JOURNAL OF THE FORESTRY COMMISSION

No. 24 1955

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EDITORIAL

Honours

In the Birthday Honours List, issued in June 1955, our Director General received the award of a K.B.E.; Sir Arthur Gosling, as we shall now know him, has an exceptionally wide knowledge and experience of every side of the Commission's work in all three countries. A native of the Forest of Dean, he studied first at the Parkend Forester Training School, and was for a few years Forester in charge of Llanover Forest, Monmouthshire. After taking his forestry degree at Edinburgh University, he was appointed a District Officer in Scotland, where he rose in due course to be Director of Forestry. His appointment, in 1947, to be Deputy Director General at Headquarters was followed by promotion to Director General in 1948. On another page we reproduce a photograph of him inspecting a new office building at Thetford Chase, which has been constructed from thinnings made in young woods of the Commission's own planting.

Mr. B. R. Davies, Chief Executive Officer at Headquarters, who was concerned with the purchasing of stores and mechanical equipment, received the O.B.E. Mr. Davies, who began his career as a boy clerk in the Office of Woods in 1909, has recently retired from the Commission's service. Head Forester W. Tribe, who was for many years in charge of our Cannock Chase Forest in Staffordshire, was awarded the B.E.M. in the 1955 New Year Honours List.

The Commission

There have been no changes in the membership of the Forestry Commission during the year, and it continues to be constituted as follows:

The Earl of Radnor, K.C.V.O., *Chairman*
Mr. J. M. Bannerman, O.B.E.
Lieut.-Col. Sir Richard Cotterell, Bart., J.P.
Mr. Lloyd O. Owen, J.P.
Major John Stirling of Fairburn, M.B.E.
Mr. W. H. Vaughan, O.B.E., J.P.
Mr. Stanley C. Longhurst
Mr. A. P. F. Hamilton, C.I.E., O.B.E., M.C.
Mr. John McNaughton, C.B.E.
Major D. C. Bowser, O.B.E.
Mr. H. A. Turner, *Secretary*

We record with regret the passing of a former Commissioner, Lord Courthope, of Whiligh in Sussex, who had served on the Commission for twenty-one years until his retirement in 1948.

Promotions and Transfers

Although the officers concerned are not due to take up their new duties until early in 1956, we are pleased to record the promotion, to the rank of Conservator, of the following Divisional Officers:

Mr. J. S. R. Chard, who is to take charge of the North-West England Conservancy.

Mr. J. A. Dickson, who is to take over the North Scotland Conservancy.

Three other Conservators will be changing their stations in the near future. Mr. G. L. J. Batters is moving from the English Directorate in London to North-East England; Mr. C. A. Connell is going from North-East to South-West England; and Mr. C. A. J. Barrington is transferring from North-West England to the English Directorate.

Mr. G. D. Rouse, who was formerly Chief Education Officer, is now the Divisional Officer in charge of the Commission's Forests in South West England. Mr. I. O. Robertson, who was formerly at the Gwydyr Forester Training School, has been appointed to succeed him as head of the Education Branch, with the rank of Divisional Officer, early in 1956.

Mr. E. R. Lewis, a Chief Executive Officer, has moved from his former post as Chief Clerk in the Welsh Directorate Office at Aberystwyth to Headquarters in London, where he has taken charge of the stores Purchasing Section. His place at Aberystwyth has been taken by Mr. T. McGeorge, who has been promoted to Chief Executive Officer from his former post as Chief Clerk in the South Scotland Conservancy Office at Dumfries. Two members of the executive staff have left Headquarters on promotion to Senior Executive Officers; these are Mr. T. Farmer, who has become Chief Clerk at Dumfries, and Mr. J. Steele, who is now Chief Clerk in the North-West England Conservancy Office at Chester.

Progress in Acquisitions

The Commissioners' Annual Report for Forest Year 1954 rightly stressed our very real difficulties in acquiring enough land to allow of an expanding afforestation programme. But nevertheless the activities of our land aquisition staff have resulted in some interesting properties coming into our charge, in all three countries. In Scotland, there has been a notable expansion in the Isle of Skye, where two new forests, Healaval and Glen Varrigill, have been added to our long-established unit of Glen Brittle. On the Isle of Mull, too, there has been a substantial increase in our land, which is all included in Salen Forest. In Wales there have been extensive additions in the Cardiganshire uplands, close to the forests of Taliesin and Bryn Mawr, and also along the Cardigan-Carmarthen border. In England, we are extending operations considerably in the region just south of the Lake District, where three new forests, namely Cartmel, Lyth, and Foulshaw Wood, have recently been created. Another interesting English acquisition is that of Joydens Wood, a stretch of devastated woodland near Bexley in Kent, which is so close to London that it may fairly be described as suburban.

Developments in Utilisation

The steadily growing output of thinnings from our woods has led to the establishment of two or three industrial plants designed specially to take them, though naturally enough these installations may draw part of their raw material

from privately owned woodlands. At Strachur, in the Glen Branter portion of the Argyll National Forest Park, a sawmill equipped with Swedish "Ari" saws, designed to deal efficiently with small-sized logs, has been established as a joint enterprise by the Commission and a firm of timber merchants. At Annan, in Dumfries-shire, an independent company which was already manufacturing wallboard in the South of England, using material of imported origin, has set up plant designed to utilise small home-grown poles, which will be drawn both from Scotland and the North of England. At Sudbrook, in Monmouthshire close to the Severn Tunnel, the first steps are being taken to set up a paper mill which will use hardwood thinnings, drawn from the woods of southern England and South Wales. It will be noted that each of these new factories has a different end-product in view—evidence both of the versatility of timber and the widespread demand for forest produce.

Publicity

Into the Headquarters Office at Savile Row comes a constant stream of newspaper cuttings, collected by a diligent agency. They reveal that our work is attracting a growing measure of attention throughout the land. Much of the credit for this naturally rests with the Information Officer, whose job it is to keep the press informed. But he would be the first to admit that he could do little without the ready co-operation of the men in the field who, by showing round the newspaper correspondents and the parties of visitors, provide that first-hand knowledge which is so essential for a worth-while press report. Many of these articles only appear in local provincial papers—for it is only the exceptional story that finds its way into the big national dailies—but everyone who has lived in a country district will appreciate how great an influence the local weekly newspaper may have. One article on your particular forest in one week's issue of a paper that circulates only in your immediate neighbourhood may look insignificant. But a collection of such articles—on many forests in many districts and sustained throughout the year, cannot fail to have its effect in making our work better understood and appreciated.

Forestry Journals—and a New Textbook

While many of our readers are already keen members of the various forestry societies, and regular readers of their journals, there may be others who are not aware of the very favourable terms on which these magazines can usually be obtained by practising foresters. The several societies have rates of subscription that vary with the class of post held by the member, but all members alike get their publications, as well as sharing in the other benefits of membership. So we give brief details below:

Scottish Forestry. Four issues a year, 5/- per issue. Subscriptions are normally: 25/- for Forest Officers, 15/- for Foresters, 10/- for students. Details from the Secretary, Royal Scottish Forestry Society, 7, Albyn Place, Edinburgh 2.

Quarterly Journal of Forestry. Four issues a year, 7/6 per issue, Subscriptions: 31/6 for Forest Officers, 15/- for Foresters and Woodmen, 10/- for students. Details from the Secretary, Royal Forestry Society of England and Wales, 49, Russell Square, London, W.C.1.

Empire Forestry Review. Four issues a year, 7/6 per issue. Subscriptions: 30/- for Forest Officers and Foresters, 10/- for students. Details from Editor-Secretary, Empire Forestry Association, The Royal Empire Society, Northumberland Avenue, London, W.C.2.

Forestry. Two issues a year, 15/- per issue. Subscriptions: 21/- for Forest Officers, 10/- for Foresters. Details from the Secretary, Society of Foresters of Great Britain, 7, Albyn Place, Edinburgh 2.

The new textbook, which appeared at the close of the year, has been written by Mr. T. A. Robbie, who was formerly Chief Instructor at Faskally Forester Training School, Pitlochry, and is now a District Officer in the East Conservancy of Scotland. Entitled *Teach Yourself Forestry*, it is published by the English Universities Press, London, at the modest price of 6/-, and forms a concise guide for anyone who wishes to learn the rudiments of a woodman's daily work.

Re-grading of Foresters

Under arrangements which were announced in December 1955, the distinction between Grade I and Grade II Foresters is to be abolished. A new grade of Assistant Forester is being formed, which will be regarded as a training grade for junior men; it will take the place, to a large degree, of the old Foreman grade.

At the time of going to press, the only available records showed the earlier gradings, which have accordingly been retained for our staff list.

Contributions to the Journal

Once again we appeal for original articles on any topic connected with the Commission's work, from any member of the staff, whether his work be on the technical or the office side.

This present issue owes much to the support of the Research Branch, but please do not imagine that, because your own duties are of a more routine character, you have nothing to contribute to the growing science of forestry, the efficiency of our operations, or perhaps the entertainment of your fellow-workers. Let us have your ideas, whether they be in the form of a brief note or a long thesis; it is up to us to re-shape them for the press, if indeed they require such amendment.

Contributions, which should preferably be typewritten in double spacing on foolscap, must be on one side of the paper only. They may be sent through the usual channels (normally the Conservancy Office) to Mr. H. L. Edlin, Editor of the Forestry Commission Journal, 25 Savile Row, London, W.1. A note of the writer's name and initials, his official position, and his address for correspondence, should be included. Diagrams or sketches are acceptable, and we can also use photographs of any subject of general interest to the staff; photographic prints should preferably be black-and-white ones on glossy paper, but enlargements are not essential. Contributions are welcome at any time of the year, but we usually go to press at the end of December.

THE FORESTS OF SICILY

By G. D. HOLMES

District Officer, Research Branch

After the meeting of the Eleventh Congress of the International Union of Forest Research Organizations in Italy, in September, 1953, I took part in a tour of Sicily. Starting at Palermo in the north-west of the island, and proceeding through the central highlands to Monte Peloritani, and the region around Mount Etna in the East, the tour provided an excellent cross section of the site and environmental conditions prevailing in the island. The great variety of geology and local climatic conditions, and their effect on vegetation, were of the greatest interest, in particular one was struck by the contrast between the problems normally encountered by foresters in Northern Europe and those facing the forest authorities in Sicily. The low rainfall during the summer and autumn leads to semi-arid conditions during that part of the year, and the danger of soil erosion during the rainy season, occurring from November to March, are climatic obstacles to rapid afforestation programmes. The difficult and steep topography of much of the country, coupled with soil instability and the limited number of access roads, all add to the difficulties. The opportunities provided during the tour, to inspect the progress made in overcoming some of these obstacles by choice of method of ground preparation, and species for planting, were most valuable.

There are a number of items of general information which should be recorded to provide a background to the account which follows. Sicily is the largest of the 19 regions into which Italy is divided, it is also one of the most heavily populated, being inhabited by some 4,500,000 persons, about 50 per cent of these being engaged in agriculture. The country-side is mostly hilly, and while some parts of it are highly fertile, most of the soil is poor. The climate is Mediterranean with a warm, wet winter, and a hot dry summer; the long rainless period in the summer has greatly influenced the natural vegetation, which is largely xerophilous. The average annual rainfall varies with locality, but ranges from 16 inches in the Central Highlands, to 30 inches on the North coast, and up to 50 inches on the high slopes of Mount Etna. Regarding land utilisation, a large proportion is under agriculture, and some 5 million acres, or 92.2 per cent of the whole area of the island, is devoted to this occupation. The forest area is the lowest among the Italian regions, forest occupying approximately 3.4 per cent of the land area. There are about 200,000 acres of woodland in Sicily, of which 150,000 acres are hardwood species, notably oak, beech and chestnut managed as coppice or coppice with standards. The remaining 50,000 acres consist of about 40,000 acres of pure and mixed broadleaved high forest, mainly oak (*Quercus lanuginosa*, *Q. cerris* and *Q. suber*), and beech (*Fagus sylvatica*) and only some 10,000 acres of conifer high forest, the latter consisting mainly of Corsican pine (*Pinus nigra* var. *laricio*), stone pine, (*Pinus pinea*), and Monterey pine (*Pinus radiata*). Mention has been made of only the principal species, but many others have been planted on a small scale or in experimental plantings. Sweet chestnut (*Castanea sativa*) is grown quite extensively and generally managed as coppice. Hazel (*Corylus avellana*) is widely cultivated, and over 34 per cent of the Italian output of hazel nuts comes from

Sicily. In recent years, increasing use has been made of exotic species and among the most successful are Aleppo pine (*Pinus halepensis*), and several eucalypt species, notably *Eucalyptus globulus* and *E. rostrata.*

It has been mentioned earlier that many of the soils of Sicily are unstable and liable to erosion, and this is particularly true for the clay soils of the Central Highlands, and the gneiss and schist clay soils of Monti Peloritani. The torrents and gullies down which the water from the winter rains makes its way to the sea are a striking feature of the Sicilian landscape, as are the extensive systems of terraces cut in the mountain slopes to prevent loss of soil by erosion.

Sunday September 27th—Palermo

A visit was paid to the Pulp and Paper Experimental Centre for Sicily, (Centro sperimentale per l'industria della cellulosa, della carta, e della fibre tessili). At the centre, Prof. Dr. F. C. Palazzo, the Director of the Institute, explained the purpose of their present work, which is to assess the possible value for pulp and cellulose fibre production of a wide variety of raw materials available in the country, and not normally utilised for that purpose. Italy is facing serious pulp supply difficulties, and is at present importing most of the raw material needed by the pulp and paper industries. At Palermo, the possibilities of utilising home grown materials is under investigation, including tests of cellulose fibre from many forest and agricultural crops, particularly small timber and sawmill waste, and the stems of wheat, broad bean, cotton and some root crops.

Monday, September 28th—Palermo—San Martino Alla Scala—Boccadifalco—Monreale. (See Photos. 2 and 3.)

A tour was made of the afforestation area around San Martino Alla Scala, a tourist resort situated about 1,500 feet up, and some eight miles east of Palermo. The area consists of a complex valley system eroded out of limestone mountains which rise to 2,700 feet. The soil is a rocky calcareous sand on the heights, giving way to a marly clay on the lower ground. The climax vegetation of the locality would correspond to that associated with the temperate sub-zone of the "lauretum" of Pavari's classification, with *Quercus ilex* as one of the main woody species. In fact, however, grazing by goats has removed most woody growth and the land is now occupied by grasses and low aromatic herbs. In common with most of Sicily, this region is charactised by a summer drought, with the greater part of the annual rainfall, 20 inches in this area, occurring during the winter, frequently as sudden heavy rainstorms causing extensive erosion. Unlike most afforestation areas in Great Britain, frost and exposure are of secondary importance compared with other factors.

The steep slopes and the danger of erosion have necessitated the terracing of all lower slopes in use for agricultural crops. These terraces, or gridoni, were prepared in a most careful manner to form a series of level shelves, or steps, up the hill-sides, and commonly the vertical face of the terraces is secured by a dry stone wall. This technique greatly reduces the soil lost by erosion, and also assists in moisture conservation. The main agricultural crops appeared to be vines, oil and seed crops (pulses, etc.), and orchards of olives, figs and citrus fruits. The difficult topography reduces the value of modern implements and techniques, and the existing methods of farming have probably been practised in the same way for many generations.

The State Forest area occupies the region between S. Martino and Monte Pellegrino, surrounding the basin of the torrent Passo di Rigano. Planting was commenced thirty years ago, and 1,500 acres have been planted to date.

Unfortunately, much of the more readily accessible planted area suffered considerable devastation during the war years owing to a severe shortage of fuel wood. Grazing goats also contributed to the damage, but efforts are now being made to restrict these animals.

Much of the earlier planting was done by the "Allegretti Method", but in recent years this has been superseded by terracing methods. Rough stone walls are built along the contours, and the soil is excavated on the upper side to form a series of level terraces about two feet wide at close intervals up the slopes. This laborious technique is considered worth while, as it is the only possible method of securing the soil on the steepest slopes, and the growth of planted trees is greatly improved owing to moisture conservation and improved conditions for growth during the dry summer months.

Aleppo pine (*P. halepensis*) has been extensively planted, and being a calciphile it has generally thriven well. Stone pine (*P. pinea*) is also growing well, and its value is enhanced by its production of edible seeds in addition to timber. Maritime pine (*P. pinaster*) has also been planted, and certain races of this species grow extremely well on the pure limestone soils of the region. The provenance of this species is important. Best results have been obtained with a Mediterranean strain from central Italy. Other strains exhibit varying degrees of chlorosis of the foliage induced by the high lime content of the soil, and this is normally accompanied by reduced vigour. The worst provenance in this respect was the French strain from the Landes. The local Sicilian race showed some chlorosis and was not so vigorous as the other Mediterranean strain. The growth of all the pines was slow, a typical height being ten or twelve feet at eighteen years. Crowns were generally wide and bushy, but full canopy was formed in only localised areas. Large timber can be grown in the area, as was shown by the fine growth of a large group of stone pine a short distance below S. Martino. Monterey cypress (*Cupressus macrocarpa*), and Mediterranean cypress (*Cupressus sempervirens*) have been planted on a small scale and appear to thrive. Later in the day a visit was paid to the University Botanic Gardens in Palermo. These Gardens, opened in 1795, now contain an abundant selection of tropical, sub-tropical and Mediterranean species of trees and shrubs.

Tuesday, September 29th—Palermo—Monte Pellegrino. (See Photos. 4 to 6.)

The large steep sided, limestone headland of Monte Pellegrino dominates the landscape to the north-west of Palermo, and rises to a height of 1,800 feet. It was noted that the depth of soil varied greatly, adding to the difficulties of planting. Much of the area was too steep and rocky for terrace construction, but more moderate slopes carried a medium depth of stony soil, on which terracing could be practised. This area was once under natural forest vegetation which was completely destroyed by the activities of man and his grazing animals several centuries ago. The natural vegetation now consists of xerophilous species, including *Opuntia*, *Euphorbia arborescens*, and a variety of tough grasses.

Afforestation work has been going on for some years and a great deal has been learned about techniques of crop establishment from the limited success of the early plantings. The first plantings were done by direct sowing of seed on cultivated patches of soil, and this was found to be very unreliable; poor germination and high losses frequently necessitated planting up the gaps in the plantation as many as five times before crop establishment could be secured. Many of the first plantations were seriously damaged or destroyed by fire, or unrestricted cutting, during the 1939-45 war years.

Patch sowing as a technique was not a success, and experiments carried out by Prof. A. de Philippis have shown that better results can be obtained by very shallow cultivation of the soil prior to sowing, or by construction of terrace systems of cultivated soil on which the seed is sown. The latter is the only practicable method on the steeper slopes. It was explained that one of the essential features in terrace construction is that the surface of the terrace slopes inwards, from the lip to the hill, to ensure maximum moisture retention. Terrace construction as a method of ground preparation is a most laborious and costly operation, but there seems to be no way of avoiding it, or cheapening it by mechanisation, owing to the very difficult topography of the area. On present methods, approximately 1,000 yards of terrace are constructed per acre, at an estimated cost for manual work of 100,000 lire per acre.

The modern method of planting is to prepare a groove, one inch deep, and one inch wide, along the centre of the terrace, into which seeds are sown directly at a spacing of about two inches. The seed is treated with a repellent preparation prior to sowing, ostensibly to protect the seed against rodents and vermin, but in fact to render the seed unpalatable to humans! Seed sowing is normally done in August or September to secure germination in the first autumn rains, and the development of a good root system before the drought of the following summer. In the following autumn, failed gaps in the plantation are filled up by planting one-plus-one transplants raised in pots. The plants are removed from the pots at the planting site, and planted complete with the unbroken ball of soil from the pot. Planting transplants with naked roots has given very poor results, and the pot technique is always used.

The main species used are Aleppo pine (*P. halepensis*), stone pine (*P. pinea*) and Mediterranean cypress (*Cupressus sempervirens*). Mexican cypress (*Cupressus lusitanica*) has been established experimentally with some success. On rocky slopes, too steep for terracing, *Eucalyptus* species, notably *E. rostrata* and *E. gomphocephalus*, are planted as potted transplants.

A visit was made to the District forest nursery near Palermo, where a wide variety of tree species were being grown for planting. In addition to the species mentioned above, other species were being raised, including *Cupressus arizonica*, *Acacia cyanophylla*, *Acacia saligna* and *Eucalyptus globulus*. In the nursery, plants are raised as seedlings in drill sown seedbeds, which are normally watered throughout the summer months. It was explained that only minimum manuring was applied to avoid production of large succulent plants which would give a high rate of failure when planted under the adverse conditions in the forest. The aim was a short, sturdy and well-hardened plant. Seedlings are normally transplanted into clay pots at one year, and spend a further year in the pots in the nursery before they are taken to the forest. Up to the present, clay pots have been used almost exclusively, but experiments are now under way to test the use of the cheaper and lighter compressed paper pots. Plants in the nursery are very rarely protected against sun heat by shading in spite of the high summer temperatures. This point was noted with interest by several North European foresters, as summer shading of nursery seedlings is a somewhat controversial issue in North temperate regions. It was also of interest to hear of the importance attached by Sicilian foresters to the formation of mycorrhizal root systems on their planting stocks. It was stated that a mycorrhizal root system was a most desirable feature and of the greatest importance in determining the performance of the plant in the forest.

At both San Martino and on Monte Pellegrino, the conditions for afforestation bear some resemblance, as they share the obstacles of soils high in bases and easily eroded, coupled with the problem of adequate moisture retention

during the summer months. These conditions severely restrict the choice of species and methods, but there still remains much scope for research on both these points.

Wednesday, September 30th.—Palermo—Enna—Piazza Armerina—Aidone—Catania—Taormina. (See Photo. 7.)

The journey from Palermo to Enna was made by train and passed through some of the most desolate scenery in Sicily. The train turned South from the coast at Castello, some 20 miles east of Palermo and proceeded through the Central Highlands. This region consists of hills of moderate height, composed of pliocene sands and clays, the latter with a high salt content, with frequent deposits of rock salt. The higher land commonly has a mantle of chalk, and sulphur deposits occur throughout the region.

The vegetation in September was very scanty, and everywhere there was evidence of soil erosion. No tree growth was seen, the vegetation consisting of the dead remains of annual weeds and crops. There is an intense demand for land in central Sicily, and every knoll was cultivated. Many of the slopes were ploughed and sheet erosion with occasional gullying was evident on much of the recently cultivated land.

The journey continued by bus from Enna to Piazza Armerina, through the Erei mountains. The erosion problem is most serious in this region, and a description was given of the work of the State Forest Service and other bodies, to prevent extensive erosion and restore prosperity to the district by large scale afforestation schemes. Here, as in several other parts of Sicily, there seems to be close collaboration between the State and private enterprise in these matters and considerable progress is being made. The Snia Viscosa Industrial Group is interested in establishing plantations for production of cellulose raw material for the pulp factory which it is proposing to construct nearby. The Regional Sicilian Government with assistance from the Cassa del Mezzogiorno is undertaking to plant large areas and offer every assistance to interested industries. The Cassa per il Mezzogiorno, which might be termed the Southern Italy Fund, was created in 1950 to finance improvement schemes in depressed areas of Italy, and a sum of twenty-four milliard lire has been set aside for terracing and afforestation of mountain slopes for prevention and control of soil losses by erosion. The S.I.A.C.E. Company of the Snia Viscosa Group, with the collaboration of the I.R.M.O. Company, began the new afforestation work in 1950-51, and by 1953 approximately 5,000 acres had been planted. *Eucalyptus* species have been extensively used in this work, and one of the first plantations was seen on the Balatella Estate a little way from Piazza Armerina.

At Bellia, a short distance away, some of the earliest plantations were seen. These were established some 20 years ago and now contain the State Forest Service Nursery "Vivaio Canalicchio". This area of greenery contrasted very markedly with the barren hills seen up to that time, and gave some impression of the extent to which successful afforestation can transform the countryside within a comparatively short time.

The main species under cultivation in the State Forest nursery and the nearby nursery managed by the S.I.A.C.E.-I.R.M.O. companies were *Eucalyptus globulus*, *E. rostrata*. As seen at the district nursery at Palermo, all plants were transplanted into clay pots after about three months in the seedbed, and grown for one year in pots before transporting to the forest as potted stocks. The nursery stocks of potted plants totalled several millions at the time of the visit, and some estimate was possible of the amount of careful work and attention required with this technique of raising trees for planting. The potted plants

require tending in the nursery, and it is necessary to lift each pot and prune off protruding roots at least once during their season in the nursery. The costs of potting and transporting the heavy clay pots to and from the forest would appear prohibitive, but this is offset to a large extent by the abundance of cheap labour. The nursery soils are an excellent fine silty sand, and when under a crop are kept watered throughout the summer months by manual or mechanical watering. A close inspection was made of the *Eucalyptus* stands at Bellia. Sample plots have been laid down in both high forest and coppice in this forest, and indicate the superiority of *Eucalyptus globulus* over *E. rostrata* in growth rate and form. It is estimated that *E. globulus* produces more than 50 per cent greater volume per hectare than the other species, however, it is not so readily established on the more difficult ground as *E. rostrata.* Estimations of the average annual growth indicate that at twenty years, with 250-300 stems per acre, the standing volumes per acre would be 600 cubic metres (say 7,000 hoppus feet) for *E. globulus* and 4,000 hoppus feet for *E. rostrata.* On the basis of these figures it has been estimated that 20,000 acres of forest in full production in this region should be capable of producing 50,000 tons of timber per annum, which would be sufficient to keep one cellulose factory operating.

Several stands of *Populus serotina* were seen, and the very close stocking was rather surprising. One stand which was about thirty feet high had been planted at six feet spacing and had never been thinned. Further results of the activities of the S.I.A.C.E. Company were seen at Aidone some 6 miles north-east of Piazza Armerina. Here an extensive watershed was planted up two years ago with *Eucalyptus rostrata.* The planting was done in trenches cut by hand along the contours, a technique bearing a close resemblance to the single furrow ploughing methods of ground preparation widely used in Britain. The planting at Aidone has been a marked success. The plants show a uniformly high survival rate, and heights of three to five feet. The young crop is poor on the high steep ridges, and judging from other plantations seen on the tour it seems that *Pinus halepensis* or *Pinus pinea* might have been a better choice on such sites.

The journey proceeded by bus through Caltagirone through a mountain region in which the I.R.M.O. Company is carrying out afforestation work for erosion control. On the road from Caltagirone to Pelagonia large areas devoted to the cultivation of citrus fruit, mainly oranges, were seen. The country around Pelagonia is one of the most important orange growing areas in Sicily. A stop was made near Pelagonia to inspect new torrent reclamation work on a steep, badly eroded clay hillside. Check dams of stone and concrete had been built across the main gulleys at intervals to check and control the flow of water. The steepest slopes surrounding this torrent bed were being broken into steps by means of explosives. Soil fixation on these slopes is a serious problem and several of the slopes seen had already been pit planted with *Eucalyptus* species and prickly pear (*Opuntia*). The latter species is very widely used where rapid fixation of soil is required. The buses proceeded alongside Lake Lentini, across the plain of Catania, on to Catania and Taormina.

Thursday, October 1st.—Taormina—Mascali

Taormina is one of the best known resorts in Sicily and is situated on the east coast a few kilometres to the north-west of Mount Etna, and it served as an excellent centre for the subsequent excursion to this mountain and to the Monti Peloritani range. After a morning spent seeing the town, an excursion was made to the beach and shingle reclamation scheme at Mascali on the coast some fifteen miles south of Taormina.

In this area, efforts are being made to establish plantations on beach shingle along the shore line. Recently a plantation has been made in the form of a belt 50 to 60 yards wide, and extending along the shingle parallel to the sea, for a distance of 4 miles. Before planting, the ground was prepared by digging trenches one metre deep at intervals of eight feet. Trees were then planted in autumn, at eight foot intervals along the trenches, and heavily watered immediately after planting.

This plantation, which is now two years old, consists of a row mixture, composed of one row of *Acacia cyanophylla* to six rows of mixed *Casuarina equisitifolia* and *Eucalyptus rostrata*. The trees have been inundated by the sea on two occasions since planting, but in spite of this, the growth of some species is promising. The *Acacia* seems vigorous and has attained a height of four to six feet, and the *Eucalyptus* also showed fairly healthy growth, having reached a height of two to three feet. *Casuarina* however, shows irregular growth and generally has unhealthy discoloration of the foliage, rather suggesting that the specific root nodule bacteria are absent. Experience with this species in India and other countries indicate that its prospect of success under such conditions are very low as it does require a fairly regular supply of water. Some parts of this plantation are protected against the hot drying winds of summer by wattle screens made from *Saccharum aegypticum*.

