained to tea in the former chapel. There Dr. Haddon gave us a short history of the chapel, castle and grounds. Originally an Esmonde estate the lands fell, during the Cromwellian wars, to a British captain whose descendants paradoxically played patriotic roles in Wexford's 1798 rebellion. The estate and castle were presented to the State in 1947 and were later adopted for agricultural education.

Mr. McNamara thanked Dr. Hadden, Mr. Le Clerc and the Agricultural Institute for making such a pleasant outing possible.

Reviews

Bark Form and Wood Figure in Home-grown Birch

By *R. J. Newall* and *A. S. Gardiner,*

Department of Scientific and Industrial Research and Forestry Commission.

Published by Her Majesty's Stationery Office, London. Price 4/-.

THIS report by R. J. Newall and A. S. Gardiner deals with the study of the bark form of birch in relation to wood figure. The object of the study was to see if the external bark characteristics of a tree, in this case birch, could give any indication of its internal grain structure.

The summary goes on to add "Thirty trees of *Betula verrucosa* were examined to determine the variation in bark form, the pattern of the grain or figure, the length of the wood fibres and the relations between these characters of tree and wood.

The wood under thin smooth bark is generally, though not invariably straight-grained; the grain of the wood under thick rough bark is usually disturbed, sometimes giving rise to flamey figure. Fibre length is greater in mature trees with thin smooth bark than in mature trees with thick rough bark. The recorded range in fibre length is from 1.23 mm. to 1.54 mm.

Where birch has a place in silvicultural practice, the favouring of vigorous trees possessing good growth habit and straight nearly cylindrical stems with thin smooth bark will enhance the value of the crop for the plywood, turnery and pulp industries; the favouring of trees with certain types of rough bark is more likely to produce logs suitable for the manufacture of decorative veneer."

Though birch is not recognised in this country as a timber producing tree, the possibilities for quick recognition of its internal structure from external examination, which this report reveals, are significant. It may be that, in time, further research will reveal that other species can be evalued by such a method.

M.J.S.

Forest Products Research 1962

Department of Scientific and Industrial Research, London.

Price 6/6.

THE political and economic changes which have followed two world wars are reflected in the annual reports of the Princes Risborough Laboratory. During its forty years in operation emphasis has passed from the study of overseas products to the investigation of native grown timber. This is most apparent in its latest report and makes it of considerable interest for workers in this country where the economic importance of native timbers will assume, before many more years, greater significance.

Indicative of the interest in timber as a material for structural engineering use, is the growing importance of measuring its quality in direct relation to the working stresses which it can withstand, the so called system of *"stress-grading"*. Already legislative requirements in the U.S.A. and Canada prescribe the use of stress-graded timber in the construction of houses, while a recent redrafting of the B.S. Code of Practice on the Structural Use of Timber in Buildings makes provision for its introduction in England. Present methods of stress-grading rely on visual inspection, and as the present report indicates, a piece of timber containing knots may in fact be stronger than a piece free from defects. An outstanding piece of work at Princes Risborough in the past year has been the development of a machine which can measure the deflection of timber, under a predetermined fixed loading, at a working rate of 80 ft. per minute. Much higher speeds have been claimed and the possibilities of adapting such a machine to commercial use for stress-grading by direct measurement are intriguing. At present it can handle only planed timber but its adaption to measuring rough-sawn material is under study.

The 1961 report referred to an examination of a shipment of *Pinus contorta* from Blessington, Co. Wicklow, and stated that in fibre length it was similar to Sitka spruce of the same age and superior to Scots pine. An investigation of the pulping properties of *Pinus contorta* grown from 19 different provenances in North Wales and Yorkshire, to which the present report refers, has disclosed considerable differences. These differences could be levelled out by controlling the cooking process, and kraft pulps of acceptable quality in 45-48% yield were produced. These results are significant for the Irish wrapping paper and board industries, and they lend additional interest to a species which was found in the earlier report to be comparatively free from spiral grain and potentially a useful constructional timber.

Limitations of space preclude reference to the other important work of this laboratory and particularly the growing importance of the activities of the newly formed science section; its engineering section has a long-established reputation. Of the 'ad hoc' investigations, a work-study of the conversion of Sitka spruce at a Scottish sawmill, and the utilisation of small softwood thinnings by conversion into shavings, for use as cattle bedding and poultry litter, merit mention because of their interest for Irish workers.