It was explained that the purpose of the plantation is to provide a coastal shelterbelt, which in addition will have the effect of improving the appearance of the bathing beaches. The costs of establishment using the methods described, must have been extremely high, but this may not be a vital consideration in this area; unemployment is a serious problem, and there is abundant cheap labour.

Friday, October 2nd—Taormina—Messina—Monti Peloritani

The Monti Peloritani form a ridge of mountains in the north-east corner of Sicily and have many features of contrast with the mountain ranges seen earlier in the tour. The mountains rise to a height of 3,500 feet, and are composed of archaic rocks, principally metamorphosed granite, and crystalline schists and mica schists. Geologically the area is subject to serious erosion, a fact which is aggravated by an almost total lack of natural tree cover, and the extensive agricultural cultivation. The topography is a series of steep hills and torrent beds, which are normally dry except for short periods during the winter rains. The soil is inherently fertile, and more acid than soils seen hitherto on the tour. The natural vegetation is dominated by *Erica arborea* and *Pteridium aquilinum*. On the road from Taormina to Messina an opportunity was provided to view the dry torrent bed of the River Agro. This torrent is one of the largest in Sicily, and provided an excellent demonstration of the extent to which these torrent beds have been cut into the rock, and the amount of silt and debris brought down and deposited on the coastal plain where the torrent runs out to the sea.

The results of some of the earliest attempts at afforestation on Monti Peloritani were seen around Colle San Rizzo where the Headquarters of the State Forest Administration are situated. The first plantings were in 1927, and included trials of many species, including *Eucalyptus*, *Acacia*, *Pinus radiata*, *Pinus longifolia*, Bishop pine (*Pinus muricata*), *Cupressus arizonica*, and *Cupressus macrocarpa*. Unfortunately, a number of these plots were destroyed or damaged by fire during the war, and at the present time only the *Eucalyptus* and *Pinus longifolia* plots are managed as experimental areas.

The visit to the *Eucalyptus* species trial was of considerable interest, even though only small numbers of each species were seen. *Eucalyptus rostrata* and

E. maideni were the most vigorous, and individual trees of *E. gomphocephala* were also good. Other species included *E. botryoides*, *E. blaxlandi*, *E. consideneana*, *E. elaeophora*, *E. macrorrhyna*, and *E. rudis*. It was explained also that experimental plantings made in 1930 with *Acacia* species have given promising results. *Acacia pycnantha* planted in 1930 is now due for its second thinning. This species and others, notably *Acacia saligna* and *A. melanoxylon*, are considered valuable afforestation species in milder regions of Sicily, and are also valued for planting in mixture with pines, reducing the fire hazard. The species are also valuable for the production of tannin from the bark.

The earliest planting amounted to only a few hundred hectares, but formed a nucleus which has since grown to a forest area of 5,000 acres. The greater part of the area now under forest consists of *Pinus pinea*, and in some localities *Pinus radiata* or *Eucalyptus* have been used with success. With the exception of *Eucalyptus* which are planted, all species are normally direct sown in the forest on terraces prepared as described earlier. As mentioned, *Pinus pinea* is greatly valued for its edible seed in addition to its timber, and in order to encourage seed production it is commonly pruned up to a height of ten feet and allowed to develop a bushy crown.

This forest area contains the only pure stand of *Pinus longifolia* in Europe, but unfortunately it was not possible to visit it. A series of experimental plots of Monterey pine (*Pinus radiata*) were visited at Conchiglia about two miles south-west of Colle S. Rizzo. This species is a marked success, and grows nearly three times as fast as *Pinus pinea* on similar site conditions. This stand which was sown in 1939 now has a standing volume of 1,500 hoppus feet per acre with a mean annual increment of 120 hoppus feet per acre, compared with a mean annual increment for *Pinus pinea* of 35 hoppus feet per acre. The original intention was to grow Monterey pine on a rotation of 15-20 years for pulpwood, but as timber size is being attained very rapidly, and the form is good, the present policy is to grow them on for timber. Current shoots had been badly attacked by *Evetria buoliana*, but it is difficult to assess the effect of this on increment. The growth of Monterey pine is extremely good, and it is interesting that the general stem form and formation of high flat branches is superior to that obtained with the species in Great Britain.

Saturday, October 3rd—Taormina—Mount Etna

The object of the excursion was to study the ecology and zonation of natural vegetation, in addition to the afforestation schemes on the slopes of the volcano. Etna is the largest active volcano in Europe, and rises to a height of 10,000 feet, greater than any other peak in Southern and Central Italy. The rock and lava flows consist mainly of basalt, and on the lower slopes this has given rise to a very fertile, acid soil. The slopes are intensively cultivated for agricultural crops up to a height of about 2,000 feet, and some of the variety of crops raised could be seen during the bus journey from Fiumefreddo to Linguaglossa. The main crops are vines, citrus fruits, olives, almonds, figs and vegetable crops grown on steps and terraces on the lower slopes. On the road from Linguaglossa northwards to the forest of Ragabo, the areas of agricultural cultivation contrast strangely with the rocky deserts of the cold lava flows which cut across them. Above 2,000 feet up to a height of 6,000 feet, which is the upper limit of plant growth, lies a region of vegetation intersected with old lava flows among the many secondary peaks formed on the sides of the great volcano in the course of many eruptions. Natural vegetation in this region is divisible into several zones according to altitude and temperature, and according to Professor Pavari's classification the zones set out on the attached summary can be distinguished.

A SUMMARY OF ZONATION OF VEGETATION ON MT. ETNA (PAVARI'S CLASSIFICATION)

Zone	Mean Annual Temp.	Mean Temp. of Coldest Month	Mean Absolute Minima	Altitude Range (feet)	Principal Components of Vegetation
1. LAURETUM					
(a) WARM SUB-ZONE .... (e.g. Acireals 600 feet)	15-23°C	7°C	-4°C	1,500-2,000	Cultivated oranges, figs, and prickly pear. Natural vegetation — *Ceratonia siliqua*, *Olea oleaster*, *Rosmarinus officinalis*, *Euphorbia dendroides*, *Ferula communis*, *Rhus coriaria*.
(b) TEMPERATE SUB-ZONE .... (e.g. Linguaglossa 1,600 feet)	14-18°C	5°C	-7°C	—	*Celtis australis*, *C. tournefortii* var. *aetnensis*, *Rhus cotinus*, *Rhus pentaphylla*, *Platanus orientalis*, *Pistacia terebinthus*.
(c) COLD SUB-ZONE .... (e.g. Castiglione 1,850 feet)	12-17°C	3°C	-9°C	Upper limits — south exposure 2,800 ft.; other exposures 2,200-2,500 ft.	*Spartium junceum*, *Phyllinea variabilis*, *Cytisus triflorus*, *Quercus ilex*, *Pinus pinea*, *Pinus halepensis*, *Juniperus oxycedrus*.
2. CASTANETUM (e.g. Capriolo 4,500 feet)	10-15°C	0°C	-12°C	2,200-2,800 ft. to 4,600-5,200 ft.	"Rich in Forest Species" *Castanea sativa* (4,000 ha.), *Quercus lanuginosa*, *Quercus cerris*, *Corylus avellana* (1,400 ha.), *Genista aetnensis*, *Carpinus betulus*.
3. FAGETUM					
(a) WARM SUB-ZONE	7-12°C	-2°C	-20°C	4,600-5,200 ft. to 6,000 ft.	*Fagus sylvatica*, *Pinus nigra* var. *laricio*, (2,500 ha.), *Quercus cerris*.
(b) COLD SUB-ZONE	6-12°C	-4°C	-25°C	6,000-6,500 ft.	*Betula alba* var. *aetnensis*, *Populus tremula*, *Fagus sylvatica* (*Taxus baccata* on North slopes, and *Carpinus betulus*, *Tilia cordata* on South slopes).
4. ALPINETUM	—	—	—	Limit of true forest lies in higher *Fagetum*. Above 6,500 feet mainly shrubs such as *Juniperus hemisphaerica* and *Astralagus siculus*, up to 9,000 feet. Above this height shrubs give way to species such as *Rumex scretatus*, *Senecio aetnensis*, *Scleranthus annuus* var. *aetnensis*. Above 9,200 feet the land is entirely barren.	

The climatic conditions on Mount Etna vary considerably with aspect and elevation. The rainfall is higher than in most parts of Sicily and ranges between 40 and 60 inches per annum. The general climate however retains its semi-arid character, as the rainfall is all concentrated in autumn and winter, even at very high altitudes, with a long rainless period during the summer.

In passing through the region between Linguaglossa and Ragabo forest, vegetation typical of the Castanetum was seen. The extensive cultivation of hazel (*Corylus avellana*), and sweet chestnut (*Castanea sativa*) is of particular interest. These species are managed as coppice, both for production of edible fruits and small timber. It was stated that no cases of chestnut blight (*Endothia parasitica*), have been reported on the island to date. Near the upper limit of agricultural cultivation at about 2,500 feet a narrow zone of almost pure oak coppice (*Quercus lanuginosa*) was seen. This area was seen to give way to pure natural stands of Corsican pine (*Pinus nigra* var. *laricio*), at a slightly higher elevation. This species forms a large block of forest at about 3,700 feet on the north, north-west and south-west slopes of the volcano, and there was an opportunity to examine stands of this species during the stop in the forest of Ragabo.

Up to the present time these pine stands have not been properly managed owing to the absence of roads suitable for extraction of produce. However an access road to the main area was completed in 1947, and closer attention can now be paid to tending the crop. The forest is irregular, consisting predominantly of trees in the 40-80 year age class. Most of the area has never been thinned so that stocking is very high, an average figure being 200-600 stems per acre at 50 years. Sample plot measurements indicate that the standing volume ranges from 1,100 to 3,850 hoppus feet per acre, with a mean annual increment of 12 to 60 hoppus feet per acre. The stands are vigorous and healthy, and the stem form good, the lower boles being almost entirely free of branches, the latter attribute being largely determined by the close spacing of the trees. An examination of felled logs showed the timber to be of good quality, being close grained and having a high proportion of summer wood.

Natural regeneration of Corsican pine occurs whenever conditions of light and soil cover permit, and the present policy is to manage the forest by the Shelterwood System, leaving about 50 seed trees per acre at the seeding fellings. A thinning cycle of 5-6 years has been adopted recently in order to improve the quality and diameter increment of the crop. The accumulation of undecomposed needles under the heavy shade of the canopy has tended to increase soil acidity in some areas, but if proper thinning treatments can be applied this should not prove a problem, as the strong insolation and high air temperatures will assist adequate decomposition of the litter layers. At the lower altitudinal limits of the pine forest it was interesting to note a region of transition, in which Corsican pine was growing satisfactorily in mixture with *Quercus lanuginosa*. The party returned down the road to Linguaglossa and proceeded by bus through Fornazzo and Milo across the Eastern slopes of Mount Etna. Near Milo a stop was made to view the cold lava stream which cut across the road, damaging houses and a considerable area of forest during the eruption of 1951. The extensive areas of solid lava over the slopes of the mountain are a most striking feature of Etna.

Recent eruptions, notably in 1669, 1928 and 1951, have resulted in considerable outflows of lava on the middle and lower slopes of the mountain. These flows now appear as plantless wastes interrupting the continuity of the vegetation zones described. Colonisation of lava by plant life is very slow, and even on the lava flow of 1669, plant growth is negligible. The lava of much earlier eruptions

has given rise to a rich soil but it requires many hundreds of years for this to occur. Studies by Professors Pavari and de Philippis indicate that although plant colonisation is slow, it eventually occurs first by development of lichens and mosses, followed by some tree species, notably *Genista aetnensis*. This species is a most vigorous pioneer, and the only species capable of establishing itself at an early stage in the weathering of the lava. It is a curious fact that grasses and herbs colonise much more slowly and do not normally appear until some time after *Genista* is thoroughly established. Hence *Genista* is a most valuable species on the more barren slopes of Etna. It frequently attains a height of twenty feet and a diameter of six inches, and where possible it is managed as coppice or coppice with standards, for production of fuel wood.

The buses proceeded through Zafferana and Nicolosi, and up to the Grand Hotel, Etna at 6,000 feet, the highest point reached on the tour. On the journey back through Nicolosi extensive fields of lava bearing sporadic growth of *Genista* were observed. A stop was made near Monti Rossi (3,000 feet), which was formed during the great eruption of 1669, and successfully afforested with stone pine. As in other areas where this species has since been used, it was direct sown on terraces cut in the hillside.

The buses descended through Nicolosi to Acireale, and thence along the coast northwards to Taormina where the tour ended.

Discussion

The tour provided an excellent first hand insight into the forestry, and conditions for afforestation in the Mediterranean region, and brought home the many problems of climate, soil conditions and topography which needed to be overcome before a successful forestry programme could be undertaken. Soil conservation is the fundamental problem of the Sicilian region, and it is impossible to over-estimate the value of forest cover in this connection. Successful afforestation in such areas will have far reaching effects, not only in providing a source of valuable fuel and timber, but in providing employment for the local population, in stabilising soils and regulating the drainage of water, which will prove of immense benefit to agriculture. Much progress has been made in recent years on techniques for crop establishment and selection of species, and application of the newest developments was seen on a large scale in several parts of Sicily. The opportunity was provided to study conditions in areas representative of the main types of environment existing in Sicily, many of them very different in character to those normally encountered by North European foresters.

During the tour one was much impressed by the extent of the activities of the State Forest Service and by the close co-operation which exists between the State authorities and private concerns such as the S.I.A.C.E. and I.R.M.O. Groups. The result of such co-operation has been to increase the scale of plantings, with the prospects not only of soil protection by increasing the planted area, but considerably increased prosperity by encouragement of local industries utilising forest produce. It is difficult enough to assess the economics of forest operations even under favourable site conditions, and it was even more difficult to do so for many of the rigorous conditions encountered in Sicily. Costs of ground preparation for planting are high, particularly on areas requiring terracing, and it is thought that there is scope here for development of mechanical methods to cheapen the process, certainly on the less steep land. One must bear in mind however that such developments may not be necessary, and may even be undesirable, in a country with a serious unemployment problem and abundant cheap labour. Forest Research on choice of species and suitable races for Sicilian conditions has, and will, pay handsome dividends.

Among the most successful exotic species introduced in recent years, one might mention *Pinus halepensis* and *Pinus radiata*, both of which show excellent development in many localities. Here it would seem that there is considerable scope for provenance studies, and this is also the case for species such as *Pinus pinaster*.

We were much indebted to our Italian hosts for their care and enthusiasm in the arrangement of our tour.

A TOUR OF FRENCH FORESTS

By JAMES MACDONALD
Director, Research and Education

After the meeting of the Permanent Committee of the International Union of Forest Research Organisations which was held in Nancy from the 27th to the 29th of September, 1954, the participants were taken on a short tour of French forests which had been arranged for them by their colleague, Monsieur Oudin, the Inspector General in charge of Research and Education in the French Forest Service. Everyone looked forward to this journey which was planned to include visits to the famous arboretum of Les Barres as well as to some of the forests in the Loire Valley and we all hoped when we set out that there would be an escape from the bitter winds and pouring rain of Lorraine, reminiscent of Edinburgh in one of her more savage moods, in the genial valley of that great river. And so it proved. The first day was cold although becoming warmer towards evening, the second day at Les Barres was ushered in by a fine Atlantic drizzle—one might have been in Argyll—the third and fourth were wholly delightful, warm, but not to excess, with unbroken sunshine.

The notes which follow are based on extracts from my diary and they merely record things as they happened or as they were observed. There is no attempt at serious discussion.

Thursday, September 30th, 1954

We had a long bus journey of 200 kilometres or so in front of us and we had to start early. At eight o'clock we set out westwards along the famous Route Nationale No. 4, Strasbourg-Paris, and travelling through the Forest of Haye, well known to forestry students from Great Britain, we were soon in sight of the towers of the ancient fortress town of Toul. On the way, the forest was separated from the road by a strip of arable land on either side, a relic of the days when ambushes were something to be reckoned with by those who went about on business or on affairs of state. There is much dairy farming in this part but the native French breeds of cattle are nowhere to be seen, nothing but those black and white milk machines the Friesians. Toul lies on the left bank of the Moselle; it is surrounded by old ramparts within which are narrow winding streets dominated by the towers of the cathedral. There seems to have been no war damage but the appearance is that of a place which has seen better days. There were no soldiers visible, but I hope they have some in the forts on the hills round about. Seven or eight miles further on we crossed, at the roadside village of Pagny, one of the great rivers of Europe, the Meuse, here a pleasant stream not quite so full as the Thames at Richmond, but a river which has counted for much in human history. And how much of it has it seen on its way to the Hollandsche Diep and the North Sea! From the crossing of the Meuse, we

travelled over some fairly high country, 1,500-1,800 feet above sea level, with much good farm land and blocks of woodland in the distance, scattered about. At one point here, the bus was accompanied for about two hundred yards by a kite which flew alongside.

Some thirty miles on we came to St. Dizier on the Marne. St. Dizier, the main supply base for the American army in the 1914-1918 war, is a growing industrial centre with new factories straggling over the countryside, but it is still surrounded by forest on three sides. Here we turned aside into the small state forest of Haie-Renaut to see some oak regeneration. Back by St. Dizier we drove through the Forest of Der, one of the most important forests in the region of the upper Marne. It was interesting to see a variety of conifers as we went past. We were informed that Der is the ancient Gallic word for Oak; I was able to refer our guides to similarities in the Celtic languages in these islands.

From Der we went on by Brienne le Chateau where Napoleon was trained in the Artillery School, and soon came within sight of Troyes. As we neared it, we passed through a chalk country, hollows and little hills, on the slopes of which were vineyards, for we were now in Champagne itself. The vineyards were interesting because they did not come down the slopes as far as one might have expected to see them. But the reason seemed to be that the hollows were frosty and the lower limits of the vineyards were just about the level to which cold air normally accumulates.

Poplars at Troyes

The old town of Troyes on the Seine, where we stopped to lunch, is a charming place full of character and well worth exploration. It used to be the great market for the wines of Champagne but this trade has now moved into the Marne valley though it has left Troyes with a wealth of caves and cellars. After lunch, we went to see the poplar plantations belonging to Les Hospices de Troyes, a local charity.

These cover an area of 200 acres on the banks of the Seine, on land, once a property of the convent of Cordeliers, which came later into the possession of the Hospices by gift. It was originally a stretch of moist meadowland traversed by branches of the river and by irrigation canals, but by the time it came into the possession of the Hospices, it had fallen into poor condition, the ditches neglected and the pasture worthless. The Hospices, finding that they could not get a tenant, decided to plant it with poplar in 1925. Unfortunately, there was little planning and little regard to choice of variety, and the mistake was made of retaining several old poplars which were already standing on the ground. Gradually the Hospices got into difficulty with their scheme and in 1934 they called in the Forest Service to help them. A plan was drawn up, the work put in hand; and the whole project completed in 1949. Now on the worthless meadows there is a very fine crop of poplar, the ground has dried remarkably well and the local people can once more come in and cut grass.

The poplars mainly represented are *serotina* de Champagne, *regenerata* and *robusta* but there are several specimens of *deltoides* and one or two white poplars. The growth is regarded as satisfactory but not outstanding. Some of the oldest trees, 25 years of age, had quarter girths of more than twelve inches and volumes of between 40 and 50 cubic feet. In the older plantations the trees were set out at 5 metres and 6 metres apart, say 16 and 20 feet respectively; experience showed that until the 15th or 17th year growth in girth was satisfactory (2-2½ inches annually in *robusta*) but that later the girth increment fell off sharply owing to the density of the stock on the ground. This reduction in

girth increment was accentuated by the dry springs of 1953 and 1954. *Robusta* demands less space than *serotina* and can be kept denser; *serotina*, which cannot be crowded, used to be planted at a spacing of 8 metres. This set me thinking that we might well pay more attention to planting distances and that it might pay us to prescribe the spacing to fit the variety of poplar.

Mistletoe is a great trouble here and efforts are made to keep the trees free from it. There were some heavy growths of this parasite on some privately-owned poplars which we passed on the way to the plantations of the Hospices. I asked my guides whether it could be sold, pointing out that it cost a lot to buy a sprig of mistletoe in London round about Christmas. They assured me very firmly that no one made any money out of mistletoe which deserved no encouragement and very politely they conveyed the impression that they thought the English very foolish to spend good money on such an unpleasant plant. So I still don't know who makes the profit in the mistletoe trade. Thirty per cent of the poplars in France are in the Paris basin, and the Department of the Aube of which Troyes is the capital is one of the most important centres of production.

From Troyes, we went by Sens, an impressive country town on that charming river Yonne, and thence to Montargis where we turned south along Route Nationale No. 7, Paris-Antibes, and after a few miles came to our destination for the night, the village of Nogent-sur-Vernisson.

Friday, 1st October

Les Barres Arboretum

In the year 1821, the estate of Les Barres, close to Nogent, became the property of Philippe-André de Vilmorin, the well-known seed merchant. De Vilmorin started planting soon after he came into possession and he paid particular attention to the pines which were then needed for ships' masts. Far in advance of his time, he started to study races of different tree species and was thus an early precursor of our geneticists of today.

When he died in 1862, de Vilmorin's heirs, recognising that the work he started could be successfully continued only if its maintenance could be assured, made over to the State his plantations and various other lands and buildings. A well-known forest officer, Gouet, was put in charge, and it is to him that we owe the Arboretum, which he stocked particularly with American and Mediterranean species. During his time, a school for the training of foresters was established to which was added, in 1883, a secondary school for training the Ingenieurs des Travaux. Gouet was followed, in 1898, as Director by Marchand who introduced many Chinese species, as a result of his close contacts with the French missionaries in the Far East. Marchand was followed in 1919 by the famous dendrologist Leon Pardé who held office until 1934, and extended the planted area considerably. On Pardé's retirement, Les Barres was formally put under the control of L'Ecole Nationale des Eaux et Forêts at Nancy and in 1936, the French Government finally acquired the remaining lands and buildings still in the ownership of the family of de Vilmorin.

Les Barres now consists of about 700 acres, of which more than 200 acres are agricultural and let to a farmer. It consists of eight collections of specimen trees as well as park trees of various sorts, the Fruticetum formed in 1894 by Maurice de Vilmorin and bequeathed to the State in 1921 by his successor Jacques de Vilmorin, a series of experimental plantations, various nurseries, a station for research in forest tree breeding and the two schools of instruction. The whole aggregation is in the charge of a Conservator.

One of the most interesting features of Les Barres is the wide range of soils; there are typical rendzina soils over the chalk at the north-eastern end of the domain, brown forest soils, leached brown soils and podzolic soils. There is also a range from fairly heavy soils to light sands. This variety adds enormously to the value of Les Barres.

The climate is regarded as a transition between the slightly oceanic climate of the Loire Valley and the rather more continental type of the Paris Basin. The mean annual temperature is approximately 50°F; the mean of the coldest month, January, is 35.8°F and that of the warmest, July, is 66.2°F. Extremes are not unknown; thus in 1947 there were 38 days, of which 13 were consecutive, with maximum temperatures of over 100°F while, on the other hand, in the preceding winter, the temperature went down to 5°F. The lowest recorded temperature at Les Barres is -24.7°F, in 1880. Spring frosts are of regular occurrence and are frequently severe. Autumn frosts are not important as the temperature hardly ever falls below freezing before the 20th of October. The mean annual rainfall is about 27 inches, reasonably well distributed except in March and April when the average precipitation falls below the level of the other months. Spring droughts are not uncommon. 46 per cent of the winds come from the directions south, south-west and west; these are the moist winds. 35 per cent come from the north, north-east and east; these are the dry winds. Throughout the long history of Les Barres there was little serious damage by wind until the 13th of December, 1952, when a great tempest struck the place in the small hours of the morning. With a wind of about 100 m.p.h. very serious damage was done among the older specimen trees, the losses including the last of the Scots pine planted by P. A. de Vilmorin. Relatively little damage occurred among the younger crops, except in plantations of Douglas fir, which suffered as they suffer here at home.

Our first visit was to the Arboretum Gouet which contains many of the older trees planted in Gouet's time. We were taken at once to see the stump of an *Abies grandis* blown down in 1952 which was one of the biggest trees at Les Barres; 76 years old, it was 140 feet high and had a quarter girth at breast height of 39 inches; it must have been a grand tree. They have seedlings from it and grafts also. In this arboretum, there are good examples of Douglas and of the *Sequoias* but by our standards they are not outstanding. *Cryptomeria* is not nearly as good as it is with us, and the same is true of several others, including the *Tsugas* and *Abies procera* or *nobilis*. On the other hand, I was greatly impressed by various species of *Abies* such as *cilicica*, 90 ft. high, *cephalonica*, 95 ft. high, *numidica*, 90 ft. high, *pinsapo*, 90 ft. high, *bornmulleriana*, 95 feet, and *nordmanniana* 100 feet high. The first four rarely do well with us. *Abies pardei* is a species named by Henri Gaussen in 1928, from three trees in the Arboretum which had been labelled *A. numidica*. They are about 80 years of age and a hundred feet high. This new species was thought to be a hybrid between *A. numidica* and *A. nordmanniana*, but since the former was discovered only in 1861 this supposition becomes very doubtful. So the origin of *A. pardei* remains something of a mystery. Arboreta are notoriously dangerous places in which to collect seed as one can never be sure that there has been no crossing. On the other hand, of course, one may from time to time obtain a good new hybrid, which may be useful if it can be repeated.

Cedrus atlantica is very good here and there is one fine group which shows the tree in forest form. Among other things, one noticed *Torreya myristica*, 25 feet in height with male and female specimens both present, and *Cupressus torulosa*, in the open, but only ten feet high at 22 years of age. The Arboretum Pardé, which we visited next, is devoted to Asiatic trees which are not yet very advanced in growth because the planting was done between 1929 and 1941. We

had little time to examine this fine collection so I was able to note only one or two interesting specimens. One of the most curious was *Platycarya strobilacea*, about 10 feet in height and fruiting profusely. This is a rare tree with us. *Keteeleria davidiana* and *Picea meyeri* also caught the eye.

At the gates of this Arboretum, by the roadside, there was a most interesting patch of scrub oak. It was *Quercus ilicifolia* no less, one of the most troublesome of the scrub oaks of America; introduced here, it has run wild and is behaving exactly as it was behaving when I last saw it in the hills of Pennsylvania more than five years ago.

Entering the part of the property known as the Grande Metairie we were shown a most interesting series of plantations of a large number of different species. Among them was a very promising plantation of *Pinus pinaster* raised from seed collected in Morocco at an elevation of nearly 6,000 feet; there appeared to be possibilities in this lot and I am trying to get some seed. The earliest plantings of this species at Les Barres were mostly killed by the severe winter of 1879-80, but a few which survived reached a height of more than 90 feet. I was told by Monsieur Bouvarel of Nancy that maritime pine from the Landes have sessile cones while those from Corsica and the Mediterranean generally have pedunculate or stalked cones.

One of the most remarkable things to be seen at Les Barres is the series of plantations of Calabrian pine (*P. laricio* Poir. var. *calabrica*, Delam.) because there are four generations, the oldest having yielded seed from which the second was raised, the second in turn giving rise to the third and the third to the fourth. Some details of the growth are given in the following table:—

Generation	*Planted*	*No. stems per acre*	*Mean Ht. ft.*	*Mean quarter-girth ins.*	*Volume per acre hop. ft. O.B.*
1	1826-27	136	110	$16\frac{3}{4}$	13,000
2	1857-59	138	98	$13\frac{1}{2}$	7,700
3	1886-87	233	74	$8\frac{3}{4}$	4,500
4	1926-27	603	40	5	—

The Calabrian pine has given good results, having the advantages of rapid growth, straight stems, a strong tendency to natural pruning and great longevity. On siliceous soils it is better than Corsican pine, but on calcareous soils, the Corsican has an advantage. Because of difficulty in obtaining seed of the Calabrian pine, Corsican is now more generally planted in France, in spite of the experience at Les Barres.

The oldest Corsican at Les Barres, dating from 1826-27, have 115 stems per acre, mean height 100 ft.; mean quarter-girth 13 in., volume per acre, over bark, 7,050 cubic feet. This is less than the Calabrian of the same age on a comparable site.

Vilmorin was working on the provenance of Scots pine more than a century ago, between 1823 and 1840, and among the races which he tried was one from Scotland, the seed for which was supplied by a Mr. James Reid. These trees, the last of which were cut in 1948, had reached a height of 72 feet in 115 years, which was less than that reached by other races in the same time; even plants originating from Riga were about 10 feet taller. The Scottish trees are said to have been rather irregular but of good form, with thin bark which was red down nearly halfway to ground level. The crowns were small and formed of fine ascending branches. Like most of the other races of Scots pine, they grew very slowly in their last years; between 1922 and 1942 they increased in girth by only 6 cm., just under $2\frac{1}{2}$ inches true girth. In this, however, they

were not alone, for some of the other races were equally slow. The view at Les Barres is that Scots pine has reached the end of its useful life by the time it is a century old; after that age, its growth becomes very slow and it becomes increasingly subject to external hazards such as the droughts, which from 1937 onwards caused the death of many of the old Scots pine, and the gale of 1952 which overthrew the last of them.

Work on the provenance of Scots pine was taken up again at Les Barres by Pardé, and has been continued since his time by the Forest Service. We did not have time to examine these later crops, but as we were passing them we were told that in France they have the same trouble as we have about Christmas trees, and they have to mount guard in many of their forests to prevent theft. Douglas fir is well represented in this section of Les Barres, but the older trees suffered greatly in the gale of December, 1952, when many of the tallest specimens were thrown to the ground. We saw the remains of one plot, planted in 1887, in which Douglas was mixed with Atlas cedar and with Norway spruce; in 65 years the Douglas had reached a height of 112 feet, *Cedrus atlantica* 86 feet and the spruce, 80 feet. There are several *Sequoias* which have withstood the gales, and we were told that both species are extremely wind-firm at Les Barres. This accords with our own experience.

In another section of the property called Barillons, we made a hurried visit to a most interesting series of plots of different conifers, dating mainly from 1925, but unfortunately there was no time to do more than glimpse at them. The lay-out was similar to that of the forest plots at Bedgebury. Among the items which I had time to see were *Abies concolor* and *A. grandis*, both about 45 ft. high and growing well, a very branchy lot of Scots pine from the Massif Central, an excellent crop of *Cedrus atlantica*, planted in 1926, 36-40 feet high, *Pinus jeffreyi*, 20 feet and *Juniperus virginiana* planted between 1931 and 1937, and varying in height from 6 to 15 feet. Western larch (*Larix occidentalis*) had been planted, but had died; Douglas fir, which at first grew well and formed a useful pole-crop, blew down in 1952, leaving a thin margin standing in a way quite familiar to us.

From Barillons we went to the Chateau to lunch but before entering we turned aside to look at the Arboretum Lemosse, named after the famous head gardener of Les Barres, which is a collection of horticultural varieties, mainly of conifers, grouped according to the monstrosity they affected, prostrate forms, columnar forms, variegated forms, *Schlangenfichte* or "snake spruces", and so on. This collection was only started in 1942 and thus the trees are small. I can imagine it in fifty years' time as a silvicultural chamber of horrors!

The sound of the hunting horn greeted us as we entered the Chateau where we took our aperitif in the library, a very bright room, possibly too bright for the good of the book-bindings. We were then entertained to lunch by the staff and their ladies. During luncheon, the *Messe Solonelle de St. Hubert* was played on gramophone records in another room, and the distant sound of the horns was exactly the right background for a foresters' meal. Mendelssohn must have heard this piece. It made me think of the horn passages in his Midsummer Night's Dream music.

After lunch we went out to the eastern part of the domain where the soils are rendzinas on the lower Beauce limestone and where there is a sharp contrast with the clay-with-flints over chalk which occurs in the neighbourhood of the Chateau. The soils are shallow and the rock outcrops here and there; it has been worked for lime fairly extensively in the past, and the surface of the land still shows where the workings were. The soil contains much free lime and has a

pH of over 7. The natural vegetation is characterised by juniper with *Festuca duriuscula* and *Brachypodium pinnatum*. In places there is a dense scrubby growth of a variety of species—*Quercus lanuginosa*, birch, *Prunus mahaleb*, *P. spinosa*, hawthorn, dogwood, privet, spindle-tree, laburnum and *Viburnum lantana*.

We were given a demonstration of various implements. The first was an interesting two-way-throw plough very similar to that which has been devised here at home, which can cut a furrow eighteen inches deep, if required, and throw a reasonably wide bank of inverted turf over on either side. It does not have a subsoiler attached but subsoiling is done, as a separate operation, the subsoiler running in the bottom of the furrow made by the plough. This seemed to me to be unnecessary since the whole could have been mounted on the plough. The plough seemed to be effective in reducing competition from the grassy vegetation, but I was a little doubtful about the subsoiling in a region of not very high rainfall, with frequent droughts and high summer temperatures. We saw also a Polyculteur scuffler with rotating blades, which is being tried for surface cultivation of the soil in order to promote regeneration in the forest.

To deal with the scrubby growth, they were experimenting with a machine —the Attila—of French manufacture, which has a rotating circular horizontal blade and is able to cut material about two inches in diameter but might not be able to deal with bigger growths. They have not yet decided on a suitable engine and appear to be trying a whole series of them. The operator, walking behind, has to be protected by a cage from the cut shoots which tend to fall back on top of him. This seemed to me to be a disadvantage; another was the very narrow swath which was cut. Nearby, we saw some recent planting on old arable land with a heavy grass vegetation which had been ploughed and subsoiled by the machines which we had just inspected. On this limestone soil, *Cedrus atlantica*, direct sown, is promising; one year seedlings have roots a foot long. When cedar is planted on this ground it fails if the young trees are put with naked roots straight into the soil; planted in pots, 86 per cent of the cedar have survived. This experience is similar to that of the Italians in Sicily.

We were then taken to see Vilmorin's Fruticetum, but after starting on the inspection of what seemed an almost infinite series of vines, we were whisked away back to the Chateau for tea. After tea we went to see the work on vegetative propagation which is being conducted at Les Barres. It was on similar lines to our own work at Alice Holt.

This ended a most interesting and stimulating day, but one day is far too short even to sample the riches of Les Barres. It is a place which must be revisited. So far as I could determine, the rates of growth of the commoner conifers expressed in our quality classes were Scots Pine II-III, Corsican Pine II, Douglas fir III, Norway Spruce III, Sitka spruce III-IV.

Saturday, 2nd October

We left Nogent-sur-Vernisson at half past seven because we had a long day in front of us. It promised also to be a fine day, for although the air was cool and damp and a patchy ground mist lay about, the sky was clear and there were all the signs of good weather to come. We did not follow the main road but went by by-roads in a direction slightly west of south through a country of light sandy soil which had grown much corn, to judge by the stubbles in the fields. In the cottage gardens as we passed, we could see little crops of tobacco, artichokes and tomatoes. After about ten miles we came suddenly into a country of woodland. This is an outlier of the great Forest of Orleans but privately

owned; it is extensive, for we travelled through it for eight or nine miles and as we went we obtained an introduction to the seamy side of French forestry. Most of this woodland was like a Surrey common, or rather what a Surrey common would be if it wasn't burnt so often—heather and bracken, poor scrubby oak, alder and *Molinia* in the wet hollows, birch and occasional Scots pine. The only unusual feature was the presence of scattered bushes of *Erica scoparia* which does not occur in Britain. This woodland is typical of much, if not most, of the privately-owned forest in France, and I wondered what would be revealed if the French conducted a Census of Woodlands on the same basis as ours. Possibly the results would surprise those whose only experience of French forestry lies in the splendidly managed and highly productive state forests. There is no doubt a greater area of unproductive woodland in France than there is in Great Britain, but the situation is not critical because the economy of France is on a very sound basis. Where the French foresters have the advantage over us is in having time in which to operate. If, for example, we could afford to allow, as the French allow, 150 years for the complete conversion of coppice with standards to high forest, we would have no derelict woodland problem. If we could allow 30 years, as they do, for the regeneration of a single block, we would have no serious difficulty; it is in having to do it in three *not* thirty years, that we create a problem for ourselves.

The woodland through which we were passing, being near Paris, commands high sporting rentals and this is one reason why no forestry is practised. In the sporting, the rabbit plays an important part, and no private owner can obtain a contribution from the National Forest Fund for the improvement of his woodland if he has rabbits on his property. Myxomatosis has almost entirely wiped out the rabbits in this district; it remains to be seen to what extent this will diminish sporting values, and to what extent it will turn the thoughts of owners to silviculture.

Before long, after passing through the village of Ouzouer, we came in sight of the Loire and we ran for a short distance on the top of the *digue*. There is no river anywhere like the Loire, the enchanting stream of Ronsard and of Rabelais. Today it looked quite perfect in the sunshine, a wide expanse of silvery water, flowing with a gentle yet irresistible current, with golden beaches and little islands of bright sand amid a prosperous and productive countryside. At Sully, we crossed the river, passing the grim old castle, once the property of the famous finance Minister and till lately in the possession of his family. And then, after following the river for a few miles, struck south-westward across the northern edge of that infertile country, the Sologne. This is a largish stretch of sandy soil overlying clay, which sometimes appears on the surface, with still considerable areas of heath and numerous small lakes and marshes. The original oak forest, which must always have been poor, has nearly all disappeared. Much of the land is now cultivated and there were extensive areas of coniferous plantations many of which have been felled and not replanted. Much of the planting in the middle of last century was carried out with maritime pine, which grew well until it was struck by the winter of 1880, when most of the trees perished in the cold. More recently, Scots pine and Corsican pine have been extensively used, and we saw from the road several plantations of these species; Corsican appeared to be the better.

The Park of Chambord

Eventually we arrived before the walls of the park of Chambord which run for about twenty miles, with only six gates, round the Park of 13,000 acres. Passing through one of the gates, we found ourselves at once in the midst of a

poor, degraded forest of coppice with stunted standards, and as we went on, the conditions appeared to become poorer, and forest was succeeded by heath. Finally we came in sight of the Chateau of Chambord. The main block of the building, in a fine whitish stone, is good, in a heavy style, but it is surmounted with a most fantastic jumble of towers, all different in size and design, as though a model of the Manhattan skyscrapers had been set down on its roof.

The forest covers 11,000 acres, and was originally of coppice-with-standards; it has suffered much in the past from exploitation, and from the ravages of game which have continued till recently. In 1938 there were 800 red deer within the walls, and thousands of rabbits. When the Forest Service took the forest over in 1947, they found it in very poor condition. Many of the stands were of low quality; some had been neglected for years and were over-dense, others were seriously understocked. There were great gaps which had gone into heath having been invaded by the *Ericaceae* (*E. scoparia*, *E. cinerea*, *E. tetralix*), *Calluna*, bracken and *Molinia*. The pine plantations were either understocked or seriously in need of thinning. The work which has been going on since 1947 has been of three kinds; the forest roads have been repaired and made fit for the traffic, the walls and the foresters houses have been extensively repaired, the heathlands and the clearings have been brought under a plan of replanting, of which about 2,000 acres will have been completed by the end of this season.

The preparation of heathland by ploughing was demonstrated to us at Chambord and it was interesting to discover that the ideas we have been following are accepted in France also. We stopped in an open area of the forest, with a heathy vegetation of the kind described, with a fair sprinkling of *Agrostis* and *Festuca;* the surface layers of the soil were sandy but not strongly leached, though, of course, acid; below that there was a deposit of a rather stiff impermeable clay, unsuitable for root activity and supporting a perched water table. The adverse conditions were those familiar to us on our heathlands, very wet in winter, very dry in summer. This land they plough and subsoil by means of a machine designed by Monsieur Peyrissaguet who does the work here on contract. It is a large double furrow plough drawn by a 70 h.p. crawler tractor made by the Acieries du Nord, and mounted on large wheels which have most formidable steel grips designed to break up and cut in pieces the kind of small shrubby growth which one finds on these sites. The plough is hydraulically lifted, but the job is not nearly so neat nor so efficient as Cuthbertson's. The subsoiling is done by moles which trail after the plough on chains. This is considered to be better than having a subsoiler fixed to the frame, especially on stony ground. The plough cuts two furrows spaced at $1\frac{1}{2}$ metres or roughly 5 feet apart centre to centre, and it can be adjusted to give a spacing of 2 metres or $6\frac{1}{2}$ feet; the depth can be adjusted between 12 and 24 inches. The moles crawl under the bottom of the furrow. A considerable amount of spoil is thrown out by the plough and this aids in suppressing weed growth. Planting is done in the bottom of the furrow but slightly to one side so that the plants are not placed on the exact line of the subsoiler. The whole concern looked most fearsome but the French are highly satisfied with it. There was also on view, but not working, a small rotovator which they use for cultivating when there is strong heath or light woody growth.

In another part of the Park we looked at a recently formed plantation. The fencing is complicated. A rabbit net, $1\frac{1}{4}$ in. mesh, and 4 ft. high is used; the bottom 6 inches are sunk in the ground and turned outwards; the uppermost 4 or 5 inches are likewise turned outwards to counter the climbing habits of the rabbits. To stop deer, two or three strands of barbed wire are strung above the rabbit netting and these are said to be effective. But there is still the wild boar to consider, for this animal would merely push his way through a rabbit fence;

so it is necessary to erect an electric fence of two or three wires one metre outside the rabbit or deer fence!

In this enclosure, where the herbage was mainly *Calluna*, bracken, *Erica tetralix*, *E. scoparia*, *E. cinerea*, *Molinia* and a large *Festuca* which no one could name, there was some very good Corsican pine about four or five years planted. These had been planted on prepared patches and spaced at five feet apart, which has hitherto been the standard method. This is now being superseded by ploughing. Planting is usually done with one-plus-one stocks between the middle of November and the middle of March; if direct sowing is carried out, it is usually effected in February and March. Conifers are used on these heaths because of the poverty of the soils and among those chiefly used are Scots and Corsican pine, Douglas, *Abies nordmanniana* and maritime pine, the last of which is invariably sown at about 15-20 lb. per acre. Douglas fir and Nordmann's fir are planted at 6½ feet apart. Along the edges of the plantations, red oak or Spanish chestnut are planted with the object of establishing an understory of hardwoods, while along the edges of fire traces, two or three rows of *Thuja* or Lawson Cypress are often put in. We were informed that Scots pine and Douglas can be planted at an all-in cost of £20 per acre, Corsican for £24, red oak for £28 and Chestnut for £32. Maintenance costs about £1 per acre per annum for the first four or five years. The preparatory work, clearing patches, subsoiling etc. is said to cost from £12 to £14 per acre.

Le Conseil Superieure de la Chasse, a body whose main function is the improvement of sport in France, has one of its main centres at Chambord where they rear about 10,000 pheasants annually for stocking forests and where they keep a breeding herd of mouflon, the wild sheep of Corsica and Sardinia. The Conseil, which is presided over by the Director-General of Forests, obtains its funds from sporting licences. From each licence, the sum of 300 francs is set aside for the work of the Conseil and, as there are about two million licences issued each year, the work would seem to be adequately financed. When we visited Chambord the pheasantries were empty but we saw the mouflon, small brown animals, very like Soay sheep. They are turned loose in the Vosges, the Alps and the Pyrenees for the sport they provide, and I gathered that it was necessary to maintain the stocks artificially as they have not yet become naturalised in these mountain ranges. They do not seem to have trouble in France with purists who would object to the liberation of exotic animals, nor do they have a Nature Conservancy. "Vive la Chasse" is a better cry than "Vive la Nature". They also maintain at Chambord a stock of deer and wild boar which for obvious reasons must be limited; they restrict the number of red deer to 500, of roe to 100 and of wild boar to 500. Surplus animals are exported as occasion requires. It was interesting to me to see how the French Forest Service have become involved in the maintenance of stocks of game; it is quite appropriate that they should, and we might learn some lessons here for the future.

The Vineuil Populetum

The National Populetum at Vineuil, within sight of the towers of Blois, was started in 1949 and thus is still in its early stages. Occupying about 40 acres of level land, about half a mile from the Loire, the site was old grassland and part of it is occasionally flooded when the river is high. The soil is a deep alluvium, light, but not too light, for there is about 20 per cent of clay in the mechanical analysis and it is reasonably fertile, only potash being short. The water level is normally at about three feet below the surface; in times of drought, it may fall to six or seven feet. The pH of the soil is between 6 and 7 which is good for poplars, and we could see odd plants of *Agrimonia* and *Poterium* among the

grass. The grass competition is severe; most of the older plants were mounded but now they are screefing the surface round the young poplars. Large plants which have their roots trimmed back at planting have done badly, and slightly smaller plants with roots which were less severely dealt with have thriven better. Really small plants have done badly, and any plant which has had a bad first season usually takes three or four years to recover. Among the poplars which caught the eye were *Populus robusta* which has been very successful, and *P. serotina* de Champagne. *Serotina* from Poitou, on the other hand, have not done well as they do not find enough moisture for their needs on this site.

The Oakwoods of Blois

After lunch we went to the Forest of Blois, on the outskirts of the town. We were received by the local officer who was both informative and elegant. And he had a most elegant forest to show us. I doubt if there is to be found anywhere a better example of silviculture and forest management than this Forest of Blois, which shows the illustrious French tradition at the very peak of its achievement.

The oak is said to be a local race, quite different from the sessile in the east of France, and characterised by long fissures in the bark. Regeneration is easily obtained; there is some seed every year and a good mast every two or three years. In one compartment, in the regeneration phase, the crop had been opened out, there was a complete carpet of oak seedlings on the ground and these same seedlings were almost buried at the time of our visit under a fresh fall of acorns. No wonder they succeed.

The forest extends to about 7,000 acres and the greater part of it is run on a rotation of 210 years. We were able to see samples of the crops at each stage and each was more impressive than the one before. This is one of those rare forests in which nothing seems to have gone wrong, and yet what we see now is wholly the result of the skill of the French foresters during the last century or so.

I have mentioned the abundant seeding of the oak. The regeneration period extends to 30 years and there was some discussion as to the necessity for this in view of the prolific crops of seed and the apparent ease with which regeneration could be established. Our French colleagues stoutly maintained their position, pointing out that things were not always as easy as they appeared to us and that, in these matters, one must allow oneself a reasonable margin of time; otherwise plans would go sadly adrift.

The regeneration fellings regularly lead to the production of epicormic branches on the remaining seed trees, but the French foresters do not view this with any alarm. They also lead to changes in the vegetation since there is a sudden diminution in the water requirement. Thus, on the less well drained soils, *Holcus mollis* and *Juncus effusus* become common and willows invade, especially *Salix caprea* and *S. atrocinerea;* on drier soils, *Aira flexuosa* develops in strong tussocks as it does with us on the Bunter sands of the Midlands. Here, at Blois, some of its flowering stems were 2½ feet tall.

In the next stage, where the young oak are forming a thicket, the first cleaning is made at about the eighth year. The oak are usually mixed with hornbeam, whitebeam, broom, brambles and honeysuckle, and the object of the cleaning is to remove any growth which may threaten the oak, principally honeysuckle and hornbeam. The hornbeam are cut through about three feet above ground level, as they say this leads to a less vigorous regrowth and the snags which are left are cut flush with the ground when they come back to make the first thinning. I asked if these snags of hornbeam were not a hindrance to

extraction; it was admitted that they were, but it was pointed out that there was an extraction rack every hundred metres. Many of the oak had good stems but very branchy crowns; this is not a cause of alarm because it can be put right by subsequent crowding. Thinnings begin between the fifteenth and twentieth year and are carried out at first at five-yearly intervals but later, from about 30 years of age onwards, at intervals of ten years. In this, the French show their perspicacity. There is no doubt that our people interfere far too often with their plantations, not helping the plantations much, but giving themselves a vast amount of work.

We saw a succession of beautiful pole crops of different ages. The crops are less mixed than they are in most French forests; there is no more than five per cent of beech and less than three per cent of hornbeam. There is, however, an important shrub layer, with much holly, a little wild medlar (*Mespilus germanica*) and locally abundant butcher's broom (*Ruscus*). The herb layer was not very interesting to me, being composed mostly of *Aira flexuosa*, *Melica uniflora*, *Anthoxanthum odoratum* and *Luzula* (*forsteri*, I was told), *Melampyrum pratense*, *Euphorbia dulcis* and *Viola sylvatica*.

We spent a little time in a set of sample plots—120 year old oak in which heavy thinning was being compared with light, and we had a good discussion. I thought the differences in treatment were not sufficiently exaggerated and suggested that so far as the growth of the dominants was concerned, there was little to choose between the two plots. The light thinning plot had a current annual increment of about 70 cubic feet per acre per annum, the heavily-thinned plot, about 95.

Mature oak reach a height of slightly more than a hundred feet but the older trees, which date from a time when the forest was badly mismanaged, are not as good as their successors are certain to be. We were told, *a propos* of the infrequency of beech and hornbeam, that much of the soil is too dry for beech, and not rich enough for good hornbeam.

There was little sign of wild life in the forest, though it has its stock of deer and boar; the few birds which were calling were unfamiliar to me but I am not good at bird calls. All I saw was a dead salamander in one of the rides, covered with burying beetles. There was also a nice fructification of *Boletus aurantiacus* on a hornbeam. We lingered on in this beautiful forest, loth to go, and it was almost dark when I made the speech of thanks to our most obliging guide, Monsieur Pringalle, who had given up his Saturday afternoon to act as our guide. We shall long remember those few hours in Blois.

FOURTH WORLD FORESTRY CONGRESS

DEHRA DUN, INDIA—DECEMBER 1954

By M. V. EDWARDS

Divisional Officer, Research Branch

Prior to the Congress a number of excursions to different parts of India were arranged. All the delegates who went on them spoke highly of the interesting times they had had. I can describe only the one to the teak forests of Madya Pradesh (Central Provinces).

On arrival at Nagpur we were entertained to lunch to meet the Forest Minister, Chief Conservator and other officials, and then taken one hundred and fifty miles by car to a forest rest house in the South Chanda Division. Here we spent three days, living in tents and messing in the rest house, spending the whole of each day in most intensively managed teak forests which have been under working plans for three-quarters of a century. In part, a simple form of selection system is in operation, but over most of the area even-aged forests are raised either by means of the *taungya* system or by natural regeneration. The latter is in fact a type of stump coppice, the small naturally regenerated plants being cut back in the regeneration coupes, but this is done when they are so small in diameter that the regrowth is in effect similar to that of a seedling. Patches of a few acres of natural regeneration are intermixed and supplemented by areas of a few acres of *taungya* plantation. The overwood remaining after the extraction of marketable timber is felled and burnt, the debris being heaped together and re-burnt to clear the ground. The plantations are made with stumps raised in nurseries and, for the first year, or sometimes even two years, the workers take some kind of food crop off the ground between the lines of stumps. The forests are completely fire protected. Extraction is very intensive. The best logs are exported either by cart for long distances or by lorry, while the poorer quality timber is extracted and sawn up departmentally in the forest sawmill. A good deal of research work into thinnings and other silvicultural problems is undertaken in this district.

It was most interesting to me to compare the Central Indian teak forests (which have not got a reputation for producing large teak of good quality) with the Burma teak forests, and the Nilambur forests in Madras to which I had paid a wartime visit. If the Central Indian teak is not naturally of such size or quality, the enormous demand and the intensive management are compensatory factors, and all the operations are skilfully and intensively organized. The Director of Forestry for Indonesia, where there are similar teak forests, was present and made most interesting contributions to the discussions. The Burma representative was more concerned with utilisation than silviculture and we were able to discuss the new experiments in Burma on the replacement of elephants by tractors.

When the Conference finally gathered at Dehra Dun one delegate was heard to murmur "What is that tremendous building?" and then express astonishment on finding that it was the Forest Research Institute. It is, of course, a palatial building in the Imperial New Delhi style and one felt that many of the foreign delegates had no idea of the extent to which forest research had developed in India and were quite impressed, especially when they saw the utilisation, wood-working, preserving, pulping, chemistry and minor forest products branches which are all additional to the main block. This Institute is, of course, the central one for the whole of India, dealing mainly with the most universal and fundamental problems. In addition, each of the states has its own research organisation, often with separate silviculturists, utilisation officers and others.

An important feature of the Congress was the number of countries that took part—more than in any previous Congress. There were 358 delegates from forty-six countries and six international agencies, including 208 from India. The U.S.S.R. and the Republic of China were both represented. It was the largest and most representative gathering of foresters that has ever been held and the first of its kind to meet in Asia.

After the usual opening and welcoming speeches it was decided that the main section on tropical forestry should meet every morning, so that all delegates

could attend. The whole field of tropical silviculture was surveyed, at many points in very great detail, as was clear from the "Highlight Paper", by A. P. F. Hamilton, one of our Forestry Commissioners, which was used as a basis for discussion, and from the other general papers in this section.

Valuable work was done by the Sub-committee on Afforestation of Arid Regions, and at further meetings of the Teak Commission. The other main sections were concerned with production, utilisation and protection in a very general sense, and these met in parallel in the afternoons. The value of the discussions in the main sections was probably rather in the range of the subjects discussed rather than in any conclusions reached. In the sub-committees, which were more specialised, more concrete detailed information was exchanged and valuable conclusions reached. But it was of great interest and importance to listen to the subjects discussed in the main sections and to hear the different approaches made by the various delegates and the diversity of views expressed.

A special sub-committee was set up to deal with multi-lingual forest dictionaries and the proposals met with unanimous agreement and promises of support in many languages.

Several local excursions afforded breaks in the discussions and the Deputy Director of the Forestry Commission (Sir Henry Beresford-Peirse) was one of the few lucky enough to see the tiger. Dehra Dun is on the edge of extensive forests of *sal* (*Shorea robusta*), a valuable building, sleeper and general purpose timber, and the forests are managed intensively both by natural regeneration and, for other species, *taungya*. Erosion control is also of importance.

The Secretary-General of the Congress, M. L. Chaturvedi, was one of the outstanding figures, as, wearing his Kulu cap and never without his baton, he directed the organisation and affairs of the Congress with so much skill and goodwill. Much of its success must be attributed to the numerous Indian hosts who, both on excursions and at Dehra Dun, did so much to entertain the delegates by receptions, parties, displays of dancing, drama and so on. At Dehra Dun these were so numberous that it was not possible to attend many of the film shows which took place every evening.

All in all, I concluded that the Conference was probably of most direct value first to the Indians themselves, who have undoubtedly broadened their views and impressed others with the extent of the managed forestry which is in progress. Secondly, to those concerned with tropical silviculture in all continents; and thirdly to all countries with undeveloped forests and no clear policy. Delegates from temperate climates received less from the Congress but were able to contribute a great deal in general guidance.

A NOTE ON FORESTRY IN NORTHERN IRELAND

By J. M. B. BROWN

District Officer, Research Branch

Climate

Northern Ireland has an oceanic climate not greatly dissimilar from that of the north-west of England or south-west Scotland. A high relative humidity, cool cloudy summers and generally mild rainy winters are the salient characters distinguishing this climate from that of the south and east of Britain. Rainfall ranges from about 30 inches around Lough Neagh, and in parts of east Down,

to 50 inches on the high hills in the east, and more than 60 inches in the Sperrin Mountains in Co. Tyrone. On the whole the climate is favourable to the growth of trees, but, except in sheltered valleys, the strong westerly winds are an important adverse factor. The wind and the coolness of the summers mean that there is little afforestation above 1,000 feet: on exposed hillslopes the planting limit is set well below 1,000 feet.

Indirectly, low summer temperatures and high atmospheric humidity influence upland forestry in another way: in most parts blanket bog, with deer sedge (*Trichophorum caespitosum*) frequent to dominant, covers all the land above about 800 feet, except on steep slopes. The change in climate, soil and vegetation, as one ascends the hills from the fertile sheltered valleys, is very rapid and a forester's abiding impression is of the contrast between the evident fertility of sheltered lowland sites like Shane's Castle and Tollymore Park, with their wealth of broad-leaved trees and shrubs, and the bleakness at about 1,000 feet of the barren uplands, which will form the Parkmore and Ballypatrick Forests of the future.