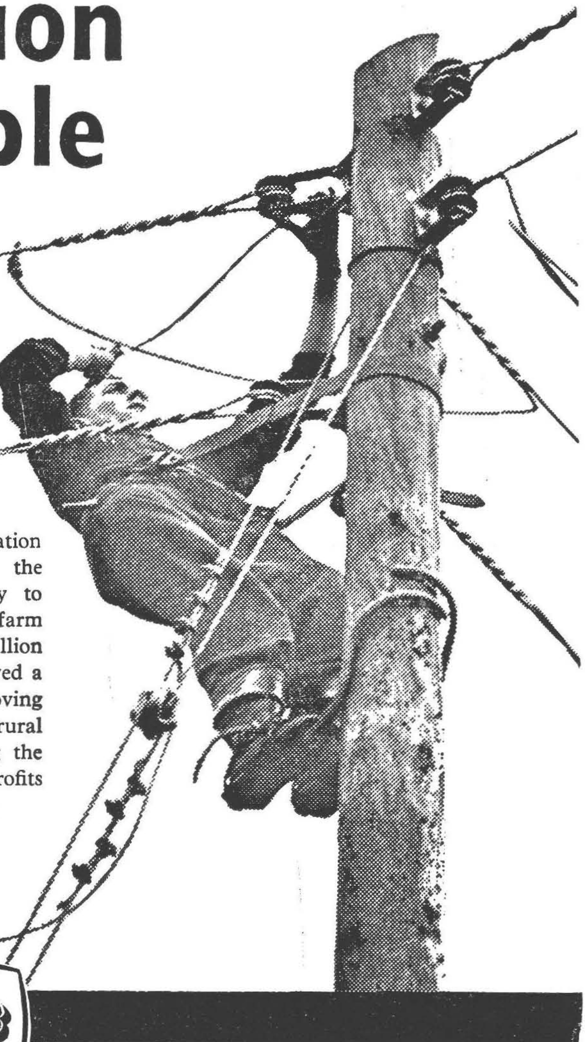
Mr. J. Bryan, formerly Deputy-Director, has been appointed Director of the laboratory, and is succeeded by Mr. F. H. Armstrong. The new Deputy Director is a Co. Down man who graduated from Queen's University and spent a considerable part of his early life in Dundalk.

D.T.F.

VISIT OF FINNISH FORESTERS

A group of Finnish foresters spent a two-day visit to this country on April 1st and 2nd. On their first day they visited Bord na Móna installations at Clonsast and Lullymore as well as seeing Trench 14. The second day was spent in Wicklow. The above photograph shows the group outside Shelton Abbey Forestry School.

Notes



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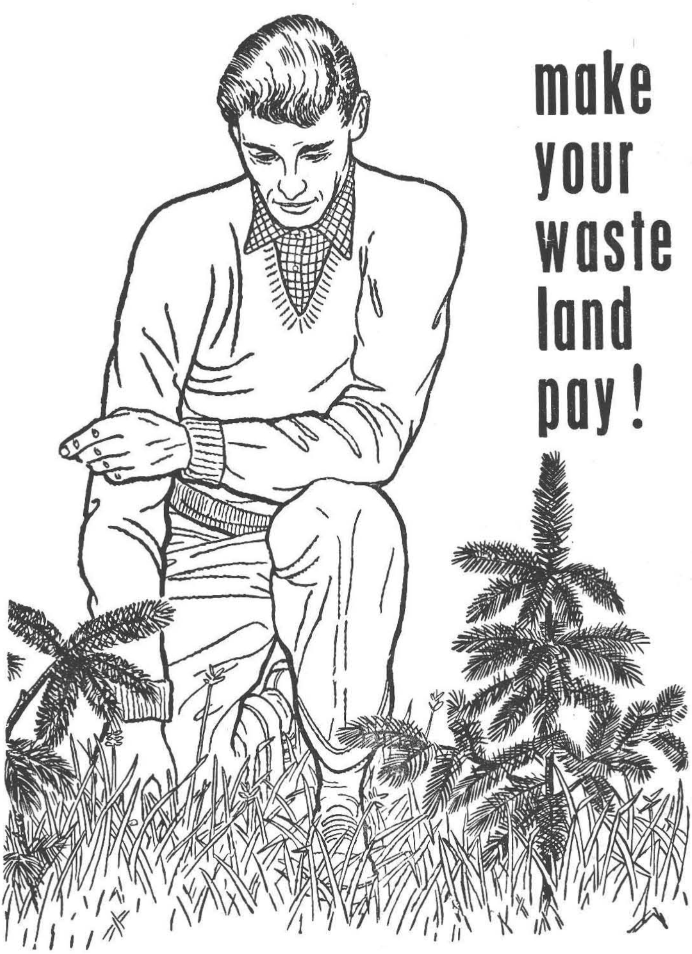

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