Geology

Northern Ireland offers much interest and variety to the geologist. Essentially the province represents a south-westerly extension of Scotland, all three geological provinces of which are well represented. The Dalradian schists of the Highlands recur near Ballycastle in north-east Antrim, crop out widely in Co. Londonderry and form the Sperrin mountains; while the Ordovician and Silurian rocks, which form the Southern Uplands of Scotland, reappear over a large area in Down and Armagh. Between these the Midland Rift Valley, composed of Carboniferous and later rocks, is represented by the rocks of south Antrim and the Lagan Valley and the country to west of Belfast. These fundamental traits are, however, largely masked by the prodigious igneous activity of early Tertiary times (mainly). In particular the Eocene basaltic lavas (contemporaneous with the basalts of Skye and Mull), which cover nearly all Antrim and parts of the adjacent counties, are of outstanding importance and provide the fine escarpment of the Cavehill which is the first thing which impresses the visitor approaching Belfast by sea. Incidentally the great mantle of basalt—a few thousand feet thick at one time—has preserved the Antrim chalk from complete denudation and so the white cliffs of the Antrim coast road remain as an attractive anomaly in a north-western landscape. Of the same Tertiary age, too, is the Mourne Mountains granite, which builds the highest mountain (Slieve Donard 2,796 feet) of the province. Older igneous activity has left less wide-spread relics.

In Quaternary Times Northern Ireland was wholly under the influence of Scottish ice from the north-east and Donegal ice from the north-west and, during that period and the subsequent recession of the ice, the present physiography was moulded. Sheets of boulder clay, diversified by numerous drumlins, cover the solid rocks, except on steep slopes or mountain summits, and have provided the parent material of the soil on all the lower ground. As mentioned already the gentle slopes above about 800 feet have become covered with peat in recent millenia.

Forest History

The forest history of Northern Ireland begins in Boreal times (about 7000 B.C.), when a widespread lowering of relative sea level and the marked dryness of the climate resulted in much advance of woodland over fen and marsh.

Birch, pine, oak, willow and other trees spread over formerly waterlogged areas and have left abundant pollen relics in the peat. In the ensuing Atlantic period (6000-3000 B.C.) there was a general rise in relative sea level, accompanied by a wetter climate which (a) submerged the lowland forests beneath *Sphagnum* peat via a wet alderwood stage; (b) initiated the development of blanket-bog on the uplands; and (c) severed the last tenuous land bridges with Britain and, indirectly, with the continent.

These changes laid the foundations of Ireland's vegetation in historical times. The main feature of the changes was a big reduction of woodland, which still, however, covered vast areas on the lower mountain slopes, on valley sides and drumlins, wherever peat was absent and the exposure moderate. Sessile oak was the principal tree on these wooded slopes, birch being a common associate on the poorer acid soils and at high elevations. On the wetter lower slopes and valley floors ash and alder tended to replace oak, ash being especially plentiful on the outcrops of Carboniferous limestone and basalt.

Primitive agriculture gradually encroached on the forest area and was reinforced in this deforestation by increasing demands for timber, used for construction and the smelting of iron and other purposes; by the depredations of sheep and cattle among regrowth; and by the Viking settlements in the eastern valleys in the ninth and tenth centuries. These encroachments notwithstanding, immense wooded areas survived the Viking and Anglo-Norman eras, serving as refuge for malefactors and rebels against the regime. A statute of the reign of Edward I (1296) provided for some methodical clearance of forest to improve communications and facilitate the measures against highwaymen. Little result came from this statute and in Tudor times the forests were of great use to guerillas. The incidental great destruction of forest, during the fighting between the Irish chieftains and the English in the late sixteenth century, was continued in the following century when the lands of O'Neill and O'Donnell were parcelled out among settlers, mainly of Scottish origin. The so called Plantation of Ulster in fact involved a great deal of destruction of woodland and very little planting as the settlers extended their farms and exploited the remaining woods. At the same time increases in the use of wood for iron smelting caused further deforestation. By the end of the 17th century folk were using peat for fuel, as contemporary records show; and an Act of William and Mary's reign (1698) recognised the serious consequences of the shortage of timber in Ireland and required all tenants of land to plant 10 five-years-old trees each year for 30 years.

Little came of this and similar enactments, however, and they were repealed in 1776. About this time Rev. Arthur Young made his tour of Ireland and recorded that "the country exhibits a dreary naked hue for want of woodland and the land is mostly tilled as if it wasn't worth tilling". Sixty years later, in the early nineteenth century, the Royal Dublin Society (founded 1731) began offering awards for successful plantations: £20,000 were paid out in this way and a good deal of practical interest was aroused. Incidentally the same Society published in 1802 a "Statistical Survey of County Tyrone" by John McEvoy, agent for Lord Mountjoy's estates at Rash, near Omagh. Outlining current local methods of afforestation, the author recommends the sowing of broom in patches among the planted trees and of gorse on ditch banks intersecting the ground to be planted: ploughing, turf-planting and contour draining are other "modern" practices described in the same treatise.

Modern Developments

The first government-sponsored afforestation scheme was one of the projects of the Congested Districts Board set up in 1890 to handle the situation

created by rural over-population and poverty. Its forestry operations failed through lack of capital and technical difficulties. A Departmental Committee on Forestry published a report in 1908, which showed that the area of woodland in Ireland (336,000 acres, or 1.5 per cent of the land surface) had changed very little since 1850. This small reserve of standing timber was largely on demesnes where planting had been carried out in the eighteenth and early nineteenth centuries. A good deal was felled in the first world war. After the war the Forestry Commission, initially concerned with the whole of Ireland, set about the acquisition and planting of waste lands. Soon, however, by the Government of Ireland Act (1920), Northern Ireland gained autonomy in several domestic services, including the organisation of agriculture and forestry. Forestry in the six counties of Antrim, Down, Armagh, Tyrone, Londonderry, Fermanagh then became the responsibility of the Northern Ireland Ministry of Agriculture. This sub-ordination of forestry to the Minister of Agriculture has had some disadvantages, but has ensured a measure of co-ordination between the two services such as has scarcely been attained in Britain. In particular there has been little clash between hill grazing interests and forestry.

Progress in afforestation was checked by a price limit on the acquisition of land and by public apathy. But under the enthusiastic leadership of Mr. David Stewart (now retired) a considerable acreage was planted in the two decades between the wars. It was evident to those taking part in the excursions that foresters in Northern Ireland had kept abreast with technical progress in Britain in those years and that, although there was no special provision for research, there was a lively interest in the trial of new species and in the adaptation of planting methods to suit the site.

The scanty reserves of standing timber in Northern Ireland appear to have suffered relatively less destruction in the second world war than those in Britain. There are now about 54,000 acres of woodland (1.6 per cent of land area), of which 32,000 acres are administered by the Government: much of the rest, in private hands, is in poor condition as a result of exploitation and the sub-ordination of silviculture to amenity and game. The Ministry's 32,000 acres are part of the 54,000 acres acquired since 1920. Of the rest, 11,000 acres are classed as unplantable, because of altitude and exposure, or the depth of ill-drained peat. Improved techniques are expected to bring some of this area into the plantable category. The following are the proportions of various species planted up to 1947: Sitka and Norway spruces—55.6 per cent; European and Japanese larches—16.5 per cent; Scots, contorta and other pines—15 per cent; Douglas fir—12 per cent. Since the war, extended use has been made of *Tsuga heterophylla*, *Thuja plicata* and *Abies procera* (*nobilis*), but Sitka spruce is still the main choice on moorland sites.

In Northern Ireland state afforestation has thus been practically 100 per cent coniferous. This is principally due to the character of the land acquired—exposed, peaty, wet. Other influences may well have been:

(1) The urgency of the need and an appreciation of the faster growth of conifers in such climatic conditions.

(2) General lack of interest in broad-leaved trees at that time, coupled with defective information about their ecological needs and performance.

(3) Consideration that owners of demesnes would often have a preference for broad-leaved trees and most of the sites suitable for them.

From time to time, however, the Ministry have purchased or leased parts of demesnes, in which fertile sheltered sites offer a much wider choice of species for replanting. Most of these carry some good standing oak, beech, or ash and it is

doubtless recognised that these valuable trees should have a place in future reforestation. Meantime the collection of information about the performance of oak, beech, ash and sycamore on the better soils in Northern Ireland would be a useful service. But in general the growing of hardwoods will probably be left mainly to the private woodland owner, who may claim planting grants as in Britain.

An illustrated booklet entitled "Forestry in Northern Ireland", has recently been issued by the Forestry Branch, Ministry of Agriculture, Northern Ireland, 4 Upper Crescent, Belfast. Copies are obtainable free of charge from that address. —Editor.

ALICE HOLT FOREST: CONTRIBUTIONS TO ITS HISTORY

By G. D. KITCHINGMAN
District Officer, Research Branch

Alice Holt is one of the oldest State forests of England. About 2,300 acres in extent, it lies in the north-east of Hampshire some four miles south-west of the town of Farnham: it is in the parish of Binsted and the hundred of Alton. It has been woodland from time immemorial, and was enclosed in 1812. From 1905 it has been managed under one of the first working plans prepared for British forests. It was acquired by the Forestry Commission from the Office of Woods in 1924.

Name

The origin of the name is an interesting study. "Holt" of course was a common Saxon name for a wood. It has often been stated that it is a corruption of Alerholt or Alderholt, the German for alder being *Aler;* but the Oxford Dictionary of English Place names gives "Alice Holt: Alfisholt in 1169, Alfiesieholt in 1242, that is Aelfsige's Wood". Now Aelfsige was a common Old English name, and it is interesting to note that in the 10th century the name of the Bishop of Winchester, who then lived at Farnham Castle and owned a great deal of land in the neighbourhood, was Aelfsige. This Old English Ae was a symbol (AE) representing a vowel sound between a and e, and was originally the Teutonic short a, the sound of "a" in "man". By 1301 it had become Halfyesholte and in 1373, in the Bishop of Winchester's Pipe Roll, we find the first record of Alice Holt. Gilbert White in 1767 calls it "Ayles Holt", alias "Alice Holt"; but Cox in his *Royal Forests of England* (1905) speaks of Alice Holt as "a comparatively modern and unfortunate corruption of Axisholt".

Surveys

The old perambulations and surveys were not mentioned in the first working plan for Alice Holt (Schlich 1905) and, although they are now difficult to interpret, it may be useful to put them on record.

The earliest known was the perambulation "de Halfyesholte" made in 1171, in the reign of Henry II. It included Woolmer and covered about 16,000 acres of country, chiefly woodland, on the borders of Hampshire, Surrey and Sussex. A second perambulation was made in 1300, in the reign of Edward I.

Another survey was made in 1635, in the reign of Charles I, when the name was given as "Alishoult". The principle interest in this survey lies in its description of the timber which was said to consist mainly of oak, with some beech and ash: nearly all the stands are described as being "of full growth and decaying". The timber was valued according to its fitness for housebuilding, ship-building and cleaving at £9,997. It was also established "that the timber, wood, underwood and thorns or bushes, were the sole property of the Crown, and that the neighbouring inhabitants had no Right whatever in the forest, except that of pasture, under the restrictions mentioned".

The fourth survey, generally known as the Middleton report, was made in 1790 and it produced a map. The report was prepared by Commissioners appointed to enquire into the state and the condition of the woods and forests belonging to the Crown. The area of Alice Holt, including encroachments, was given as 2,744 acres.

Copies of all these surveys are now in the Commission's library at Alice Holt, those of 1300 and 1635 being included in the appendices to the Middleton report.

Officers of the Forest

The ancient government of Alice Holt, under the Forest laws, was similar to that in other forests; by a Lieutenant, Ranger or Keeper, Verderers, Woodwards, Regarders, Agistors and Foresters or Under-Keepers; and these officers held Courts of Swanimote and Attachment, which took cognisance of all offences done in the forest.

But the office of Lieutenant or Keeper of Alice Holt had during the 17th and 18th century been granted on lease for lives, or terms of years, with the power of appointing a Deputy, and the usual number of foresters and underkeepers. This led to grave abuses which came to light during the enquiries leading to the Middleton report.

Amongst these grantees were Viscount Wallingford (1602-1629), William Legge (1662-1699), General Howe and his Lady Ruperta (1699-1741) and Lord Stawell (1766 onwards). Shore, in his history of Hampshire (1892), says that "during parts of the 17th and 18th centuries, owing to the great speculation which went on by Rangers and others, the country did not get half the value of the timber in the Hampshire forests. Mrs. Ruperta Howe, who certainly had no special knowledge of forestry, was appointed Ranger of Woolmer and Alice Holt in 1699 and held the office for 45 years, during which time the country got little and the Ranger got much of the profits from the timber on these Crown lands".

Venison

In the old days both Alice Holt and Woolmer seem to have been well-stocked with red and fallow deer. In 1271 Henry III ordered the Warden of the forest to give Godfrey Gifford four live stags and eight live does in order to stock his park at Itchel in the hundred of Crondall; and two years later Adam Gurdon had to deliver two stags at Windsor Castle, as the King's children were staying there. In 1276 and 1277 the same keeper was instructed to give facilities to a royal huntsman who was sent down with his dogs to take harts for the royal household from the forests. In the survey of 1635 the deer are said to be "about four or five hundred in number". Gilbert White, in his *Natural History of Selborne* (1767), when speaking about deer, says "at present the deer of the Holt are much thinned and reduced by the night hunters, who perpetually harass

them, in spite of the efforts of numerous keepers and the severe penalties that have been put in force against them, as often as they have been detected, and rendered liable to the lash of the law. Neither fines nor imprisonment can deter them; so impossible is it to extinguish the spirit of sporting which seems to be inherent in human nature." In 1777, when Lord Stawell was Lieutenant of the forest, there were about 800 fallow deer in Alice Holt. The red deer, which were apparently restricted to Woolmer, were removed to Windsor about 1760, certainly before 1790. General Howe turned out some German wild boars and sows in his forest, to the great terror of the neighbourhood; at one time a wild bull or buffalo: but the country rose upon them and destroyed them.

Timber for the Navy

No fellings were made for the Navy till about 1780 when 1,777 loads of oak were supplied at 38/- a load. These were taken by road to Godalming when the river Wey was navigable, and thence to the dockyards on the Thames, at Deptford. The Middleton report recommends "the fall of all timber that is fit for the Navy, of which there is a great quantity". So we may conclude that at the end of the 18th century there was little big timber left.

Management during the 19th and 20th Centuries

The forest was enclosed in 1812, and 1600 acres replanted between 1815 and 1825. The old oak we see today is thus about 135 years' old. For many years the whole forest was systematically managed to produce ship-building oak, and heavy thinnings were made to produce widespreading and branchy crowns. Records kept between 1847 and 1904 show that £70,446 13s. 11½d. was received for forest produce during that period, classified as "flitterns and spalings, poles, bark, cordwood or stackwood, fagots or bavins, underwood, miscellaneous wood, timber and various items". Bark, mainly oak bark for tanning leather, was the largest source of revenue. Between 1881 and 1903 about 50 acres of the worst oak areas were cleared and planted with conifers.

In 1905 a working plan was made by Sir William Schlich. His survey of the oak woods showed that only about 300 acres were of first quality. Of the remaining 1,500 acres he proposed that about 300 should be converted to conifers, and 850 felled and replanted with oak and conifers, in groups of oak or conifers according to the quality of the soil. In 1918 it was decided to allocate 600 acres to the growing of oak and 1,180 acres to conifers.

The Growing Stock

Foresters are naturally interested in what their forests produce, and Alice Holt has some quite interesting figures.

(a) 1790. The Middleton report estimated the value of the timber (all oak of course) at £60,000; but it made no volume estimate. Most of this had undoubtedly been felled by 1812, the year of the inclosure.

(b) 1903. The forest was replanted between 1815 and 1825, and in 1903 Schlich estimated the hoppus volume of oak timber at 1,249,600 cubic feet which he valued at £78,100. Including cordwood and bark the forest was valued at £95,020.

Sales between 1847 and 1904 amounted to £70,466, so the total production was £165,486, or about one guinea per acre per annum.

(c) 1951. In 1951 all Inclosures except the Straits Inclosure were enumerated. All hardwoods over 6 inches quarter-girth were recorded to the

nearest ¼ inch of girth and the timber height to the nearest 5 feet, and the volume calculated from volume tables. The volume of conifers over 2½ inches quarter girth was calculated by means of one-tenth acre sample plots: there was one plot for every two acres of forest which means that 5 per cent of the forest was sampled.

The result showed a standing volume of hardwoods (stemwood over bark) of 1,219,000 hoppus feet, of which 1,138,000 was oak. The volume in the coniferous areas was 679,000 hoppus feet, the main species being Scots and Corsican pine, European larch and Douglas fir.

The oak figures showed that during the 50 years of the plan the area under oak had been reduced by about a half, but that the volume of oak timber was only a little less than the 1903 estimate.

The age-class distribution was not at all satisfactory in that as much as 88 per cent of the conifers were below the age of thirty, and only 15 per cent of the hardwoods, of which oak formed 90 per cent, below 120 years. Stocking was on the whole good throughout the forest, the oak areas averaging 2,000 hoppus feet to the acre.

Rates of Growth

A few figures on the present rates of growth may be of interest.

In the new conifer areas the pines are doing well. A Corsican crop aged 69 in 1954 was quality I, with a mean height of 101 feet, and a Scots pine crop of the same age was 85 feet. The Weymouth plot, despite the ravages of blister rust, has a very high volume: trees that have survived are growing very fast and have a mean height of 60 feet and a mean quarter-girth of 9 inches at the age of 48.

Figures for the past rate of growth of oak have been calculated, but they are not a guide to what oak could do in Alice Holt because the treatment it was given in the past was, in a sense, faulty. Trees were grown wide apart when young, to produce those large branches on the trunk so much in demand by the Navy. Subsequently when the crowns closed up these lower branches died and the trees were attacked by the pipe-rot fungus (*Stereum gausapatum*). In the new young crops of oak, the spacing has been close enough to make the boles cleaner and less branchy, and consequently in future the danger of dead branch stubs, and attacks by this fungus, will be greatly reduced.

What has come out of the data, however, is the certainty that the mature oak, now about 130 years (from the plantings between 1815 and 1825 following the Inclosure) cannot be left standing more than another 20 to 30 years without serious deterioration.

The "Grindstone" Oak

Lastly I must not forget to say something about the famous Grindstone oak. It used to stand in Compartment 23, near the Bucks Horn Oak; and the remains of its root system are still to be seen. In the Commissioners' report of 1790 it was described as "an ancient and decayed tree and one of the largest trees in England, measuring about 34 ft. and a half at 5 ft. from the ground and computed to contain 27 loads of timber". Unfortunately this grand old tree was "set alight to by boys and burnt to the ground" about 50 years ago; but an engraving of it by Charles Seawell of Marelands is still hanging in the offices of the Farnham Council. As the Commissioners said, it proves what Alice Holt "is capable of producing, if properly taken care of".

THE BENMORE FOREST GARDEN

By S. R. P. WRAY
Ganger, Research Branch

The object of the Forest Garden at Benmore, Argyll, is to grow stands of timber trees under forest conditions in a high rainfall area of the west of Scotland. The garden contains approximately 200 acres on a hillside, rising from sea level to 1,000 feet, and has a south-westerly aspect. At present there are between ninety and a hundred different species of conifers and hardwoods contained in the garden in individual plots, and each year shows the introduction of more species.

The general principle of plot lay-out is the division of the garden into several genus blocks. Some plots, which were planted pre-war, are growing outside their proper genus block, but are retained as ground cover and treated as temporary plots, which are likely to be felled to make room, when required, for new species to be introduced into that particular block. No species is considered a failure in the forest garden until it has failed at least twice; the plantings having been in separate years and on different soil types.

New plots are at least one quarter of an acre in size, but smaller plots are acceptable for very rare species such as the small groups of *Eucalyptus* now being tried, or for very short-growing trees, such as certain hardwoods which are not expected to attain fifty feet at maturity. There are also specimen tree groups which may contain as little as two trees or even one. Shapes of plots may be irregular, but plots are not made too elongated as this may tend to bring about a false impression, in record form, of the general condition of the plot. Irregular blank spaces are interspersed among the plots in order to provide viewing points, and paths not less than twenty feet wide are specified between plot borders.

Plots are tallied by means of lead tally strips, fixed on the side of posts, three or four inches square, and facing in towards the plot. These tallies give sufficient information pertaining to the plot as regards plot number, planting year, Latin and English names, identity number and origin of seed. Tally posts are positioned at plot corners except in the case of specimen tree groups, where a single small post, two inches square, is placed before the group, or individual tree, as the case may be, and carries along with the tallies the additional letters "S.T." (specimen tree) at the top.

All plots in the garden are indicated on a twenty-five inch to the mile map as soon as planted. At that time they are outlined in pencil only. At the end of the first growing season they are shaded in pencil and cross-shaded at the end of the second growing season. By the end of the third growing season they can usually be considered to be established and are then outlined in ink on the map and shaded with their genus representative colour. Temporary plots in the garden are marked with pencil only on the map and are thus distinguished from the coloured permanent plots.

Most of the plots in the forest garden are as yet too young to prove that the plants in them may be of any real value for use as forest trees, although some even in the young stages have taken well to the site and look most promising. For example, in a plot of *Pinus banksiana*, planted in 1950 on an exposed site at an elevation of 800 feet, the plants were topping four and a half feet at the end of the 1952 growing season, with almost full stocking, and they are healthy and vigorous. It may be of some interest to note that the plants were pit-planted

one-plus-one from Wareham nursery. The site was heather and bracken. Many of the *Eucalyptus* in the garden are also thriving well.

Benmore Forest Garden is enclosed by a deer, sheep and rabbit proof fence and any rabbits which may enter, as young ones may do in the early summer, are kept down by the trapper. Unfortunately, however, no safe method of dealing with the vole menace can be put into practice. Some of the 1953 plantings have already suffered from this source. The damage in one small plot of *Ailanthus glandulosa* was so bad that almost all the plants were completely stripped of bark. Plots of Norway spruce and Douglas fir have also been pretty severely damaged.

ACCOUNT OF THE LARCH PLANTATIONS ON THE ESTATES OF ATHOLL AND DUNKELD

This Account is one of the classics of British forestry, but copies of the original book, published by C. G. Sidey of Perth in 1833, *are so scarce that our readers may appreciate this abridged account. It was contributed by Mr. J. D. Matthews, District Officer, Research Branch. The author of the original work is unknown, but it was prepared at the request of the Trustees of John, Fourth Duke of Atholl, who was born in* 1755, *succeeded to the estates in* 1774, *and died in* 1830.

The Scotch acre, used throughout this account, is equal to about 1.2 statute acres—Editor.

As the Larch is a plant which grows naturally in elevated situations, among the central alpine ranges of the Continent of Europe, it were reasonable to expect that it should grow with vigour in any other alpine country, the mean temperature of which is not materially below that of its native site, and the mountains of which could afford due shelter from the influence of the sea air. The same result, even before the actual experiment of transplanting the larch should have been attempted, might also reasonably be expected to be exhibited in any country, the climate of which is similar to that of the elevated part of the native country of that tree, whether the similarity should arise from an altitude above the level of the sea, or from a higher parallel of latitude. In this country the results of experience accord exactly with the expectations of reason. The larch in Great Britain has grown with vigour in all the mountainous districts in which it has been planted, and has acquired its greatest development in situations removed from the immediate influence of the sea air. Where it has exhibited itself in a diminutive state of growth, has been near the sea shore, and on soils quite unsuited to its nature. In such cases the failure must be ascribed not to the nature of the materials experimented on, but to the misapplication of the tests employed. Enough, however, has already been achieved, by many individuals, in rearing the larch to perfection, to encourage many more to follow their example; and thus create a great source of emolument to individuals, and of internal strength to the nation.

There is no name that stands so high in the list of successful planters as that of the late John, Duke of Atholl. It is true, few people possess the fortune and property which his Grace did; but how many are there who do possess them, and who "never think of these things"; and how many groups of mountain ranges are there in Britain, which rear their bare and sterile sides to the strife of the elements, while those of Atholl are clothed with the beautiful and stately productions of the vegetable kingdom. The contemplation of this forest scenery

excited a natural warmth in the breast of his Grace, and which he thus notes down in his memorandum-book: "Drove up to Loch Ordie, and home by the back of Craig-y-barns, every way much gratified with the growth of the larch and the spruce,—a very fine, grand, picturesque drive, not to be equalled in Britain. The extent of the drive through woods of my own planting, from one to forty years old, is fifteen miles". Were even the less improvable parts of smaller, properties clothed with a forest-mantle of larch, they would develop in the course of time new sources of wealth to their proprietors, of greater value than the discovery of a diamond-mine, or of that other inflammable mineral which is said to be the remains of pre-existing forests. No language of exaggeration is required to indicate the probable value resulting from the planting of the larch. Sober calculation will work out products, surprising to those who have never thought of the subject.

The late Duke planted, in the last years of his life, 6500 Scotch acres of mountain-ground solely with the larch, which, in the course of seventy-two years from the time of planting, will be a forest of timber fit for the building of the largest class of ships in his Majesty's navy. It will have been thinned out to about 400 trees per acre. Each tree will contain at the least 50 cubic feet, or one load of timber, which, at the low price of one shilling per cubic foot, only one-half of its present value, will give £1000 per acre, or in all a sum of £6,500,000 sterling. Besides this, there will have been a return of £7 per acre from the thinnings, after deducting all expense of thinning, and the original outlay of planting. Further still, the land on which the larch is planted is not worth above 9d. to 1s. per acre. After the thinnings of the first thirty years, the larch will make it worth at least 10s. an acre, by the improvement of the pasturage, upon which cattle can be kept summer and winter.

The Duke remarked, in 1815, before he had commenced planting his great larch forest, in anticipation certainly, but not in ungrounded expectation, that "if one-fourth part of the product of 2,600,000 larches arrive to maturity in seventy-two years, by the time the present century expires, it will supply all the demands required by Great Britain for war or commerce. The success which has attended our efforts will probably induce, and indeed has induced, many already to plant to an extent which will not only meet the wants of Great Britain, but enable her, possibly with a century, to export wood to an immense amount. Under these circumstances, the prices of wood for ship-building may, and probably will be, much decreased at the same time. The grounds I have planted and intend to plant, I consider admirably calculated to produce the best wood; and I think, too, that my plantations will be the first in the market for a number of years, to any considerable extent; and, lastly, the greater quantity, though of less price, will make up and probably be productive of an income to a much greater amount than that of any subject in the kingdom. The price of larch-wood will, no, doubt always be regulated according to the demand; but I have no hesitation in saying, that the price, when the wood is thoroughly known, will long continue superior to the best foreign fir-timber, and little inferior to the oak."

Introduction of the Larch

The larch is mentioned by Parkinson in his *Paradisus* so early as the year 1629; but it was then "nursed up but with a few, and those lovers of rarities". Evelyn, in the later editions of his *Silva*, published at the close of the 17th century, alludes to specimens of the larch tree then existing near Chelmsford in Essex, "of good stature", which "sufficiently reproach our not cultivating so useful" a species of tree. For many years after this, larch continued to be

cultivated merely for curiosity, or as an ornamental tree. Till towards the middle of the 18th century, no one appears to have thought of planting it with the view of profit, or to have regarded it as calculated to afford timber for the purpose of civil and naval architecture. The Rev. M. Harte, who wrote about 1770, mentions that "forty years ago (i.e. about 1730) some larch trees in England were bearing cones every season". Goodwood, the property of the Duke of Richmond, was probably the first place at which it was planted as a forest tree, and even there it was only in small numbers.

There is much greater certainty regarding its introduction into Scotland in 1738. In that year, Mr. Menzies of Megeny, in Glenlyon, brought a few small plants of it in his portmanteau from London, five of which he left at Dunkeld, and eleven at Blair in Atholl, for James, the second Duke, the grandfather of the late John, Fourth Duke of Atholl. The five were planted in the lawn at Dunkeld, in an alluvial gravelly soil abounding with rounded stones, and in a sheltered situation at an elevation of 40 feet above the River Tay, and 130 feet above the level of the sea. Two of the five were felled by the late Duke in 1809, and one had been cut, by mistake by the gardener about twenty years before, and made into mill-axles. Of the two felled in 1809, one, containing 147 cubic feet of wood, was sent to Woolwich Dockyard, and formed into beams for the repair of the *Serapis* store-ship. The other, containing 168 cubic feet, was bought on the spot by Messrs. Symes and Company, ship-builders, Leith, at 3s. per foot, or £25: 4s. the tree. The two which remain are still growing in great vigour. The one is above 11 feet, the other above 12 feet in girth, at four feet from the ground; and the largest, according to a measurement made by a professional gentleman in the summer of 1831, contains 350 feet of timber. The eleven which were planted at Blair, at an elevation of 500 feet above the level of the sea, measured in 1817 from 8 to 12 feet in girth. The interest which attends the fate of that which is first introduced in any useful branch of industry, in any country, will gladly treasure up these facts regarding the oldest and largest larches in Scotland as important.

In 1740, six larch plants were brought up in the green-house at Dunkeld, and not appearing to thrive in it, they were planted out, three on each side of the greenhouse. They had evidently suffered from the warmth of the house, and though they are now fine trees of 7 feet in girth, and are ninety years of age, they are much smaller than many larches that were planted after them; it is not mentioned whether they had been raised from the seed. As five had been planted in the open air two years before, and must have been thriving, it is difficult to account for their being put into the greenhouse, except on the supposition that they had been raised from the seed.

Between 1740 and 1750, Duke James planted 350 larches at Dunkeld, at an elevation of 180 feet above the level of the sea, and 873 at Blair, among limestone gravel, in a sheltered situation, which was worth from 20s. to 30s. per acre, at an elevation above the sea not exceeding 560 feet. All these larches were planted in the ornamental ground around Dunkeld House and Atholl House, the two residences of his Grace. So situated, and in regular rows wide part, they were evidently intended more as a trial of a new species of tree, than for forest timber. But, in 1759, Duke James planted 700 larches, over a space of 29 Scotch acres, intermixed with other kinds of forest trees, with the view of trying the value of the larch as a forest tree. This plantation extended up the face of a hill from 200 to 400 feet above the level of the sea. The rocky ground of which it was composed was not worth above £3 a year altogether. It was covered with loose and crumbling masses of mica-slate. This may be considered the first attempt at mountain planting in Scotland. According to the fashion of the time, the trees were arranged in rows, and they converged towards a small piece of water in the

centre like radii. This concluded the whole attempts at planting by Duke James. Before he died, however, in January 1764, he had tried the quality of the larch as timber, and was quite satisfied of its superiority over other firs, even in trees of only eighteen or nineteen years old.

To show how well this planting throve, a larch was cut out of it by the Fourth Duke in 1816, aged fifty-seven years, for naval purposes, which contained 74 cubic feet of timber, and was sold exclusive of all expense at 2s. 6d. per foot, or £9: 5s. the tree. "I don't believe", says the late Duke, in speaking of this very plantation, "there is another species of tree in the 29 acres, oak included, except a few spruces, that would bring a guinea. Some of the spruces might contain from 30 to 40 feet, and be worth 2s. per foot".

John, the Third Duke, succeeded his father in 1764. It was he who first conceived the idea of planting larch by itself as a forest tree, and of planting the sides of the hills about Dunkeld. The former of these ideas was put into execution in 1768, by the planting of 3 acres with larches alone on Craigvinian, above the wood which Duke James planted on the same hill in 1759, at an altitude of from 100 to 200 feet above it, or 500 or 600 feet above the level of the sea, on soil that was not worth 1s. per acre. The latter idea of Duke John was effected by the inclosing of a considerable extent of ground for the planting of mixed wood, as 190 acres on Craig-y-barns, 30 acres at Callie, 30 acres at Haugh-end, 90 acres on Craigvinian, 25 acres of the Hermitage plantation, and several small clumps, including in all 5 to 6 acres, all at Dunkeld, and near 300 acres at Blair, forming a total of 665 acres. Of these he finished the planting of 410 acres before his death in 1774.

The greatest obstacle to the progress of the Duke John's (the Third Duke) planting was the scarcity, and consequent dearness, of the larch plants. He had raised a few plants himself from the cones gathered from some trees at Blair, which began to bear fruit at the commencement of his operations; but this supply did not exceed 1,000 plants in a season. At the same time, three and four years transplanted larch was selling in the nursery grounds as high as 6d. per plant. All that could therefore be obtained for planting did not exceed fifty plants per acre in the large plantations; and the rest of the quantity, amounting to 4000 plants per Scotch acre, that being the allowance of plants to the acre at that time, were made of the Scotch fir and the different kinds of hard wood. The larch was planted at a height not exceeding 600 feet, and the Scotch fir at 900 feet above the level of the sea. Another difficulty which the Duke John had to encounter was from the broom, furze, juniper, and heath, which flourished abundantly in the region allotted to the larch, and which had not been entirely eradicated before the planting began. The broom, though indicative of a good soil for larch, is a troublesome plant to young trees, its long switch-like elastic twigs whipping their tops violently in windy weather. The furze with its thick set spiny branches smothers or draws in prematurely the young trees. These, and many other obstacles, would no doubt have been removed by the Duke John had he had leisure to attend to planting only; but having been obliged to be frequently in London regarding his title, and the affairs of the Isle of Man, his attention was otherwise occupied for the greater part of the short time which he enjoyed his property.

Such were the state and extent of the larch plantations at Dunkeld and Blair when the Fourth Duke succeeded his father in 1774.

Development of the Atholl Plantations

The first object of the Fourth Duke was to plant the 225 acres which formed a part of the plantations that where left unfinished by his father at his death in 1774. This, with some larches planted about the Loch of the Lows, occupied

him so long as the year 1783. This delay was owing to the difficulty of obtaining larch plants, all the number that could be obtained during that time amounting only to 279,000.

Observing the rapid growth and hardy nature of the larch tree, the Duke determined on extending the sphere of its occupation to the steep acclivities of mountains of greater altitude than any that had yet been tried. Hitherto the larch had chiefly been planted along with other trees. But the Duke enclosed a space, including 29 acres, on the rugged summit of Craig-y-barns, and planted a stripe, consisting entirely of larch among the crevices and hollows of the rocks where the least soil could be found. At this elevation none of the larger kinds of natural plants grew, so that the ground required no previous preparation or clearing. After 1774, larch plants fell in price from 6d. a plant to 35s. per thousand, two and three years transplanted, and ranging from 2 to 3½ feet in height. The expense of inclosing and planting at this time was the same as in the time of Duke John, namely, £1 19s. 1½ per acre. This alpine plantation was formed in 1785 and 1786.

From 1786 to 1791, the Duke planted 480 acres at Dunkeld, the greater part of which was only sprinkled with larch from 6 feet to 30 feet asunder, owing to the difficulty of procuring a sufficient number of plants; and 200 acres at Blair, which were planted wholly of larch, at 6 feet apart. The number of larch plants consumed in these plantations in the five years was 500,000. Wages rising at this period, and there being a greater substitution of larch for Scotch fir, the expense of planting was considerably increased. That, with the inclosing amounted to £2 10s. 6d. per acre. The pitting alone cost 10s. 6d. per acre.

In eight years from 1791 to 1799, the Duke still continued to diminish the number of Scotch fir, and to increase that of the larch; in this time the banks of the Bruar Water, extending to 70 Scotch acres around the beautiful water-fall were planted. It is not unlikely that the *Humble Petition of Bruar Water*,

"To shade its banks wi' towering trees
And bonnie spreading bushes,"

so well expressed in the words of the poet Burns, might have had the effect of drawing his Grace's attention the sooner to the embellishment of this delightful spot. At Logierait, Inver, and Dunkeld, the space altogether planted extended to 800 acres, 600 of which were entirely of larch, but only planted so thick, from a paucity of plants, as merely to leave, after a scanty thinning, a sufficient number of trees for naval purposes. The Duke's desire to extend his plantations solely with larch, in elevated situations, had to struggle very severely and painfully against the scarcity of plants that prevailed in the country, even at this period, when the value of the larch tree was begun to be appreciated. The expense of planting this piece of ground was the same as the last, and the number of larch plants consumed in it only amounted to 800,000 and even this number was obtained with great difficulty.

Still observing with satisfaction and admiration the luxuriant growth of the larch in all situations, and its hardihood even in the most exposed regions, the Duke still farther resolved in pushing entire larch plantations to the summits of the highest hill. The Scotch fir, that was planted at 900 feet above the sea, was beet up ten years afterwards by the late Duke with larch, as an experiment. In 1800, when the Duke was anxious still farther to extend his larch plantations the effect of this experiment confirmed him in an opinion which he had previously conceived, of the very hardy nature of the larch plant. These Scotch firs, in a period of near forty years, had only attained a height of 5 or 6 feet, —while the larch, which had been planted ten year after among them were from 40 to 50 feet. Nine hundred feet was an elevation at which larch was supposed

incapable of vegetation. A favourable circumstance, too, occurred in 1800, which concurred with the result of the above experiment to give an impulse to the commencement of a great undertaking in planting.

In that year several of the farms at Dunkeld fell out of lease, and as they were all in miserable condition, his Grace took them into his own hand, to improve them, and to build suitable farm-houses and offices on them. This circumstance gave the Duke the command of a range of mountains, extending from the edge of Craig-y-barns, over a space of ground of 1,600 Scotch acres. This space included a commonty, the rights of which the Duke bought up. It formed the back ground to the farms which the Duke had taken into his hands. It was situate from 900 to 1,200 feet above the level of the sea. Its soil, presenting the most barren aspect, was strewed over thickly with fragments of rocks, and vegetation of any kind scarcely existed upon it. "To endeavour to grow ship-timber", remarks his Lordship, "among rocks and shivered fragments of schist, such as I have described, would have appeared to a stranger extreme folly, and money thrown away. But, in the year 1800, I had for more than twenty-five years so watched and admired the hardihood and the strong vegetative powers of the larch, in many situations as barren and as rugged as any part of this range, though not so elevated, as quite satisfied me that I ought, having so fair an opportunity, to seize it".

During the same period in which the Duke planted the above mountain range he also planted 400 acres in other situations; 150 acres at Haughend, and 259 acres about the Loch of the Lows. These make a total of 2,409 Scotch acres, 1,800 of which consisted solely of larch, and 300 acres of this latter amount occupied a region far above the growth of the Scotch fir. These plantations, in inclosing and planting, occupied the long period of years from 1800 to 1815. This delay arose greatly from the difficulty of obtaining larch plants, and which only permitted them to be planted to a thickness of from 1,500 to 1,800 per acre. From a different mode of planting being adopted, however, and the selection of plants of an earlier age, an account of both of which will be afterwards given, the cost of fencing and planting this extensive range of ground did not exceed 10s. 6d. per acre.

Having no doubt whatever of the successful growth of the larch in very high situations, the Duke still farther pursued his object of covering all his mountainous regions with that valuable wood. Accordingly, a space to the northward of the one last described, containing 2,959 Scotch acres, was immediately inclosed, and planted entirely with larch. This tract, lying generally above the region of broom, furze, juniper, and long heath, required no artificial clearing. An improved mode of planting was employed here, that of using young plants only, two or three years seedlings, and put into the ground by means of an instrument invented by the Duke, instead of the common spade. This change of arrangement facilitated the operations, and, at the same time, greatly increased the supply of the plants, so as to enable the whole ground to be planted in three years, from the 4th December 1815, to the 2nd December 1818. The increased number of plants per acre, and the high price of the plants, enhanced the cost to 16s. 8d. per acre, for inclosing and planting this forest of Loch Ordie, so named from a beautiful sheet of water in it, of 100 acres extent.

In 1824, the growth of the larch in Loch Ordie forest having greatly exceeded the most sanguine hopes and expectations of the Duke, he determined he would add on to it an extensive adjoining tract, consisting of 2,231 Scotch acres, denominated Loch Hoishnie. The preparations of fencing, clearing where that was necessary, making roads, and procuring plants from different nurserymen, occupied the time till October 1825, when the planting commenced,

and was carried on in good earnest; and the whole was finished by December 1826. The fencing and planting cost 15s. per acre. There was no plantation which his Grace had executed that gave him so much satisfaction in the work as that of the forest of Loch Hoishnie.

The planting of this forest appears to have de-terminated the labours of the Fourth Duke in planting; though it is highly probable, from his great desire to extend his larch woods, and particularly from the following entry in his private diary, that he intended still farther to prosecute them:—"Wednesday 28th July, 1824—Mr. Urquart, the nurseryman at Dundee, went up to Loch Ordie with me. He is to furnish 50,000 one-year-old transplanted larch, and 1,000,000 of seedlings, 500,000 of which he engages to transplant, and to be ready to put into the ground in the autumn of 1825, and to deliver the remainder as seedlings. These, with 100,000 transplanted seedlings, to be furnished by Donaldson at Dunkeld, and 500,000 more in autumn 1825, with what I shall try and collect otherwise, will make good beginning in my new forest of 6,000 acres".

The total amount of larch plants, mixed or unmixed with other kinds, planted by the three Dukes, will amount to the enormous number of 14,096,719 plants; and, if we allow 2,000 plants per acre for the amount that was mixed with other kinds of trees, these would occupy a space, if planted alone of larch, of 533 acres, so that the whole extent of ground occupied by larch amounts to 8,604 Scotch acres, or 10,324 acres imperial.

James, the Second Duke (1690-1764), had little opportunity of introducing improvements in planting. The properties of the new tree, larch, were not so well known by him as to stimulate him to an extension of its culture. He followed the fashion of the day, of placing trees in parallel rows, in diverging rays from a centre, and in quincunces. Gusts of wind, having free access through these alleys, blew down many thousands of the Scotch firs, and broke down as many, their heavy heads and superficial hold of the soil, rendering them unfit to resist the effects of a strong gale. To Duke James, however, belongs the honour of having introduced the larch into the woods of Atholl; and the experiments which he made with it, limited as they must necessarily have been, convinced him that it was a valuable species of timber.

Preparing the Ground

John, the Fourth Duke, conceived the grand idea of clothing all the beautifully diversified grounds around Dunkeld with wood; and with this laudable intention, ventured to place the larch in considerably elevated situations. He always judiciously inclosed the ground that was allotted to planting; but not having sufficiently cleared of the larger growing natural shrubs, such as broom, furze, juniper, and long heath, they grew up and choked many of the larch plants. This destruction was the more easily effected, as the larch plants were inserted into pits, and were three or four years transplanted out of the seed-bed. Having been tall and not very strongly rooted, they could not contend with the natural plants, which shot up vigorously from the old roots.

Seeing the advantages of enclosing the ground before planting it, as practised by his father, in preserving the woods from the depredations of men and animals, he enclosed every piece of ground substantially with a high stone wall, dry built, for which there was abundance of excellent materials on the spot, before it was planted. Seeing also the disadvantages of allowing the wild shrubs to interfere with the growth of trees, he had them all previously removed by burning, pulling and eradicating. These shrubs never grow to a troublesome height at an elevation exceeding 700 feet above the level of the sea.

At lower levels most of them grow from 10 to 12 feet in height, the juniper pushes out strongly, and even the heath attains to the height of upwards of two feet. Feeling, too, the inconvenience of being shut out from viewing the interior of a plantation—as for instance, in the case of a hollow planted with trees by Duke James, which he had not seen for years, and in which one night a hurricane blew down and broke many hundreds of Scotch firs, as if they had been hewn down by the hatchet, and which were removed with great difficulty—he caused roads to be formed in every convenient direction through the grounds which were to be planted. These roads were not metalled as may be supposed, like a Macadamized one, but they were made quite accessible, to wheel-carriages, by the filling up of hollows, and the levelling of elevations by making a ditch on each side of them and sufficient openings across the hollows, to let off the superfluous water, and by running them across the face of the acclivities, not only to avoid currents of water from the high grounds, but swampy places in the low grounds. Paths only of from 4 to 5 feet in width, were left in the highest parts of the ground, where wheel-carriages could not venture, but which were necessary as footpaths for the inspection of the woods. These roads and paths were always formed before the ground was planted, as the lines of them could then be more easily traced on the ground. It was not found necessary to drain the acclivities of the mountains. Open cuts were formed in low swampy grounds, which were always planted with spruce instead of larch, as being a tree more suited to that particular state of the ground. The Duke frequently bears very favourable testimony to the value of the spruce tree, as supplying a superior and desirable sort of timber. These preparations, exclusive of the planting or the value of the ground, amounting to 18s. 2d. per Scotch acre, were, no doubt, expensive, but without them justice would not have been done to the trees.

Planting Methods

The season of planting the larch commences as soon as the last year's shoots are entirely stripped of their leaves or spines. In seedlings, this is long in taking place, not till the end of November or the beginning of December. About the 12th April the buds of the larch break forth rapidly into leaf. So that 65 days will embrace the longest period which can be allotted to the planting of the larch. With a planting instrument one man will plant from 800 to 1,000 larches in a day, and if 2,000 plants be allowed to a Scotch acre, the cost per acre will be two day's wages of a man.

Finding great difficulty in collecting a sufficient number of trees and four year's transplanted larches, the age at which he had begun to plant, the Duke resolved, previous to the planting of the large forest of 2,409 acres, begun in 1800, on trying one or two years seedlings, or at the oldest one-year transplanted plants. After the large shrubs were entirely removed, young and small plants seemed more desirable than large ones, especially as young ones could be inserted with greater facility into the ground, and at much less cost than old ones. The plan of making pits with the spade is always an expensive one, and the planting in pits can never be accomplished without the assistance of two people, one to hold the plant upright, and the other to shovel in the turf and earth with the spade.

The slit, formed by the planting instrument, resists all ingress of wetness or cold, the surface closing together as if it has never been cut, and the natural grassy covering protects the young plant from the severer effects of the frost. A one year old transplanted plant or a seedling when inserted into a slit in the ground, takes immediate hold of the mould below, and grows onwards without molestation from the weather. This planting instrument consists of a flat piece

of iron, shaped like the head of a flat spear or a mason's trowel, 10 inches in length and 5 inches in breadth at the widest part its neck, which is of one piece with the blade, is 7 inches long, and passes through and is rivetted to a cross handle of wood, that remains firm in the plane of the blade. The whole instrument is made stout, and of the best materials; it costs only 1s. 6d. In using this instrument, the planter holds it in one hand and the plants in the other, and he makes a slit in the ground of the requisite depth for the plant to be inserted; then pushing down the roots of the plant carefully into the slit, so as that they shall not point upwards, he finishes the operation by treading with his heel the ground firm around the plant.

The expense of labour in planting was greatly reduced by the use of this instrument. Pit-planting required 20 men to pit and plant an acre, in a day, whereas two men will do the same work in the same time with the spear-planter. The three and four year's old transplanted larch cost 10s. per 1,000. The seedlings only cost 2s. 6d. per 1,000.

Planting Density

Generally in mixed plantations there were put in from 700 to 1,000 plants per acre. In the first attempts at planting them entirely by themselves, they were increased only to 1,500 plants per acre, from the want of plants. The keeping of the plants in the nursery-grounds till they were three and four years transplanted from the seed-bed tended greatly to decrease the disposable quantity of plants from such sources. Finding 1,500 plants rather too few among broom and furze, they were increased to 1,800 per acre. Even after seedlings were planted, which practice immediately let loose immense numbers of plants on the market, they were only extended to 2,000 per acre, on the higher and barer parts of the mountain range.

Improvement of Pasture

The process of the thickening of the soil by the larch being very important in its results, it deserves to be particularly described. The lower and stronger branches meet together in six or seven years after planting, so as to form a complete matting over the ground. The air and light being excluded by them, all plants that are under them die. At the same time the annual deposit of leaves from them, by means of decomposition, forms, in the course of time, a soil of considerable depth. At the age of 24, the larches lose the spines on the lower branches altogether, and that is the natural mark of their being ready to be removed by thinning, to a considerable extent. On the air being re-admitted by the removal of the trees, the surface of the new-made soil wherever it has been formed even among the rocks, becomes immediately covered with natural grasses, of which the *Holcus mollis* and *H. lanatus* seem to predominate. These grasses continue to grow and to thicken into a sward by the annual top-dressing which they received from a continued deposition of leaves. The improvement of the natural surface of the ground for pasturage, by means of the larch, appears to be a property peculiar to this tree. This pasturage is quite capable of improving the condition of cattle either in winter or summer.

Thinning

The first thinning should consist of a light one of about one-fifth of the whole, by removing only those trees that are of least value or worthless. After 24 years from the time of planting, the spines fall off the lower branches, which are of course no longer useful to the soil below. From to 20 to 30 years

old, then, the thinning is carried on so extensively, as to remove two-thirds of that which was left standing by the first thinning. In thinning, it is necessary to observe that all the strongest and healthiest trees should be left, even if two or three of them should be closer together than 12 feet. These small clumps happening to light on a favourable situation, they will thrive well, as the air has access to each tree, around two-thirds of its circumference. This thinning being delayed so long, the trees thinned out will be valuable for a variety of purposes. One of these purposes is the profitable use which may be made of the bark. The last thinning should be given when the trees are from 30 to 35 years old, which will leave from 380 to 400 trees per acre. The 380 will require a little pruning and trimming of the lower branches, in order to give head room to the cattle which are to browse on the grass below. The whole prunings and thinnings will cost about £5, and their produce will fetch about £12, leaving a profit on them of about £7 an acre.

Increment

Taking the average height, then, of an average larch of eight years from the seed, at 11 feet, it will nearly be accurate to allow 16 inches as the annual growth till the tree is fifty years old, and after that only 10 inches per annum for twenty-two years longer, as the length of the tree lessens in growth as the bulk of the wood increases. These data give a larch tree, of seventy-two years of age, a height of 93 feet 4 inches, a fair average agreeing with actual experiment. The shoots of larches beyond thirty-five years of age are heavier, though they are not so long as those of younger trees; the larch like the oak, puts forth two shoots every year, the one in spring, the other in autumn. The spring shoot has no lateral branches; the autumnal shoot pushes out like the spring one, but at the time this process is going on, the spring one is throwing out lateral branches. These lateral branches are firm and woody.

In regard to the growth of the girth, a larch tree, on an average, will acquire an inch in girth per annum, till it be twenty-four years old; and, from that time, till it has acquired the venerable age of seventy-two years, it will grow $1\frac{1}{4}$ inch in girth every year; thus,

In 24 years, it will be 2 feet in girth, at 1 inch per annum.
„ 48 „ more, „ 5 „ „ „ „ $1\frac{1}{4}$ „ „ „

In 72 „ it will be 7 feet „ „ .

The larch begins to make heart-wood at twenty-four years of age.

At 50 years old it will contain 26 cubic feet of wood
„ 60 „ „ „ „ „ 14 „ „ „ „ more.
„ 72 „ „ „ „ „ 20 „ „ „ „ „

In all, 60 „ „ „ „ or one load of 50 cubic feet, and 10 feet more.

These results correspond exactly with the quantities which the Duke obtained at these respective ages. Larch appears to be on its greatest increase for timber from fifty-seven to seventy-two years old. A larch containing 50 cubic feet, or one load of timber, is quite fit for naval purposes. At half that size it is suitable for every country purpose.

Pests and Diseases

The larch, like other trees, is liable to accidents and diseases. Wind may drive them down by the roots, but it can very seldom break them, which shows

the toughness of the wood. In November 1826, a hurrican was very fatal to the Scotch fir, and it tore up many larches by the roots. The depredations committed by wild animals are sometimes considerable, such as those done by red deer, the roe, hares, rabbits, and even the black game. Fences of good stone-walls will certainly form a powerful barrier against the inroads of all these creatures, but still they find an entrance into the woods by gateways and such like openings, for the sake of shelter. The red deer but seldom leave their more herbaceous pasture about Blair, but the roe deer commit considerable depredations about Dunkeld, insomuch that war was obliged to be declared against them in 1816; and in that season 170 were brought in dead, and others dying from wounds, would swell the number of slain that season to upwards of 200. Before 1774 the roe-deer were not known to exist nearer than thirty miles to Dunkeld, and then they were scarce anywhere; but since they have received shelter and protection from the numerous plantations, they have increased very fast in numbers. Their habits are peculiar; they always go in herds of odd numbers, from three to nine. The doe generally produces two at a birth, and can rear them easily; but one or both of the fawns are often destroyed by the foxes. The weight of a good buck with the skin, but without entrails, is 40 lb.; that of a doe from 32 lb. to 38 lb. The principal mischief committed by them is by the buck rubbing his horns between two trees to get rid of the velvet which covers them. A dozen of trees may be seen at one view, of from 7 to 8 years of age, completely stripped round of their bark. Both the buck and the doe eat the tops of the young larch. Hares and rabbits, but particularly the former, appear to be seized with an idle but mischievous curiosity to taste the tops of a new plantation in its first years growth, though they never eat the tops they nip off.

Not destroying for the gratification of hunger, their depredations are the more extensive. Black game, too, nip off the tops of young plants for a year or two, but they never eat them. Plantations above 700 feet of elevation are only annoyed by the deer.

Previous to the year 1795, a blight (occasioned by an insect) affected the larch, and of those in low situations many died. At that time the frost was very severe, and heavy frosty fogs hung about the trees in spring. After this phenomenon the blight appeared. Trees above 30 feet in height, and in high situations, escaped this affection, where the wind could shake them. This blight destroyed the flower of the larch, and prevented the formation of the seed, and, consequently, the propagation of the plant. The first appearance of the blight was indicated by a substance on the larch resembling small balls, of a fine white matter like cotton. These balls or nidi enclosed small insects, a species of Aphis, the two sexes of very different appearance. They appeared to live upon the juices exuding from the bark of the tree, and not upon the leaves; and they probably prevented the sap from ascending, at least no fresh shoots were thrown out by the tree that season. Many trees were much injured by this disease, and for a long time afterwards they presented a remarkable appearance, that of being completely covered over with lichens. The trees, however, shot up clean stems 20 to 25 feet above the fogged part, and these stems were as healthy as those of the healthiest trees that had never been affected. On cutting the wood, the fogged part was no more injured in quality than the wood of the healthiest trees, though the lichen had adhered to them for fifteen years. The effect of this blight, then, was only superficial. The existence of this disease for eight or ten years certainly retarded the growth of the trees, but it did not cause the Duke to relax in the least in his efforts to form large larch forests. On the contrary, it impressed upon him the necessity of planting the high ridges of the mountains, in order that the trees might be placed beyond the influence of the disease, which did not appear higher than 600 feet above the level of the sea.

Uses of Larch Timber

The value of larch timber may be seen from the prices which the Duke received for it for various purposes. In 1806 the Duke cut twenty larch trees of the age of 64 years, to make the centres of the middle arch of 90 feet span of the bridge that was building across the Tay at Dunkeld. They were from 105 to 109 feet in length, and they contained from 80 to 90 cubic feet of timber each. After standing for three years as centres, they were sold by public sale at 2s. 8d. per cubic foot. In 1810, Messrs. Symes & Co., Shipbuilders in Leith, bought eleven trees, producing 1,066 cubic feet, at 3s. per foot. In February 1819, the Duke sold to Messrs. Bolton and Watt, and laid down for them at Evan's yard, London, 4,176 cubic feet of larch, at 3s. 6d. per foot, for the building of steam-boats. Mr. Ainslie, shipbuilder, Perth, bought 500 trees, yielding not less than 12 feet each, at 1s. 6d. per foot, the buyer paying all expenses of cutting down and carrying away. The Duke also supplied larch for the building of two brigs at Perth; the one the brig *Larch*, built by Mr. Brown, of 171 tons register, and another of 240 tons, built by Mr. Ainslie. He also sent, at different times, large quantities to Woolwich dock-yard for the use of the navy.

The value of larch wood, exclusive of the value of the pasture under it, may be estimated in this manner. Suppose the plantation are thinned out by thirty years to what they are to stand for shipbuilding, that is, to 400 trees per Scots acre; suppose, after that period, the whole were cut down at the following respective ages, the value of the whole, per acre, at the different periods, would be as follows:—

400 trees at 30 years old, at 2½ cubic feet each tree, =1,000 cubic feet, or 20 loads, at 1s. 6d. per foot profit,= £75 per acre.

400 Trees at 43½ years old, at 15 cubic feet each tree, =6,000 cubic feet, or 120 loads, at 1s. 6d. per foot profit,= .... £450 ,, ,,

400 Trees at 59 years old, at 40 cubic feet each tree, =16,000 cubic feet, or 320 loads, at 2s. 6d. per foot profit,= .... £2,000 ,, ,,

400 Trees at 72 years old, at 60 cubic feet each tree, =24,000 cubic feet, or 480 loads, at 2s. 6d. per foot profit,= .... £3,000 ,, ,,

The average of these prices would be £1,381: 5s. per acre; so that £1,000 per acre is not a high a calculation of the value of the Duke's larch plantations.

The uses to which the larch tree may be applied are various and important. In one instance the Duke applied larches successfully as nurses to spruce firs, which were going back. The requisite shelter recovered the health of these valuable trees. The great thinnings of larch plantations which take place from 20 to 30 years of their age, supply useful materials for various purposes. Post and rails for fencing may be made either out of the tops or the trunks of young trees. While fir posts and rails last only about five years, and are worm-eaten after that period, the larch posts stand for 20 years, and never get worm-eaten. But the trunks of young trees are preferable for this purpose to the tops, as they have less sapwood.

Conclusion

It is gratifying to see a person of rank and fortune devoting the greater part of his time to the improvement of his estate. Few, perhaps, on the account of their public duties, can employ any considerable portion of their time in this manner, and fewer have the inclination, even when they possess the leisure.

The late Duke of Atholl was certainly an extraordinary instance of a patriotic country gentleman; but his example may be followed by every one, however limited the field of his operations. The above details afford but a very indequate idea of the extensive improvements effected by his persevering energy, to form a true estimate of which, it would be necessary to inspect the magnificent forests with which the previously desert and dreary ranges of the valleys of the Tay and Tummel have been clothed. Among the numerous cultivators of wood in Britain, none has hitherto held a higher rank than the late Duke of Atholl, whose name must henceforth occupy a conspicuous place in the list of those who have eminently benefited their country.

COLLECTION OF LODGEPOLE PINE SEED FROM BRITISH CROPS

By R. F. WOOD, M. V. EDWARDS, and J. D. MATTHEWS
Research Branch

The selection of seed stands of lodgepole pine cannot yet be based on any very firm principles because the question of their provenance is such an important factor. As yet our provenance experiments are not old enough to give any long term data. Even the oldest stands of lodgepole pine in the country are few and of uncertain origin, and are only some 40 years old.

The various provenances in our collections may be grouped according to their geographical locations as follows:—

Coastal	These vary from the coarse "shore pine" type to the lodgepole pine type, e.g. Coast of British Columbia, Queen Charlotte Islands, Coastal U.S.A., Olympic Peninsula.
Skeena River	Near-maritime type of climate and "lodgepole" type of tree, e.g. Terrace, Hazelton.
Interior of British Columbia	Lodgepole type, e.g. Prince George, Shuswap, Kamloops, Clearwater.
Interior of U.S.A.	Lodgepole type, e.g. East Washington, East Oregon.
Areas East of Rocky Mountains	Lodgepole type, e.g. Alberta, Idaho, Montana.

There are indications that the behaviour of the provenances in this country differs between these various groups, but this cannot be decided until the results of the experiments have been worked out in more detail. However, some conclusions have already been reached.

(1) Northern provenance experiments, (i.e. from Achnashellach to Allerston) afford undoubted evidence that the Coastal U.S.A. provenances are markedly more vigorous than any others. They look dark green and healthy, but they are branchy and the stems are often coarse. The same form is apparent in coastal lots from further north, but their vigour is less, and in the case of one lot from Queen Charlotte Islands only similar to mountain pine.

The oldest coastal plot (Culbin Compartment 53, Experiment 2.P.22, now sample plots 136 and 137) was of typical coastal form in early youth, but the improvement in its appearance as evidenced by photographs is very marked. It now includes a high proportion of Class 1 stems.

On sites covered with dense heather, or severely exposed, the bushy form of the coastal type is, of course, an advantage during the establishment phase.

(2) At the other extreme, the most easterly Canadian lot, from Alberta (Id. No. 26/58 probably from near Kananaskis on the east of the Rockies) has long been commented on as a particularly good type, from the point of view of good stem form and appearance. Evidence from experiments shows that it is relatively slow-growing. However, the occurrences of frost damage and fungal attack investigated by Mr. W. R. Day, and reported in Imperial Forestry Institute Annual Reports, were only found on this provenance, and since then it has been noted to shed its needles freely, sometimes even two-year-old needles yellowing and dropping off. Experiments at Inchnacardoch and Glen Righ have been seriously affected, and in many forests in eastern and other parts of Scotland the same has been reported. There is little or no evidence that a fungus is the primary cause, although *Lophodermium* has been suspected, and the trouble is perhaps due to the inherent unsuitability of trees of this provenance to our climate.

(3) The bulk of lodgepole pine seed imported into this country has been from the interior valleys of British Columbia or Washington, Oregon, etc. midway between the summit of the Rocky Mountains and the coast. Trees of these provenances are not easily separated, even in provenance experiments, but their foliage is usually yellower in colour than the coastal lots, and they are intermediate in vigour between the fastest coastal and the Alberta provenances. The stem form is usually good. Some of the inland U.S.A. lots appear to retain their needles for only an extremely short time.

(4) Work on climatic matching suggests that we should use coastal strains in this country, except possibly in the more Continental parts of England, and it will be seen that there are in fact suggestions in the growth of our young crops of lodgepole pine that these inferences are correct. It remains to be seen whether at later stages of life the inland provenances recover from their unhealthy appearance, or whether their troubles get more serious, when increment will probably fall off and attacks by various pests increase.

(5) There are areas in England and Wales, for example, the poorer sites on the Bagshot Sands, certain Cornish Heaths (Wilsey Down, Cornwall) and certain central Welsh sites with strongly maritime climatic characteristics (Tarenig, Cardigan, and Myherin, Montgomery), where the performance of inland provenances has been particularly disappointing. In some instances, there has been complete failure to form a crop. On *some* of these sites the performance of coastal origin has been noticeably better. Particular caution is needed in the use of lodgepole pine on these sites, and full attention must be paid to the origin of the seed. Any home collection of seed for such sites should be restricted to plantations of coastal origins.

(6) In the past we have collected seed from all crops of lodgepole pine as there has not been sufficient evidence to exclude any as unsuitable. It might be expected that any crops which have passed through the nursery stage in this country and survived as a forest crop will yield seed which will be of value to us and quite possibly more suitable than seed of the same provenance imported direct from America. One generation in this country may weed out the weakest individuals. Such may have been the case in the past with European larch.

(7) In conclusion, we are beginning to have indications that the most easterly inland provenances may be climatically unsuitable. In spite of their attractive appearance in youth, we should therefore bar the collecting of seed from crops known to be of provenances from the east of the Rockies, i.e.

Alberta, Montana, and Idaho. Seed from all other provenances which have yielded vigorous and healthy stands of reasonably good form should be collected, and every effort should be made to ascertain and record the provenance of such stands. It is also important to ensure that provenance records of the progenies are carefully maintained, so that in say twenty years when the critical provenance experiments will have yielded more definite information, it will be possible to take any necessary action with regard to other crops which may then exist.

VARIATION IN BRANCH FORM IN THE PROGENY OF INDIVIDUAL JAPANESE LARCH TREES

By R. LINES
District Officer, Research Branch

Three experiments were planted in 1939-40 at the forests of Achnashellach, Wester Ross; Clashindarroch, Aberdeenshire and Corriedoo, Kirkcudbrightshire to compare the progenies of twelve individual Japanese larch trees. The seed had been collected in Japan by the Chief of Planting, Tokio District, and was supplied by Kyushu University, together with descriptions of each parent tree.

The trees are yet young and significant differences in rate of growth are found only at Clashindarroch, where the site of the experiment is the most uniform. There it was noted that the progeny of the most vigorous parent trees were growing fastest (*Report on Forest Research*, 1949, p. 52), and this is being maintained.

In 1945, differences in the form of the plants at Corriedoo were recorded, and in April 1953 these differences were described in more detail. Certain of the progenies were then characterised as "fine and bushy-branched", having numerous twigs. The branches on others were noted as stiffer and with fewer branchlets. The same differences have since been noted in the other experiments. No records exist of the characteristics of the finer branches of the parent trees.

These differences have since been defined by von Schrötter (1954) as "fine-slender" and "coarse-stiff", and the chief characteristics of the extreme forms as seen in these experiments are as follows:—

Coarse-stiff: These have a good stem form, straight and erect even on rather exposed sites. They have long stiff side branches which bear few secondary and tertiary branches. These secondary branches are seldom arranged in one plane but stand out stiffly all round the branch. There are more short shoots per lineal inch of long shoot than in the other type. (See Fig. 1). Owing to the sparse branching, this type does not suppress the vegetation so quickly as the "fine-slender" type. No clear indication can be obtained from the survival figures as to which type is superior, as at Achnashellach the "coarse-stiff" type is the best, whereas at Corriedoo the "fine-slender" type is best. At Clashindarroch there seems to be little difference.

Fine-slender: Though sheltered trees inside the plots seem to preserve a reasonable stem form, in general these have a very tortuous stem and a tendency

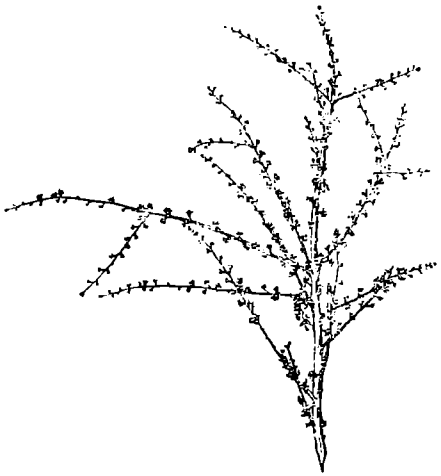

Fig. 1 Characteristic branch of the "coarse-stiff" type of Japanese larch.

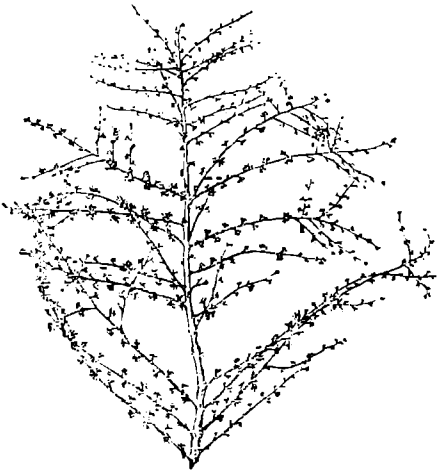

Fig. 2 Characteristic branch of the "fine-slender" type of Japanese larch.

for leader dominance to be lost, producing forked trees with several leaders. On windy sites many stems lean. The trees have a large number of fine slender side branches, sometimes slightly pendulous but never so straight and persistent as the other type. Each side branch has large numbers of secondary and tertiary branches and on the lower branches these are most often arranged in a horizontal plane like a silver fir. There are fewer short shoots per lineal inch of long shoot than in the "coarse-stiff" type. (See Fig. 2). At Corriedoo in particular, the canopy is fully closed and vegetation suppression is well under way in this type, whereas in the former the ground flora is still vigorous.

There is no great difference in flushing time; if anything, the "fine-slender" type is earlier.

In the spring of 1955 the experiment at Corriedoo was assessed for the percentage of survivors which had a reasonably good stem form. This assessment was based on the numbers of plants surviving in 1949, so that where deaths have occurred since there are slight discrepancies. At the same time a branch count was done as follows:—In each intensive plot an accessible and fully illuminated side branch was selected from the most vigorous tree. The number of secondary and tertiary branches in the terminal two feet of this branch were then counted. There were nearly three times as many branchlets on the most definite "fine-slender" type as compared with the most definite "coarse-stiff" type.

These morphological characters clearly have important silvicultural values, and for most purposes an intermediate form having the straight stem characteristic, combined with at least moderately good vigour and enough bushiness to provide early vegetation suppression, seems desirable. For firebreaks, the bushiest type possible is desirable, whereas for mixtures with other species one of the finer-branched types would be preferable.

These experiments tend to confirm the conclusions reached in others, namely that there are no marked broad differences between Japanese larch trees from different geographical areas in Japan, although there is considerable

individual difference. (*Report on Forest Research*, 1952, p. 52 and Matthews, 1954).

References:—Matthews, J. D. *Japanese Larches at Dunkeld, Perthshire* (Forest Record No. 25), 1954.

von Schrötter, F. W. "Uber zwei Typen der Japanlärche in Schleswig-Holstein". *Zeit. für Forstgenetik und Forstpflanzenzüchtung* 3 (2), p. 33. 1954.

WHENCE THOSE HOPS?

By H. L. EDLIN
District Officer, Publications

The spent hops that prove so potent a fertiliser in forest nurseries in so many parts of the country, have their origin in only two or three districts, and there must be many foresters who have never seen the growing crop. There is a substantial hop-growing district on the borders of Herefordshire and Worcestershire, and a much smaller one around Alton in Hampshire, close to Alice Holt Forest, but the great bulk of the crop is grown in Kent. The crop is normally a profitable one, but since over-production would lead to uneconomic prices, the acreage devoted to it is restricted by law, and only certain farmers have a quota of hop-growing land.

A hop-garden, as the small field of five or ten acres devoted to this singular crop is usually called, must be situated on fertile, well-drained soil, in a warm district, and should enjoy a high degree of shelter from wind. The rolling Kentish countryside, with its little hills and vales, scattered woods, orchards and hedgerow trees, provides excellent conditions, but even so most growers take an exceptional precaution against wind damage. This is to grow a hawthorn hedge ten or twelve feet high, quite narrow and closely trimmed, around each garden—an excellent object lesson to those who doubt the value of shelterbelts as protection for crops or stock.

Since the hop plant takes the form of a vine or climber, it needs support, and this is provided by an elaborate and expensive system of poles, wires, and twine. The main supports are the "king-poles", of stout chestnut, about fourteen feet long by eight inches butt diameter, with two feet or so buried below ground level. Although sweet chestnut is such a durable wood, the growers find it worth while to creosote the butts by the open-tank, hot-and-cold treatment, which gives added life to the thin sapwood zone; creosoting tanks may be seen on practically every farm. There is a steady demand for such poles, for renewals, and many are supplied from Commission forests, but each pole has a life of many years, and the structure is quite a permanent one. The galvanised steel wires that run horizontally from pole to pole are also permanent. They support vertical or slanting lengths of twine that run down to pegs at ground level, on one or another of several patterns. This twine is renewed each year; endless miles of it are strung up each spring and cut down with the crop each autumn.

Occasionally, one finds a garden still run on an older system, under which the hop bines climb up lighter poles, only a few inches in diameter, cut from the chestnut coppices and supported by overhead ropework.

Incidentally, there are many private woodlands and quite a few Commission forests—Bedgebury, Hemsted, and Challock are examples—situated in and around the hop gardens. But, as those in charge are only too well aware, the soils in those areas left under woodland are usually far inferior to those on the other areas—often adjacent—devoted to agricultural crops.

The hop plant spends the winter as a rhizome, grown from a cutting and set some six feet apart from its neighbours. The crop is always heavily manured, with phosphates especially in spring, and nitrogenous manures later. Organic manures are applied liberally, including shoddy or woollen waste from the Yorkshire textile mills, rags, fur waste, and fish manure; this may help to explain the high phosphate content of the spent hops. In spring the rhizome sends out climbing shoots, two or three of which are trained, by hand, to climb up the twine or pole. Each plant is of one sex, and as the males yield no fruits, only a few are planted per acre, just enough to ensure the fertilisation of the female flowers. The leaves, borne along the twining stem, are three-lobed with a serrated edge, while the flowers are small and inconspicuous.

By September, the clusters of ripening fruits are turning from green to golden yellow. The conspicuous parts of each oval cluster are simply bracts, the actual fruits lying at their bases. These bracts are covered in golden glandular grains, called "hop-meal", which contains the flavouring agent lupulin, for which alone the hops are grown. The crop must now be harvested quickly, and local labour is reinforced by thousands of "hoppers", who move out from East and South London in families, to spend a fortnight or so in encampments—nowadays usually permanent buildings of brick or timber—amid the fields. Incidentally, this provides another demand for forest produce as the farmers, by custom, provide them with stacks of firewood and kindling. The hop bines are torn down by the pickers, who strip off the hops with nimble fingers, over sacking cribs, and then pack them into sacks. A machine has been devised for picking, yet many growers still prefer to engage gangs; the difference in cost is slight, as the machine must stand idle for most of the year, incurring capital charges; while a breakdown in the short picking season would entail heavy loss.

The green hops are promptly despatched to the oast houses, those curious round buildings with conical roofs seen only in hop-growing country. There they are laid a foot deep on "floors" of hair cloth, over fires of anthracite, which dry them with a slow smokeless, heat. The dried hops are next packed in big sacks, or "pockets", and sent to the breweries. Years ago, charcoal was the main fuel in the oasthouses, which led to a thriving industry of charcoal burning amid the Kentish woods.

Although the hops are said to improve the keeping quality of the beer, their main purpose is to impart a bitter flavour. After this bitter principle has been extracted, their work is done, and the brown "spent hops", sodden with moisture, are disposed of by the brewers to farmers who will take them away by the lorry load. Sometimes a charge is made, but in some districts they are, occasionally at least, given away. This is where the Commission comes into the picture, because hops provide a first-class organic manure, rich in elements essential for the growth of tree seedlings. Moreover they are cheap, available in nearly all parts of the country for little more than the cost of transport from the nearest brewery, and absolutely weed-free; while they break down readily and have no harmful effects on nursery soil. Elaborate formulae have been worked out for making them into composts, with the aid of dried blood or other active ingredients. But many foresters have secured equally good results simply by leaving the pure hops in heaps to ferment awhile, and do their own composting.

It will be seen from the foregoing account that the cultivation and preparation of hops is an expensive procedure. If ever the supply from the breweries failed, it would be out of the question to grow them just as manure. But as a by-product from a luxury trade—if beer can be classed as a luxury—they are a very valuable aid to our work of growing forest trees by the million.

NOTES ON PLOUGHING EQUIPMENT

By T. J. SARGEANT
Engineering Branch

The Cuthbertson Drainage Plough

(See Photos. 8 to 12)

The Cuthbertson drainage plough was primarily designed and developed as a speedy and economic means of cutting open hill drains, thereby improving the grass on land which was becoming derelict. It was soon seen that this machine, fitted with a different mouldboard from that used for hill drainage (Type H) could be an excellent piece of equipment for purposes of afforestation under certain peaty ground conditions. Experiments were therefore carried out with the result that a single-furrow mouldboard known as Type F was developed for forestry purposes. Further experiments took place and a double-furrow mouldboard known as Type P was developed. Both types of mouldboards are interchangeable on the same machine.

Description of Cuthbertson Drainage Machine fitted with Single Furrow Type "F" Mouldboard

The Cuthbertson drainage machine is made up of the following parts:—

(*a*) Drawbar arrangement with collar and shear pin manufactured from mild steel, for attaching the plough to the tractor. A bollard is placed at the forward end of the draw bar over which the wire rope is secured when it is required to haul the plough from a stationary tractor. The shear pin protects the machine from excessive strain.

(*b*) The main beam, a prefabricated box section of mild steel, forming the link between the drawbar and the mouldboard.

(*c*) Cross shaft to which the discs are attached.

(*d*) Two cutting discs 36 inches in diameter.

(*e*) Transverse spring connected to the forward end of the disc arm enabling the disc to ride over obstacles without damage.

(*f*) Stabiliser which is attached to the beam passing inside the stabiliser tube.

(*g*) Transport arrangement comprising two broad wheels, portal with stub axles, a connecting jib for suspension on the beam and a bracket for carrying the stabiliser tube.

(*h*) Mouldboard comprising a share, heel, mouldboard body and trailing mouldboard. The mouldboard body and trailing mouldboard are of mild steel. The share and heel are of chilled cast steel with hardened surface edges where excessive wear occurs.

(*i*) Hoist tackle to enable the plough to be lifted from the operating position to the carrying position on the frame. It is necessary to have a power driven winch on the tractor to operate the hoist tackle.

Description of Type P

As for Type F with the following modifications:—

(*a*) Double furrow mouldboard.

(*b*) A 21 inch diameter tooth-edged central disc.

(*c*) Transverse cutter (optional).

Setting the Plough to Correct Depth

The depth of the drain is controlled by the angle of the mouldboard, which when once set correctly will maintain a level bottom to the drain irrespective of the undulations of the ground.

There are two methods of setting the plough to the required depth:—

(*a*) By means of the draw bar quadrant plates (first phase).

(*b*) By means of the jackscrew arrangement housed at the rear of the mouldboard.

Both methods should be used in conjunction with one another:—

(*a*) for approximate depth—(*b*) for final and exact requirements.

In presetting the depth by method (*a*) the following should be noted. There are three holes in the drawbar quadrant plates—when the securing bolt is in the topmost hole the plough from this method of adjustment is set to plough its shallowest. To increase the depth of drain, set the securing bolt in the hole nearest the ground that gives a depth of drain nearest to that required. To check the depth of drain the plough should be moved forward a few feet and the actual drain cut measured.

To obtain final setting of the mouldboard by method (*b*) the following is the procedure.

(1) Having checked off the depth of drain that is being cut by method (*a*) determine whether the mouldboard has to be set to increase or decrease the depth of drain required.

(2) Slacken off the four bolts securing the mouldboard to the main beam.

(3) To increase the depth of drain unscrew the jackscrew behind the mouldboard. Move the plough forward a few feet and check depth of drain. If correct tighten up securing bolts—if not then repeat procedure until desired setting is obtained.

(*b*) To decrease the depth of drain first slacken off the lock nut on the jackscrew and then tighten up the jackscrew. Move the plough forward and check depth of drain. If correct, tighten the lock nut and the securing bolts. If not correct, repeat until desired depth is obtained.

Note: The winch rope must always be slackened off when the plough is being set.

All adjustments are correct when the heel of the mouldboard presses firmly into the bottom of the drain and the required depth of drain is cut.

Setting the Discs

It is essential if a neat and tidy drain is to be cut that the 36-inch diameter discs be set correctly, both as to width and depth. This naturally varies with the

type of surface vegetation—ground conditions—i.e. mineral soil or peat—and the depth of drain to be cut. In some instances it may be necessary to bring in the discs past the line of the mouldboard but the following details will serve as a guide.

Shallow Drain: 8″– 9″—Discs in line with or up to ½″ clearance of the mouldboard.

Medium Drain: 10″–15″—Up to 1″ clearance.

Deep Drain: 16″–24″—Up to 2″ clearance.

Care should be taken to see that the discs are set to cut through top vegetation and root system only. The cutting depth of the discs is controlled by the bolt connecting the disc arm to the transverse spring link. The bolt should be removed and the discs lowered or raised according to requirements. Six holes in the transverse spring link make adequate allowance for setting the discs to correct depth.

Both the mouldboard and the discs, when the machine is operating on molinia peat or mineral soils, can be set to cut a drain to almost precise dimensions.

On fibrous peat (basin peat) or pseudo-fibrous peat (hill peat) the setting of the plough to cut a drain or furrow slice of desired dimensions is a matter of trial and error. Generally speaking it will be found that under these conditions both the mouldboard and the discs will need to be set deeper and wider to produce the required furrow slice than on molinia peat or a mineral soil.

The fact that the edges of the drain are ragged is an indication that the discs are set "too close".

Uses of the Cuthbertson Draining Plough

The "Cuthbertson" used as intended by its designer is an efficient and economic machine. Its main uses for forestry purposes are on the wetter and more peaty soils where it may be considered that turf planting is a cultural requirement. Depending on ground conditions type F and type P may be used in conjunction with one another or alternatively alone. Where a main drainage system is required, however, type F must always be used, due to the fact that type P is not designed to cut a drain to the depth normally required.

Type F is primarily a drainage machine and would almost inevitably be used on the wetter grounds where it would be operated at the desired spacings from five feet upwards. Wherever possible and subject to silvicultural requirements, the closer spacings should be adopted in order to make maximum financial savings. When used at the wider spacings hand cutting and spreading of turves—a very costly item—has to be undertaken.

There are, however, cases where ploughing at the closer spacings is not practicable and in some cases may not be considered desirable. An example of this may be ground conditions where the constant turning round of an outfit in a confined space may lead to a danger of bogging. A bogged machine is useless and can well lead to a considerable wastage of funds. In addition, a tractor that has been badly bogged may be put out of action for some time due to the need to strip down and examine the working mechanism. This is particularly important where it is suspected that water—particularly peaty water—has percolated to the working parts.

It is of paramount importance that the full silvicultural requirements of any area are carefully worked out *before* any outfit is set to work. Road alignments,

rides, grazing strips and compartment boundaries should be set out well in advance of the mechanical operations. This will eliminate wastage of machine hours and where a large programme has to be carried out, will lead to considerable financial savings in an increased output per machine hour.

The topography of the ground should be carefully studied—existing natural and artificial drainage channels in the form of streams, sykes, sheep drains, etc., should be carefully studied. Care should be taken to ensure that all furrows cut for the provision of turves for planting are so aligned that they feed into new main drains to be cut and thence to the natural outlet. In some cases furrows may well feed direct into the natural outlet.

It should be remembered that for differing types of soil conditions there is an optimum gradient for both main drains and furrows ploughed for the provision of turves. Main drains particularly should be so sited that they will perform efficiently the work intended. They should be at a gradient that will enable them to take away surplus water and be as near as is practicable self-cleaning. If sited at too steep a gradient they can well result in serious erosion—if at too flat a gradient they will not function efficiently—may choke up very easily—and on steep side slopes under certain soil conditions may well lead to serious land slips.

The type P Cuthbertson is essentially a "planting" rather than a "drainage" machine. It has been designed as a "provider of turves for planting". Normally it is set to cut a furrow slice from 6 to 9 inches in depth and operates most efficiently on "molinia peat-deep", or "molinia peat-shallow" with a mineral soil below, or on a light mineral soil. The draw bar pull required to haul it is similar to the type P, i.e. a class IV Crawler Tractor—P.D.3—T.D.9 or D.4, etc. A central tooth-edged disc 21 inches in diameter splits the furrow slice in two equal sections. The mouldboard lifts and spreads the resultant furrow slices left and right at 5 inch spacings centre to centre.

The great benefit of this machine is that it automatically doubles the output of furrow slice available for planting purposes, thereby reducing the cost of preparation of ground for planting by half. In addition, where fire danger has to be considered, some additional benefit does accrue due to the increased area of suppression of surface vegetation.

Both machines type F and P are operated and adjusted in a similar manner. When required to move across country, the power winch on the tractor is operated to lift the main beam and mouldboard into its carrying position on the frame where it is suspended by means of the trip carrier catch. To release the trip carrier catch in order to get the plough into action, the plough must be lifted slightly by the power winch to clean; the trip catch is then pulled forward by means of the light rope which extends forward to the tractor. The brake is then released from the winch and the plough falls to the ground. On forward movement of the tractor, the plough digs itself into the ground to the predetermined depth.

Whilst the plough is in operation it is not supported on the transport wheels.

The mechanical preparation of ground is a means to an end; the end is the efficient establishment of a successful plantation with the greatest economy of expenditure. No effort should be spared to ensure that all mechanical equipment is used efficiently and in the manner intended—the object should not only be for the machine to earn its keep—it should make a profit in that it should carry out work cheaper than any other means.

Other Uses of the Cuthbertson Drainage Plough

In addition to its use for ploughing for planting the Cuthbertson type F has been successfully used for the close ploughing of rides for fire protection on the deeper peaty ground. The procedure is to use the machine in a similar manner to agricultural ploughing, the resulting furrow slices being disced by the use of heavy disc harrows to provide a fireproof strip.

On the deeper peats this can be a somewhat difficult operation due to the fact that one track of the crawler tractor used has to travel in the drain cut (after the first furrow slice) in order to obtain close spacing. This difficulty can be overcome by using two crawler tractors in tandem. The first machine is coupled to the second machine by a ten to fifteen yard length of one-inch steel wire rope and travels on the unbroken surface, slightly offset to the tractor directly coupled to the plough. This has eliminated the serious danger of bogging. The plough is normally set for this work to its maximum limitations as to width and depth.

The type F Cuthbertson has also proved to be the most economic means of cutting new drains alongside forest road projects. The plough can be operated to throw the furrow slice in towards the road, or outwards, simply by the direction of travel. When used to throw the furrow slice in towards the road the furrow slice is used to assist in the formation of the berms.

Motive Power or Drawbar Pull required to Haul the Plough

The drawbar pull required to haul the "Cuthbertson" varies according to the ground conditions on which it is to operate and the depth of drain it is set to cut. On relatively easy conditions and set to cut a shallow drain, the drawbar pull required may be as low as 4,000 lbs. Set to its maximum depth and width, the drawbar pull required when operating purely for drainage may be about 10,000 lbs. For normal forest purposes under average conditions, the drawbar pull required will be in the region of 6,000 lbs.

It will thus be seen that for most areas the Class IV Tractor i.e. Fowler F.D.3, International T.D.9—Caterpillar D.4—Fowler Marshall V.F. are well suited to haul the "Cuthbertson". Most of the Class IV Crawler Tractors have a maximum drawbar pull between 9,000 and 10,000 lbs.

Output per Machine-Hour Type F and P

Output in chains cut per machine-hour is very similar for both types of machine when engaged on "ploughing for planting". The point to be borne in mind however is that type P cuts the furrow slice in two sections, making available double the amount of turf for planting purposes. The great advantage of the type P machine is that it automatically halves the cost of "preparation of ground", and reduces very considerably the capital that needs to be laid out in "new tractors". It can also lead to the making available of the motive power for other forestry operations in that the time taken to plough a given area is halved.

The following are some of the points that materially affect the output per machine hour.

(*a*) The mechanical efficiency of the tractor and plough.

(*b*) The skill of the operator.

(*c*) The correct setting of the plough.

(*d*) Topography of the ground etc.

DIMENSIONS OF CUTHBERTSON PLOUGHS

Type	Overall Dimensions				Weight	Maximum Drain Dimensions			Class of Trailer required to Pull
	Length	Width	Height from ground to top of Portal	Height from ground to top of Stabiliser		Depth	Width at top of Drain	Width at bottom of Drain	
F Old	18 ft. 9 in.	8 ft. 3 in.	7 ft.	10 ft.	T. C. Q. 1 11 1	24 in.	34 in.	12 in.	IV
P New	18 ft. 9 in.	7 ft. 8 in.	7 ft.	10 ft.	1 11 0	24 in.	34 in.	12 in.	IV
F	18 ft. 9 in.	7 ft. 8 in.	7 ft.	10 ft.	1 12 0	—	—	—	IV

Taking all things into consideration and averaging out ground conditions a Class IV tractor fitted with tracks of a width suitable to the ground conditions upon which it is to operate should throughout the whole of a ploughing season average 100 chains of drain cut per machine-hour worked. At five-foot spacings, using type F mouldboard, this equals 0.75 acres—with type P mouldboard it equals 1½ acres.

It is imperative that every incentive possible is given to tractor operators engaged on ploughing for planting. When weather conditions are favourable they should be encouraged to work as long hours as can be considered reasonable. In addition bonus rates should be paid for good work and good output. Where bonus is paid, a weekly target in acres should always be given. Alternatively if conditions warrant it a piecework rate may be more suitable.

It is essential that machines are not allowed to stand idle—all waste time should be completely eliminated. A loss of one hour per day per machine is equivalent to a loss in the course of a year of *over* £300 *per machine.*

Maintenance

The maintenance of the Cuthbertson drainage plough requires the following attention:—

The lubricating points should be greased daily. The wheel grease caps should be filled with grease once per week.

When a plough has completed its annual ploughing programme it should be thoroughly cleaned down and the main body, if necessary, repainted. Those part subjected to wear and probably rust should be painted with a black bitumastic paint—i.e. mouldboard body, trailing mouldboard, and discs.

The plough should always be taken to the nearest depot and garaged if it is likely to be out of action for some time.

THE BEGG HILL PLOUGH

(See Photos. 12 and 15)

The Begg hill plough has been developed for forestry purposes as a light plough to provide the silvicultural requirements primarily on the better type of "hill land". It has been developed in three stages and the current model known as: Hill Type No. 3 has proved to be a very efficient machine when used on the type of ground for which it has been designed.

Description of Begg Plough

The plough is composed of the following main parts:—

(*a*) The drawbar arrangement for connecting the plough to the tractor.

(*b*) The main beam—a box section of prefabricated steel.

(*c*) The main body unit of the plough.

(*d*) The mouldboard, which is welded direct to the main body unit. A mouldboard tail is affixed to push the furrow slice clear of the drain.

(*e*) The transport arrangement comprising two broad wheels on a U-shaped axle, the whole being supported beneath the main beam by two brackets.

(*f*) The disc assembly being a single 18 inch diameter disc supported by two arms attached to a bracket on the forward end of the main beam.

(*g*) The trip mechanism for lifting and carrying the plough when not in action.

(*h*) A sole shoe welded direct on to the main body unit of the plough.

(*i*) The share which slides into the main body unit and is held in position by one bolt.

(*j*) The depth control quadrant.

Setting the Disc

Only one adjustment is necessary to the disc, and this is in respect of the cutting depth. Holes provided at the point of fixture to the forward stiffening bracket permit of raising or lowering the cutting depth.

It should be noted that under certain soil conditions this plough operates quite successfully, due to the design of the share, without the disc.

Use of the Begg No. 3 Hill Type Plough

The Begg No. 3 Hill type plough is a light and efficient plough and is mainly used for forestry purposes on the better type of hill land where a furrow slice of moderate depth is required.

Depending on ground types, it may be used alone to provide the cultural requirements, or as is frequently the case, in conjunction with other types of plough, mainly the Cuthbertson. Where this takes place the Cuthbertson would normally undertake the more difficult ground leaving the easier areas to the Begg. It operates most efficiently on a light mineral soil with a light vegetation of mixed grasses or on shallow peat (3 to 4 inches) with a mineral soil below.

The plough can be set to cut a drain of from 10 to 12 inches in depth with a maximum width at the top of 21 inches and 13½ inches at the bottom. The normal setting however is to provide a furrow slice of from 6 to 8 inches in depth.

The use of the disc, under certain soil conditions and light surface vegetation, is optional. When the disc is not used, however, the quality of the work would be somewhat ragged. The disc should normally be set to cut through the root system of the surface vegetation.

When required to move across country the trip mechanism is put into action to lift the plough into its carrying position. To do this the cord from the trip lever to the tractor is pulled and by so doing sets in motion the trip mechanism. This causes the U-axle to move from a horizontal position to a vertical position, thereby keeping the plough clear of the ground.

To engage the plough simply haul on the release cord going forward from the plough to the tractor. The plough then falls to the ground and on the forward movement of the tractor digs itself in to the pre-determined depth.

The ideal ploughing position is to have the sole shoe marking along its entire length the bottom of the furrow, i.e. the plough must run level.

The Begg plough should not be used on the following types of ground.

(*a*) Where it will frequently come up against large stones.

(*b*) Where there is a growth of heavy surface vegetation.

Setting the Plough to Correct Depth.

This is a simple matter and is carried out by altering the position of the pin in the holes provided for this purpose, in the extension bar to the depth control quadrant. The plough is set to cut its deepest furrow when the pin is in the most forward hole.

Motive Power or Drawbar Pull required to Haul the Begg Plough

The drawbar pull required to haul the Begg No. 3 Hill type plough varies according to the ground conditions and the depth it is set to plough. Operating under the conditions for which it has been designed, and varying with the depth to which it has been set, the drawbar pull required may vary from 2,000 to 6,000 lb.; in extremely difficult ground a drawbar pull in excess of 6,000 lb. may be necessary but this is the exception rather than the rule. For normal forest purposes under average conditions the drawbar pull required will be in the region of from 3,500-4,000 lb.

It will thus be seen that any tractor, wheeled, half-tracked, or full-tracked, falling within the Class V category will haul the Begg plough under average conditions. The need to use wheeled, half track, or full track depends on the soil conditions—i.e. danger of bogging—dry or wet condition and the topography of the ground, i.e. side slopes of varying gradients.

Maintenance of Begg Plough

This is a simple matter covering the points detailed below. Each point mentioned should be oiled daily.

(*a*) The pin in the swivelling coupling on the forward end of the draw bar.

(*b*) The hinge pin connecting the drawbar to the forward stiffening bracket.

(*c*) The disc bearing and the pin fixing the disc arms to the forward bracket.

(*d*) Wheel bearings.

(*e*) Pin connecting the depth control quadrant and bar.

(*f*) The plain bearings in the bracket supporting the U-axle to the main beam.

(*g*) Plain bearings, racket, quadrant and pins of the trip mechanism.

After completing its operations for a season, the plough should be thoroughly cleaned down and the body if necessary painted. The share, mouldboard and sole shoe should either be given a liberal coating of grease or painted over with black bitumastic paint. It is essential that the plough be put into store when not in use.

RUSSELL'S R.L.R. PLOUGH MK. II

(See Photos. 13 and 14)

The R.L.R. plough was produced as a single mouldboard type of plough to provide the desired cultivation for purposes of afforestation on the heavier soil types such as those found on the North Yorkshire Moors. In principle it is similar to the normal agricultural plough but of more robust construction.

Description of R.L.R. Plough

The R.L.R. plough is composed of the following main parts:

(*a*) *Drawbar attachment*—The means of connecting the plough to the tractor. It is adjustable in three positions vertically for drawbar height. Provision is also made to "off set" the plough when necessary.

(*b*) *Main frame*—Is made of individual component parts of 6 inch by 1 inch steel to facilitate repair when necessary.

(*c*) *Transport Arrangement*—Composed of $2\frac{1}{4}$ inch diameter solid steel U-shaped axle, two land wheels 3 feet 6 inch in diameter with 6 inch tread, and a rear swivel wheel 2 feet 3 inch in diameter mounted in a heavy-duty fork. A wheel scraper is also fitted. The ends of the U-axle are turned to form stub axles for the two land wheels, the whole being fixed to the top of the main frame by two split plain bearings.

(*d*) *Self Lift Mechanism*—Consisting of a pair of "grab arms" which are brought into action by hauling on the rope extending from the trip lever forwards to the tractor. This causes the hooked or curved end of the "grab arms" to engage the lift rollers fitted to annular rings on each side of the land wheels, thereby bringing the axle to a vertical position and lifting the plough out of the ground.

(*e*) *Main body of Plough*—Of laminated steel construction curved at the forward end to take the Killifer sections. The land side is fitted with replaceable wearing plates. The body is mounted into the frame in a manner that permits of some flexibility, i.e. it is not a rigid fixture.

(*f*) *Point*—Which is fitted in the form of a shoe to the forward end of the main body and held in position by a retaining bolt.

(*g*) *Share*—Made in two sizes 16 inches or 22 inches, depending on the width of furrow slice required.

(*h*) *Mouldboard*—Which is made up in two sections, each being renewable. A tail piece is provided for use when necessary. The mouldboard is attached to the main body of the plough.

(*i*) *Discs—Central and Side*—A central disc 21 inches in diameter is fitted forward of the main body and can be adjusted laterally and for depth. Lateral adjustment is by spacing rings and depth by means of the clamping bracket.

A side swivelling disc coulter is available for use when necessary.

(*j*) *Depth-control Mechanism*—Operated by a screwed handle which, through a system of links, controls the angle of the U-axle and also the height of the rear wheel.

(*k*) *Locking Pin*—Provided to lock the rear forks when it is necessary to reverse the plough.

Drawbar Pull or Motive Power required to Haul the R.L.R. Plough

The drawbar pull required to haul the R.L.R. plough varies more than any other plough at present being used for purposes of afforestation. The depth to which it is set, and the ground conditions upon which it is operating, result in the need of a drawbar pull that varies from 5,000 to 14,000 lb. In exceptional circumstances even 14,000 lb. may be slightly exceeded.

It will, therefore, be seen that in view of this great variation, the utmost care should be taken in determining the most suitable tractor to haul the plough if the desired silvicultural results are to be obtained.

As a guide to determining the most suitable tractor to be used, the following table gives details of the maximum drawbar pull that is exerted by certain classes of tractor.

Class	*Types*	*Maximum Drawbar Pull, 1st Gear*
II	T.D.18, D.7, etc.	20,000 to 21,300 lb.
III	T.D.14, D.6, etc.	13,500 to 14,300 lb.
IV	T.D.9, D.4, F.D.3, Fowler Marshall V.F.	9,000 lb.

Under average conditions in those areas for which the plough has been designed the drawbar pull required can be considered as being between 7,750 to 8,250 lb.

Setting the R.L.R. Plough to Correct Depth

There are two adjustments for depth control:—

(*a*) The depth control screw.

(*b*) Tilting bracket or cam.

The former is operated by a long handle threaded to take a "barrel nut" or depth control adjusting screw. A lever attached to the "barrel nut" at one end, and a cam fixed to the U-axle at the other end, lift or lower the U-axle as the handle is turned. As the axle is attached to the main frame, this is at the same time raised or lowered. In addition, as the above operation is taking place, so the rear wheel is raised or lowered by a system of levers and cams by the "rear wheel control rod".

To increase the depth of ploughing the U-axle should be lowered, whilst to decrease it the reverse process should be adopted.

The second adjustment (*b*) is a very important feature in the setting of this plough. The main body unit is housed in the frame in the manner of a simple hinge which permits of adjustment in the angle of the mouldboard. It should be particularly borne in mind under two diametrically opposed conditions of ploughing (1) very hard stony ground (2) soft ground conditions. In the case of (1), if set at too steep an angle, severe breakages may occur—if set too steep under conditions as at (2), it may well dig itself in. The ideal setting is a matter of trial and error—careful noting of the quality of the work will soon result in the most suitable setting of the brackets or cams. To increase the depth by this method, the bracket should be moved towards the rear of the plough, the retaining pin or bolt being fixed in the appropriate hole, to give the depth required. It will be noted that the end of the main body unit is stepped. This is to limit the angle at which the mouldboard can be set, and also to provide of some flexibility or up and down movement of the main body unit—a very important feature on rough and stony ground.

Setting the Discs

The forward or central disc is adjusted for depth by placing the securing bolt in one of the adjustment holes in the supporting bracket so as to give the correct cutting depth. Eight holes in the bracket provide ample allowance. Lateral adjustment is by one-inch spacing rings on either side of the disc. The normal setting of the disc is—for depth—to cut through the root system of the surface vegetation—for lateral adjustment—to permit of a two-inch clearance between the disc and the wearing plates on the landside of the main body unit.

The side-swivelling disc is adjustable for depth by easing off the clamping bracket. It is normally only used when a heavy growth of surface vegetation is present, which causes the furrow slice to fall back into the furrow; the disc then serves to cut the vegetation and destroy the "hinge effect". It may also be used on some of the rather heavy and wet clay soils where drainage is a matter of consideration. When used on the latter conditions, the bigger type of tractor is advisable as its extra speed will cause the furrow slice to be thrown almost clear of the furrow, thereby permitting the furrow to operate quite satisfactorily as a drain, at least until such times as the furrow slice has weathered and fallen back.

Use of R.L.R. Plough

The R.L.R. plough is primarily used for purposes of afforestation in those areas where deep cultivation is considered to be the silvicultural requirement. In principle it is similar in design to the majority of agricultural ploughs. It is however built on robust lines to enable it to cope with the more arduous work connected with forestry operations. It is used mainly on the heavier soil types, particularly on heathlands or where a pan is present.

As with all cultivating equipment used for preparing ground, it is essential that the silvicultural requirements are clearly defined before the plough is put into action. Is it a matter of simple cultivation—is drainage a prime factor for consideration—if a pan is present is the fracturing of it a matter of major importance—or is the suppression of weed growth the over-riding factor? It may well be that the requirements are a combination of the above, with other special considerations applicable to individual sites.

Having decided on the requirements, care should be taken to ensure that the plough is fitted up correctly to produce the desired results. There are two shares available for fitting to this plough—a 16-inch and a 22-inch. The latter should be fitted where a broad furrow slice is required, and where suppression of weed growth is a major matter.

Coupled with the above should be the selection of the most suitable tractor to haul the plough to produce in the most economical manner the desired results. It is not practicable to give all the points that need consideration as individual sites may well produce their own peculiarities. The following are some of the points that do need watching:—

Topography of the ground. Is it an area that, irrespective of the alignment of the furrows, can be ploughed two ways, i.e. level or near level ground? Are side slopes involved, and if so are they of a gradient such that if contour or off-contour ploughing is required, the land can be ploughed both ways? If two-way ploughing is adopted will there be a danger of one furrow slice falling back into the furrow? Should this be the case, would ploughing up and down the gradient be possible with a tractor of the correct drawbar pull?

Nature of the ground. Is it good firm ground free from stones—or are boulders likely to be encountered? If so how frequently? Are there any boggy patches in the area that could be ploughed with one type of tractor but not another?

Type of Ploughing. Moderate depth or maximum depth and width.

When required to move across country, the plough is lifted into the carrying position by hauling on the rope that extends forward from the trip lever to the tractor. This causes the "grab arms" to engage with the rollers fitted to the annular rings attached to the inside of the land wheels. This causes the body to be lifted clear of the ground. At the same time that this action is taking place, the rear wheel control rod, through a series of links, raises the rear wheel and keeps the tail of the body clear of the ground.

To engage the plough, haul on the cord attached to the safety catch. This causes the plough to fall to the ground and on the forward movement of the tractor the plough digs itself in to the pre-determined depth. When adjustment to the depth control has been carried out, the tractor and plough should be moved forward and the depth of the furrow measured to check that it is as required.

With all cultivating equipment used for preparing ground, certain points should be carefully borne in mind. The following are particularly applicable to the R.L.R.

(1) The plough should always be lifted clear of the ground before starting to turn. Failure to do this may well result in damage to the main beam or frame.

(2) With crawler tractors the drawbar connection should always be left free to travel the full width of the carrier—it should not be pegged to one position.

(3) At the first tendency to bog—disconnect the plough—do not dig the plough and tractor in—care in this will save many machine-hours. The plough can always be winched out.

(4) Poor quality work may well be caused by one of the following items:—

(*a*) Incorrect setting of the plough.

(*b*) Damaged or worn point, share, land-sides.

(*c*) Discs out of alignment.

(*d*) Drawbar on plough not related to drawbar connection on tractor—too high or too low.

The essence of good work can be summed up as follows:

(1) A highly skilled operator.

(2) Mechanical efficiency of tractor and plough.

(3) Correct setting of the plough.

If the desired results are to be produced in the most economic manner it is essential that all the above points are carefully watched. Operators should be encouraged to take a pride in the quality and output of their machines. It is of the utmost importance that they are given a clear picture of what is required—unless this is done one cannot hope for the best results.

Maintenance of R.L.R. Plough

The following points should be greased or oiled daily:

(*a*) The pins holding the drawbar to the main frame.

(*b*) Bearings to the land wheels and rear wheel.

(*c*) Bearings supporting U-axle to main frame.

(*d*) Depth control mechanism—threads on the control handle, pins through levers or cams, and slide.

(*e*) Disc bearings.

(*f*) Chains fitted to side of frame along which forward end of body rolls.

(*g*) Discs, mouldboard and landside of main body must be smeared with oil or grease at end of each day's work.

(*h*) Pins connected with rear wheel elevator and links.

(*i*) Locking pin hole and bearing in rear forks.

Note: The rollers fitted to the annular rings on the inside of each land wheel should be kept clean and free from dirt. As and when necessary they should be washed down with diesel oil.

ESTABLISHMENT OF HARDWOODS IN SCOTLAND

By R. FAULKNER
District Officer, Research Branch

An experiment to compare several methods of bringing a three-year-old sycamore plantation out of check on a grassy site was established at Brownmoor Forest, Dumfriesshire, in 1954. Treatments under test are stumping the plants, mulching with sawdust, vegetation screefing and top dressings of nitrogen. In addition experiments on the position of planting of oak, sycamore and gean (*Prunus avium*) on tine-ploughed clay soils were planted, and also experiments to compare the performance of pedunculate and sessile oak, red oak and beech. On the marginal hardwood site at Brownmoor, an experiment comparing the effect of different rates of lime applications on the establishment of beech and wych elm was planted.

At Ross Priory, Garadhban Forest, Dunbartonshire, experiments to compare the performance of sessile with pedunculate oak, and beech with *Nothofagus procera* and *N. obliqua*, were planted. A third experiment was established to compare Norway spruce and Lawson cypress as nurses for ash. Plots of sycamore, small- and large-leaved limes, and sweet chestnut were also planted.

On a new area at Saltoun Forest, East Lothian, a provenance experiment comparing beech of South Scottish origins was planted on ploughed ground. In addition, comparison plots of *N. procera*, *N. obliqua* and beech were planted on both ploughed and unploughed ground.

NOTES ON PLANTING PERIODS AND RESULTANT PERCENTAGE OF FAILURE

By B. R. G. HAMMOND
Forester, South-West England

During the last two years, at Moccas and Aconbury Forests in Herefordshire, both of which are new areas, some interesting results have occurred in connection with late planting.

In 1954 the preparation of ground work was not commenced at Moccas until the 7th January, and owing to labour difficulties and a vast rabbit population, the area of forty acres which was scheduled for planting, was not ready for this work until April. The main species used were oak seedlings, and fairly large European larch transplants, and the main planting site was a steep north-facing slope, of heavyish clay loam over old red sandstone.

The weather both during planting, and for a short time afterwards, was very dry, and as the planting was not completed until May the 5th, there was reason to anticipate heavy losses especially in the larch transplants. In actual fact, almost 100 per cent take was the result, and beating up was unnecessary.

Even more startling results have been seen this year, as again planting was seriously delayed both by the bad weather, and very great shortage of labour. The sixty acres of planting at Moccas was completed by only three men and a boy, but not finished until the end of May. A similar site to the previous year was planted, but owing to changes in soil, and rock outcrops on the steeper slopes, with some wet pockets, the species used were oak, Norway spruce, European larch, *Tsuga* and *Thuja*, with some poplar and beech, and a fairly extensive block of Douglas fir.

The Douglas firs were large four-year-old transplants, and when planted were flushing strongly, and it was these that gave most rise for anxiety. As in the previous year, the weather during planting, and for about a fortnight afterwards, was warm and dry, and much against the forward stocks. From preliminary inspection, it appears that again losses are negligible, and the large Douglas firs are showing vigorous growth with no sign of check.

From these results which may of course be merely examples of chance, it does appear however, that good results can be obtained with late planting, if the conditions are not too severe. We did take one or two precautions which may have contributed to the results. The first was to chose the coolest most protected sites for the "heels" or "buries", and where possible, select the wetter pockets.

Secondly the large Douglas firs were heeled very carefully and exceedingly thinly, and we made special efforts to prevent root drying, both by speedy transference from the heel to the planting bags, and by not carrying many plants in the bags—we found by experiment that the larger-rooted trees tended to dry out rapidly, and it was only by leaving them in the heel, and collecting in small quantities which were planted as rapidly as possible, that roots could be kept reasonably moist. This was no doubt more expensive, having to make frequent returns to the heel, but the plant survival has well justified this.

Thirdly, on the steep slopes where standing was very difficult, let alone planting, we had to adopt a system whereby two worked together, one making the holes and the other planting the tree; we made sure the hole digger did not advance more than three plants distance from the planter, to avoid drying of the hole. In this way we found we could plant the steeper slopes considerably faster, and more satisfactorily, than with men working one to a row. This is an important point, as on these steep slopes a man carrying a bag of trees and a spade finds great difficulty in keeping his balance, and the bag tends to slip, and make progress slow and difficult. Whereas with one carrying the bag, and one measuring and digging the holes, the planter can concentrate on securely planting his trees without having to concern himself with spacing or straightness.

Lastly one operation, that of firming up the planting after completion, was carried out immediately. Owing to the dry weather the plants had all been blown by the wind, and as they had not had time for root adhesion to take place, the entire area was walked row by row and every plant refirmed. This operation I am convinced largely contributed to the success of the planting, as there was one small area of about an acre on the top of the hill that was planted with *Tsuga;* as it was planted first we did not firm, and it is in this area that we have suffered some 50 per cent failure.

To sum up I would say judging by this experience, and past experience with beech on dry chalk sites, late planting need not necessarily mean heavy losses, providing:—

(1) Heeling is careful, speedy, and ensures thin positioning of plants in the heel.

(2) Small quantities only be carried at one time by each planter, and that frequent journeys to the heel are justified as plants are kept moist and do not dry out in the bags.

(3) Planting is rapidly done; where two can work more speedily on one row they should do so.

(4) Planting is firmed up thoroughly after completion of planting.

(5) Very careful choice of species is made to ensure as much possible chance of survival. It is better to avoid planting at all if the season is advanced; and if only a species which is not tolerant of the conditions is available for planting.

TREATMENT OF FELLED BROADLEAVED AREAS IN THE MIDLANDS

By R. CARNELL
District Officer, South-West England

Some time ago we were asked to summarise the results which have been obtained in the rehabilitation of devastated woodlands and it was felt then that details of particular areas might be of interest. The types of which the writer has a little experience lie on the heavy boulder clay areas of the East Midlands where considerable areas of oak standards over mixed coppice were felled during the 1939/45 war. Generally speaking, within a couple of years of felling, *Calamagrostis epigeos*, or *C. lanceolata* appeared, followed by coppice re-growth. Where the coppice was dense the *Calamagrostis* gradually disappeared, but where sparse the grasses prevailed and blackthorn came in. These felled areas divide themselves broadly into two main types.

1. Those having a full crop of coppice with heavy grasses and bramble fast disappearing.
2. Those having scattered slow growing coppice together with blackthorn, briar and bramble and an extremely heavy growth of grasses.

In the first type it was found advisable to allow the coppice to grow on until it was (*a*) saleable and (*b*) was of sufficient height that when thinned it would cast sufficient shade so that weeds would not grow profusely and yet pass sufficient light for oak planted underneath to come away. This method was a success at Kesteven Forest, where it was found that once the oak starts to grow the overhead shade has to be removed within five years.

With regard to second type, it is evident that a smothering crop is needed and the success or otherwise of the methods and species used are discussed below.

(*a*) **Complete clearing, draining where necessary and planting with conifers.**

My observations on the species used are as follows:—

European larch is generally poor, cankers and never completely suppresses the rank growth. Japanese larch is also very poor except on

slightly sloping and well drained areas. Corsican pine shows up to advantage, but requires incessant weeding. Once it reaches the thicket stage this species does kill out the rank growth, while Scots pine is very poor, grows rough and is subject to most of the diseases and pests. Douglas fir does well on well drained and slightly sloping ground. Norway spruce is easily the favourite and although slow to start it will completely suppress the grasses and coppice.

(*b*) **Complete clearing and planting a mixture of oak and Norway spruce.** There are various arrangements of these two species, but by far the best seen is at Hazelborough where the two-row by two-row method at four-foot spacing was a marked success.

(*c*) **Cutting strips of widths up to one chain.** Generally it can be said that if the width of the cut strip is over half a chain then the same poor result will be obtained as on a clear-cut area. The best results were given by cutting half a chain and leaving a quarter of a chain.

(*d*) **Cutting groups up to 20 feet square at a density of up to 120 groups per acre.** This method was a marked success at Fermyn, Rockingham Forest, and a dismal failure at Bardney Forest. Weeding is costly and control of weeding gangs is difficult.

(*e*) **Random groups.** These have been resorted to, mainly as an economy measure. These meant the minimum of cutting around any bare areas and planting with oak. The results at Fermyn are fair, but can in no way be described as satisfactory.

A small amount of planting of beech was also carried out, and the general result has been the same as with oak planting, i.e. very slow growth, continual frosting back, and continuous weeding required.

The conclusion reached by the writer was that there was no easy way of rehabilitating these woodland areas. They would need constant attention after planting, and while oak was desirable it would be advisable to mix it with Norway spruce.

It is interesting to record that the late Forester Gulliver who had known the Salcey, Yardley and Hazelborough forests for over sixty years, and whose uncle had been forester before him, informed the writer that the custom in his uncle's time had always been to plant oak with a conifer. The conifers were removed at ages up to sixty years. In passing he mentioned that the normal practice was to plant oak from four to six feet in height!

TREE GROWTH ON ACID SOIL

This article, contributed by Mr. M. V. Laurie, is reprinted from the journal "Nature", by kind permission of the Editor.

A joint session of Sections K (Botany) and K* (Forestry) of the British Association devoted the whole day at Oxford on September 7th, 1954, to a symposium on "The Interactions between Acid Soils and Forest Trees". Biologists whose joint research interests covered a wide variety of subjects combined with practical foresters in an attempt to solve, or at least to restate in simpler terms, the problems of establishment and maintenance of forests on heathy and peaty soils.

Mr. M. V. Laurie, Chief Research Officer of the Forestry Commission, opened the discussion by presenting the foresters' point of view, based upon the thirty-five years' experience of the Commission. He pointed out that much of the land at present available for reafforestation in Britain is acid and that two classes of problems therefore exist. First, the problems concerned with the effects of acid soil on the establishment and growth of trees; and secondly, those concerned with the effects of the trees themselves upon soil fertility. Soil is the working capital of the forester and he has therefore a duty of maintaining it, undiminished in productivity, in perpetuity while producing the right crop of the highest quality.

On the land available, the solution of the problems of tree establishment consumed much of the early effort of the Commission. Preliminary treatments such as ploughing, draining and the application of fertilizers are effective on many sites; but the degree to which they are valuable and the magnitude of the improvement in tree establishment that they produce are not easily predictable. The full interpretation of the results of early successes and failures demands not only long-term experiments on a large scale but also the co-operation of experts. The effectiveness of mixtures of Sitka spruce and Japanese larch or pine, the beneficial effects of broom on spruce growth, and the universally adverse effect of heather on all tree species must be interpreted by ecological experimentation. The stimulation of many species by phosphate on sites where lime and nitrogenous fertilizers are ineffective, requires the co-operation of physiologists and microbiologists for explanation. Microbiologists, too, must assist in helping to determine the rival claims of organic manures and composts as against balanced applications of artificials. All these problems concerned with forest establishment are in the process of being solved with the help of specialists, but the long-term question of fundamental importance—the effect of trees on the soil—remains.

The vigorous forests of young conifers which have been established are undoubtedly changing the soil. In the place of the much-modified heath soils, acid woodland mor with a deep layer of needles is being produced. It is held by many ecologists that mor conditions lead to serious soil degeneration. Two points must be considered in this regard. First and foremost, the demand for timber is mainly a demand for pine and spruce. A supply of poor-quality hardwood, even if such a crop prevented mor formation, would not be economic. Secondly, it would seem that what we believe to be natural northern coniferous forest exists almost exclusively on mor or podsolized soils as a self-regenerating natural forest.

Dr. G. W. Dimbleby, of the Department of Forestry, Oxford, was opposed to the view that mor conditions should be allowed to develop in newly established forests. He stated that podsol and its attendant raw humus layer form an undesirable medium for the growth of forest in Britain and it is, moreover, avoidable. Dr. Dimbleby described the work of a research team in Oxford which had undertaken fundamental research on many aspects of tree nutrition. The team concentrated its attention on areas in Yorkshire, where tree establishment on high-level heather moors is beset with great difficulty. It has often been stated that these moors are a natural ecological climax. This view has been shown to be erroneous by the study of the soil surfaces and profiles beneath bronze-age earthworks. On the surface below these artificial mounds, charcoal of birch and oak is found on the sites of hearths. The soil surface is rich in the pollen of hazel, oak, lime and alder and lacking in heather pollen. The soil profile below is typical of a brown forest mull. Indeed, the podsol profile of the heath goes over the top of the earthworks and is undoubtedly of more recent development. The vegetation and the soil have undergone a change from mixed

deciduous forest on brown earth to heath on podsol since bronze-age times, and evidence suggests that man's activity in cutting, burning and grazing is the cause. Nowadays, when burning and grazing are prevented, birch and pine may seed themselves into the heaths. Of these, birch becomes established, its roots break through the iron-pan of the podsol, and its leaf litter, and the detritus from associated plants, convert heather mor to mild humus, so that a forest soil with a vigorous fauna becomes established. Pine, on the other hand, fails to break the pan, and the mor conditions and bad drainage are exaggerated, and acidity and poor nutrient status are maintained.

The effects of birch in this sequence are essentially similar to the effects of soil treatment. Ploughing causes breakage of the pan and improves drainage and aeration. Mulching and manuring temporarily simulate the beneficial nutritional status of mull. If pine is planted this improvement is reversed; and leaching and podsolization develop with the accumulation of deep needle litter in which vast stores of minerals, which would otherwise be available, are locked.

The beneficial effects of birch and other species under which brown earth develops can probably be partly interpreted in terms of the behaviour of their litter during breakdown. The cellulose in the walls of the mesophyll of heather and mor-producing species is protected from breakdown by a resistant layer of a tannin-protein complex which is laid down upon them as they die. This is usually lacking in species not producing mor and, indeed, admixtures of birch litter or extracts of it can be used to stimulate breakdown of mor.

Prof. L. G. Romell, of Sweden, who was guest speaker, discussed the formation of mor. He pointed out that the humus turnover in mull soils is not faster than that in mor, and indeed the amount of organic matter is often higher in them. Moreover, when mor is isolated and stored, loss of organic matter and release of available nitrogen occur. The form of the curves relating these changes with time of storage is such as would be expected when a material high in nitrogen content is available for decomposition. The application of lime to decomposing mor in storage increases the rate of loss of organic matter but decreases the rate of release of available nitrogen. The immobilization of nitrogen in the presence of lime is due in part to reaction of ammonia with quinoid complexes in the humic matter.

The examination of a mor profile shows it to be characterized by a great concentration of roots, mycorrhizas and mycelia. Acidity is not, however, a diagnostic character of mor because mull may have a similar pH range. In beech soils, mor develops inevitably as the forest ages, so that liming and forest treatment cannot arrest the change from mull to mor. In the time of P. E. Muller (who first used the terms "mor" and "mull" in their present sense) mor was widespread in Denmark; now it is rare. The old beech stands are gone, and in the young forests mull exists in its stead. Similar parallelisms between mor development and the age of stands are found throughout the spruce forest of Sweden.

The factors affecting the development of mor have been analysed by ecological experiment. Addition of nitrogenous manures causes stimulation of ground flora and tree growth on mor soil. Other fertilizers have little effect. The death of trees from natural causes or felling is followed by a quick response, and dense ground flora develops. Trenching experiments where roots are cut have similar effects, producing dense ground flora, high nitrogen and phosphorus content of vegetation, and the disappearance of the mor profile. All these experiments, taken in conjunction with estimates of the release of available nitrogen during storage, indicate that the prime factor in mor formation is nitrogen starvation. The intensification of competition for nitrogen by roots and

mycelia as a stand ages, leads to formation of mor, decrease of ground vegetation, and slow growth of trees. Such a view of the mechanism of formation of mor, although it runs counter to many accepted teachings, explains more closely the ecological and experimental data.

The wide experience of Prof. Romell and the intensive researches of the soil nutritional team described by Dr. Dimbleby seemed, therefore, in full agreement concerning the relative productivity of mor and mull and the need to prevent development of mor. Suitable silvicultural measures could prevent its development, and these were dealt with in subsequent discussion.

Dr. S. D. Garrett described work done at the Botany School, Cambridge, on the microbiology of acid soils with respect to soil-borne disease. He took two examples where there is an apparent correlation between pH and intensity of disease. Both in the case of *Fomes annosus* butt-rot of pines and spruces, and in *Pythium* disease of seedling roots; disease is less intense in acid than in alkaline soils. The diminution of the damage caused by *Fomes* on acid soils can be ascribed to an effect of pH upon the soil micro-flora rather than upon the pathogen or host. *Fomes* spreads inside and along the surfaces of living roots and passes from host to host by root contact. Rapid advance along the root-surface, leading to widespread disease, is possible on alkaline soils, because *Trichoderma viride*, a virulent antagonist of *Fomes*, is absent. On acid soil only an internal spread of *Fomes* is possible, and the disease is of less importance. *Pythium* diseases of seedling conifers are also less intense on acid soils, and in this respect they contrast with similar diseases of cruciferous plants. The effect of pH may here be ascribed to a direct effect on the host and not upon the pathogen. The ecological optimum of conifers lies on the acid side of neutrality, so that they resist the disease on acid soils.

Although these examples illustrating the causes of increase or decrease of virulence with soil conditions appear simple when the final conclusions are reached, they are based upon wide ecological surveys in which apparent correlations, many of them spuriously giving the impression of causation, are observed. Such observations must be followed by detailed controlled plot and laboratory experiments.

Dr. J. L. Harley, of the Department of Botany, Oxford, also discussed soil microbiology in an attempt to fit work on the physiology of mycorrhiza done in Oxford, into its ecological perspective. The concentration of roots and mycelia in the mor profile described by Prof. Romell is easily observable in beechwoods in Britain. Estimates of weights of absorbing roots in various horizons of mull and mor confirm the intense colonization of the *F* and *H* layers of the latter. These roots are mainly mycorrhizas and are completely clothed in a tissue of fungus through which all nutrients entering the tree must pass. Observations on spruces by Wilde in America and on beech in Oxford show that similar subsurface aggregation of roots can be induced by treating even highly nutritive soils with excessive surface layers of organic material. Following the aggregation of roots, starvation symptoms can develop. The conditions in which mycorrhizal roots show their greatest development are these conditions of intense competition for nutrients. It is possible with beech, as has been shown in Sweden and America for pine and spruce, to vary the intensity of mycorrhizal infection by arranging a deficient supply of nutrients in the soil while ensuring rapid photosynthesis and carbohydrate production. The ecological conditions of intense mycorrhizal formation are those in which growth-rate may be small. Indeed, an inverse correlation of growth and mycorrhizal infection is often observed in natural conditions. Such correlations provide no evidence concerning the functioning of mycorrhizal organs, which must be sought in laboratory experiments.

If conventional physiological methods of studying nutrient absorption by roots are applied to mycorrhizal roots, it is readily shown that they accumulate salts in their tissues. The rates of accumulation of phosphate, ammonia and the alkali metals are rapid, and the mechanism of absorption is linked with metabolic activity. The rate is very sensitive to temperature, oxygen supply and the presence of metabolic poisons. It is very rapid in oxygen concentrations approximating to that in air and, in some conditions, is closely correlated with oxygen consumption in respiration. Comparisons of the rate of absorption of minerals by mycorrhizal and non-mycorrhizal roots of beech and pine show greater rates of accumulation into mycorrhizas of all salts tested. The mycorrhizas may therefore compete on more level terms than uninfected roots with the mycelia and other roots in the soil. The primary destination of the salts absorbed is into the fungus, and phosphate in particular accumulates in the fungal layer at first, so that during absorption the supply of phosphate to the host tissue is no greater in mycorrhizal than non-mycorrhizal roots.

Two mechanisms have been studied by which the ions trapped by the mycorrhizal sheath of fungus can be made available to the host. First, it has been shown by direct observation and photographic record that beech mycorrhizas have a life-period of about eight months only. Hence there is a periodic release of mineral-rich organic matter into the actual rooting region of the host. Secondly, there is in the tissues a metabolic turnover of phosphate, sensitive to oxygen and temperature, the net result of which is the movement of phosphate from fungus to host during periods when the rate of uptake is low. Hence, during periods of rapid release of minerals from newly fallen litter, nutrients may be trapped and accumulated in the fungal layer of mycorrhizal roots and, in the subsequent periods of slower mineral release, phosphate and perhaps other minerals are passed to the host. Laboratory physiological experiments, therefore, are providing a credible picture of the functioning of mycorrhizas in ecological conditions.

Dr. L. Leyton, of the Oxford Forestry Department, described detailed work on mineral nutrition of conifers which has been carried out in the same areas as that described by Dr. Dimbleby. His description of the soil profiles of Sitka spruce forest in Yorkshire was exactly comparable with that of previous speakers, and his analysis of mor and mull again emphasized the deficiencies of available soil nutrients, especially of nitrogen. Significant increases of growth were obtained by the application of nitrogenous manures, and little increase was obtained with phosphate. Dr. Leyton described the technique of analysis of foliage to determine the nutrient status and mineral deficiencies of the site. On untreated soils, needle weight and nitrogen content are positively correlated, and the effects of the use of nitrogen fertilizers, removal of heather and mulching, owe their efficacy in promotion of growth to increase of available nitrogen. Application of phosphate only affords a secondary stimulation.

The humus layer contains as much as two per cent of dry weight as nitrogen, so reasons were sought as to why this is not made available. Calcium deficiency is very marked, and it is possible that microbiological activity is limited by this factor. On the other hand, the soils in question are often water-logged in winter and dried out in summer. This adverse water regime may be counteracted by mulching, which results in a rapid increase of microbiological activity in the rooting layer.

The method of needle analysis has proved very valuable in this study, for it can be used to predict as well as to follow the effects of soil treatments on trees of any size. In all cases where treatments improve growth, an immediate response in needle colour and weight precedes increased growth. The needles of the

following year's crop are laid down in the buds of the current year, so that although immediate growth response to treatment is not observable, the constitution of the needles provides a satisfactory basis of prediction of growth in the future.

With these set papers as a background, the whole subject was discussed. Prof. Romell pointed out that the effects of liming are complicated because of the stimulation of white rot fungi above pH 4.5, and the lack of effect of lime treatments mentioned by Mr. Laurie and others might be explained by the trapping of nutrients by them. He asked about the stimulation of turnover in mor by hardwood litter, and Dr. Dimbleby and Mr. Murphy stated that it can occur and is associated with increase of faunal activity. Dr. Dimbleby spoke strongly in favour of developing stands of mixed tree species, but Mr. Hiley emphasized that adequate thinning of conifers would encourage ground flora, the detritus of which would have the required effect of reversing the tendency to formation of mor. He also described how mor develops under old oak stands and how felling of such stands and replanting with conifers may give rise to mull with an *Oxalis* and *Rubus* ground-flora. Dr. Harley pointed out that such a change might be the result of felling and planting rather than an effect of the conifers themselves. Mr. Laurie showed that there are still untouched problems concerning the factors leading to the aggregation of roots so characteristic of mor. He asked if some of the known effects of mycorrhizal and other fungi on the growth and branching of roots could be a factor in the process. Dr. Harley and Dr. Leyton suggested that a study of oxygen supply and water supply in the surface soil layers would perhaps be a better first approach to these problems, as both these factors greatly affect root-growth and activity. Prof. W. H. Pearsall, who was in the chair, commented that although there was clearly evidence that many of those present disagreed on various grounds with the planting of conifers on many sites in Great Britain, no battle had developed on this subject. The first problem in reafforestation, he said, is to make difficult sites productive and then to ensure that their soil tends to change towards mull rather than away from it. Britain is a region of brown forest soils, and present policy should be to re-establish them. No doubt it was felt that such a discussion would lead the meeting away from biology into economics, for in spite of this challenge no battle developed.

The meeting was a highly successful discussion of a most important subject, and indeed was a hard but valuable day's work for those who took part.

PLANTING CORSICAN PINE IN TRENCHES PLOUGHED IN SAND

By D. A. WOODBURN
District Officer, East Scotland

Tentsmuir is a large pine forest in the dry north-east corner of Fifeshire, Scotland. The soil is fine sand, thrown up by the sea and River Tay, rapidly stabilised by marram grass, then succeeded by heather and bent grasses. Planting, which commenced in 1922, was completed in 1949, the traditional practice of screef and notch planting having been followed for most of this period.

With the acquisition in 1950 of an adjoining moorland area of the same sandy soil, the opportunity was taken to try out two departures from normal practice, which had come into vogue on other sites in the East of Scotland, but not heretofore attempted in light sandy soil, viz., ploughing, followed by planting in the bottom of the furrow.

The mechanical outfit, a crawler tractor pulling a light Solotrac plough, made rapid progress in the soft, almost level sand. The dimensions of the ploughed trench were width 18 inches, and depth 4 inches, sufficient to tear out the strong matted grass roots.

Corsican Pine transplants, aged two-plus-one, were "L" notched into the bottom centre of the trench. Although this species and age of transplant is recognised as difficult to establish, the loose texture of the sand, bared of vegetation and roots, enabled the planting to be done both rapidly and skilfully with, as it turned out, an almost 100 per cent survival rate.

The smothering of the plants by blown sand did not materialise to the extent anticipated. Experience proved that plants survived smothering of all their needles provided the terminal bud projected above the sand. Almost 95 per cent of the plants overcame the one-year period of dormancy commonly found with Corsican pine after planting, and grew leading shoots of one to several inches in the first year.

Four-year height growth measurements are as follows:

Initial Height, when planted: 2-3 inches.

Average: Total Height 32 inches	1st year	2 inches	growth
	2nd ,,	7 ,,	,,
	3rd ,,	9½ ,,	,,
	4th ,,	11 ,,	,,
Largest Trees: Total Height 51 inches	1st year	6 inches	,,
	2nd ,,	8½ ,,	,,
	3rd ,,	15½ ,,	,,
	4th ,,	18 ,,	,,

Weeding was negligible. Ploughing stimulated a luxuriant growth of grass by about the third year, by which time the pine were beyond the need of weeding. The growth response is attributed to the greater availability of moisture, a limiting factor in this site, combined with the freedom from grass root competition for that moisture and nutrients.

WATTEN EXPERIMENTAL AREA, CAITHNESS

By G. BARTLETT

Forester, Research Branch

In the north of Scotland the Department of Agriculture are at present, under the provisions of the Hill Farming Act, increasing the size of many crofts to a more economic unit, improving buildings and access, and in general improving the position of the crofting community.

At Watten in Caithness, two holdings or crofts have been merged, the crofters house is being modernised, a steading comprised of a byre, granary and hay store is being built, and access has been improved in the form of a new road and bridge. It is hoped that with the land reclamation schemes, crops will be

grown and harvested on land which in the past has been entirely unproductive, except for sheep grazing. It is also hoped to provide summer feed and winter fodder for cattle, of which at present the croft has none. Into this scheme of things (though not within the provisions of the Hill Farming Act) the Forestry Commission Research Branch with the co-operation of the Department of Agriculture, to whom the land belongs and for whom the work is done, have laid down an 80 acre shelter block.

The usefulness of shelter for agriculture has long been known, in as much as it provides shelter for stock, and produces grazing earlier in the spring and later in the autumn, a very big consideration in the northern counties of Scotland. In addition to this, the Forestry Commission Research Branch hope to gather knowledge which will benefit them, when and if it is ever decided to afforest such areas on a large scale, with especial reference to the north coast of Caithness and Sutherland, and the islands of Orkney and Shetland.

The shelter block at Watten has been laid out in such a way as to guarantee the maximum amount of shelter to stock on any one side. It forms an irregular figure, roughly square, but with the sides indented so as to provide bays into which the stock can move, and so get shelter on three sides.

The rainfall is about 35 to 40 inches per annum, but despite this comparatively low rainfall, most of the area carries deep peat from 6 to 22 feet thick. Exposure is severe from the north, east and west. The block has a north-facing aspect rising from 250 to 320 feet. The vegetation is dominated by heather and deer grass.

Owing to the possibility of both roe and red deer coming down to the area in winter, and an abundance of hares and rabbits, the area had to be enclosed with a six foot deer fence with rabbit netting at the bottom.

The ground was so soft, and with memories of another such area where great difficulties were met on ploughing, it was decided that the only suitable tractor for drawing the ploughs was Cuthbertson's "Water Buffalo". This tractor only exerts a pressure per square inch on the ground equal to approximately half that of the human foot. With this tractor it was decided to use two of Cuthbertson's ploughs, namely, the single and double mouldboard draining ploughs. The ground was ploughed in a series of six furrow strips, using the double mouldboard plough, this giving twelve planting ridges. Between these strips, a space of 15 feet was left unploughed. This form of ploughing increases the stability as it gives a series of windfirm edges. The double mouldboard ploughing was done in a south-north direction, i.e. with the fall of ground; but as the double mouldboard ploughing does not leave a drain well suited to the conduction of water, cross draining was carried out with the single mouldboard plough every two chains down the hill. In addition main drains were ploughed with the single mouldboard plough in a south-north direction between every three strips of double mouldboard ploughing. The cross drains ran into these main drains, and the system was found quite satisfactory in clearing the surface water from the area.

It has long been proved that when planting trees on peat, if the roots can be introduced into the two layers of rotting vegetation, i.e. between the ground surface and plough ridge where the two layers of vegetation are sandwiched, not only are the chances of survival increased, but the trees get an initial food supply, to carry them over, until the roots explore the ground further. The ploughing also reduces vegetation competition in the early stages until the tree is better established.

All trees on planting received an application of 1½–2 oz. of ground mineral phosphate. This dosage has been varied experimentally at Watten as will be

reviewed later. The application of phosphate gives the tree an additional boost in its first few years, when the position is so precarious.

It was decided that planting at Watten would be done over a three-year period, 1951, 52 and 53. Work began in 1950 when the area was fenced, and 20 acres ploughed for planting in 1951. In 1951, four experiments were laid down on the area, as detailed below.

Experiment 1.P.51

The object of this experiment was to establish a trial plantation on very poor peatland, making use of the most likely methods, species and mixtures as suggested by experimental work on poor peatlands elsewhere. Nine species were used; the main one, of which 75 per cent of the whole consisted, was shore pine, the coastal variety of lodgepole pine or *Pinus contorta*.

In mixture with this shore pine in a 3:1 ratio are the following species.

1. Inland lodgepole pine —*Pinus contorta*
2. Scots pine —*Pinus sylvestris*
3. Japanese larch —*Larix leptolepis*
4. Hybrid larch —*Larix eurolepis*
5. Sitka spruce —*Picea sitchensis*
6. Serbian spruce —*Picea omorika*
7. Western hemlock —*Tsuga heterophylla*
8. Noble fir —*Abies procera*

The mixture was a very simple one, being every other line pure shore pine and intermediate lines alternate plants of shore pine and the other species. This method ensures that should all the other species fail, sufficient numbers of shore pine remain to form a stand. The ideal is of course a mixed stand of shore pine and other species, taking out shore pine to form eventually pure plots of the better species.

Plots consisted of 1 chain in length by 12 furrows wide, containing 144 shore pine and 48 of one of the other species. 6 blocks were planted; each block contained 9 plots, one for each of the other species and one plot of pure shore pine.

Experiment 2.P.51

The object of this experiment was to produce further information as to the amount, placing and differential manuring of phosphate and to endeavour to obtain equal height growth of Sitka spruce and shore pine on the same area. These were the only two species used.

The shore pine was given either ½ oz. or 2 oz. dose of ground mineral phosphate while the Sitka spruce in mixture with it received doses varying in amount from 2–24 oz. As the amount of phosphate applied increased, so was the area of application round the tree, to a maximum of 24 oz., spread over an area of 5 ft. by 5 ft. Basic slag was also given a further trial.

Different placements of 2 oz. only were also tried, the phosphate being placed in the notch before planting, being used as a top dressing after planting, and being spread along under the turf to simulate a mechanical spreader.

Experiment 3.P.51

This is a shelterbelt experiment designed with two objects:—

(*a*) To find out whether mountain pine and Scots pine are essential in shelterbelts or whether shore pine alone is sufficient.

(*b*) To investigate whether close spacing is essential.

There are 3 main treatments with split plots for spacing at 2 ft. and 4 ft. The treatments are:—

(1) Two lines mountain pine, two lines Scots pine and two lines shore pine.

(2) Three lines mountain pine, three lines shore pine.

(3) Six lines of shore pine.

The experiment runs up the east side of the block, close to the fence, and therefore exposed to all east and north-east winds. The outside 6 lines are planted in randomised blocks, split for different spacing. The belt is further widened for the whole of its length by planting a 3:1 mixture of shore pine and Scots pine respectively, on a further six ridges to the west, making the belt approximately 1 chain wide for the whole length of the eastern fence.

Experiment 4.P.51

The object of this experiment was to compare the survival and growth rate of transplants (1+1), seedlings (1+0), and direct sowing on this type of *Scirpus* peat. The stock of trees and seed were all progeny of Id. No. 25/68 shore pine.

Plants were given 2 oz. ground mineral phosphate on planting. Direct sowing patches were however given an application of nitrogen phosphate and potash similar to the applications given in nurseries in the form of:—

Nitrogen	—0.75 oz. Flash.
Phosphate	—0.60 oz. ground mineral phosphate.
Potash	—0.15 oz. Sulphate of potash

For the direct sowing, a semi-tilth was made, artificials applied and worked in, approximately 5 seeds sown and covered thinly with sand.

Assessments were made at the end of the first growing season and losses were high. Some of these may be accounted for, in that the planting was not finished until mid-June, during very dry weather. This was owing to the very bad weather in February and March and a large programme to cover, Watten being the last area to be planted. Beating up was done in Spring 1952 and losses appear to be very small, although no final assessment figures for this year are available yet.

The area for planting in 1952 was ploughed in November 1951 and two further experiments laid down in spring 1952. It is of interest to note here that about 5 acres at the south-western corner of the block were not ploughed. Despite the "Water Buffalo" having only approximately 3 lbs./sq. inch pressure on the surface of the ground, the ploughs behind were so working that the "Buffalo" was breaking the surface and sinking. The five acres were left and had to be done by hand for planting in 1953.

Experiment 5.P.52

This is a race and provenance trial, whose object is to compare the survival, rate of growth, yield, form, disease resistance, and any other differential characteristics of *Pinus contorta* from coastal and inland districts of British Columbia and U.S.A. Five different lots were used and intensive blocks and extensive sections planted.

Experiment 6.P.52

This experiment is a continuation of 1.P.51. Two of the other species have been dropped for the present namely:—Japanese larch and Noble fir. With shore pine again the predominant species, the remaining six other species have been tried again in different mixtures and placings.

With inland lodgepole pine, Scots pine and hybrid larch, the shore pine has been tried in both 3:1 ratio and 1:1 ratio. The 3:1 was as for Expt. 1.P.51, the 1:1 ratio was in a 3 line, 3 line mixture along the furrows.

With the Sitka and Serbian spruces and Western hemlock the 3:1 alone remained, but in different patterns amongst the shore pine matrix. These patterns were:—

(*a*) Alternate lines shore pine and lodgepole pine or other species as in Expt. 1.P.51.

(*b*) Three lines shore pine, one line other species along the furrows.

(*c*) Rings of other species within a shore pine matrix.

(*d*) 20-plant groups, i.e. 5 by 4 plants, of other species, spaced at 20 feet in a shore pine matrix.

Spare corners are being planted up with a 3:1 mixture of shore pine and Scots pine in mixture, as Expt. 1.P.51. At the northern end of the area a small block of Sitka spruce has been planted, and a smaller plot of Austrian pine.

If this shelter block is a success, not only will it provide the shelter and feeding already mentioned, but in years to come may well be of particular value in providing estate timber in a timberless area. It may also help to show one answer to the unemployment problems in the far north of Scotland, by providing a new industry there.

LIME-INDUCED CHLOROSIS OF CORSICAN PINE AT FRISTON FOREST, SUSSEX

By J. S. MURRAY
District Officer, Research Branch

Deaths of Corsican pine, planted in Forest Year 1927, in Compartment 9 of Friston Forest were reported by the Conservancy, and as the species has been reported dying elsewhere on chalk, a preliminary investigation covering 13-15th of April 1955 was made. This was mainly concerned with the crown symptoms and rooting habit of the species.

Symptoms. Symptoms are those of a typical chlorosis. The distal part of the needle is first affected, becoming lighter green, yellowish and finally bright yellow with increasing severity, while also a greater part of the needle gradually is affected. The older needles are the first to suffer, and different stages of chlorosis can often be seen on the needles of a shoot of one year's growth. The extreme tip of all affected needles is brown in colour. Premature defoliation occurs so that trees may carry only one or two years' growth of needles instead of three. There is no apparent reduction in needle length. Height increments are not apparently reduced in the young stages, though when the trouble becomes chronic, as in Compartment 9, a falling-off in height growth does occur.

Contrary to expectations, the chlorotic symptoms were found in all ages of Corsican pine examined, and there was no question of their appearing at some definite stage in the history of the crop, such as canopy closure. Thus competition between trees has no effect on the appearance of the symptoms, although it may exert an important additional effect later in the life of the stand.

Different types of Corsican pine appear to react differently. All over Friston two principal types occur in the same plantations. One is the Corsican type proper, distinguished by good height growth, light branching, and flexible light green needles. The other approximates more to the Austrian pine, with shorter height increments and heavy branching which gives it a bushy appearance, and rigid, dark green needles. The latter type suffered far less from chlorosis than the former, and also was less badly affected by exposure which is an extremely important factor in this forest. Although less desirable silviculturally, the Austrian type seems to be far better suited to conditions at Friston than the true Corsican type.

Other Species. Chlorotic symptoms were noted on other conifer species. Scots pine reacted as did Corsican. Lawson cypress and *Thuja plicata* responded with a general yellowing of the foliage. In one plantation of *Cupressus macrocarpa* examined, the trees appeared symptomless, and although planted on an exposed top appeared to suit the conditions well.

Root Development of Corsican Pine

Wherever roots were examined, the soil was found to be sufficiently shallow to permit rooting into the underlying chalk at an early age of the tree.

Soil Pit No. 1. Compt. 17, P.52, Beech and Corsican pine planted 3 rows by 3 rows. Aspect southerly, medium to steep slope, exposed to south and south-west.

Vegetation. Mixed grasses with herbs including docks, buttercups, dandelions, thistles, wild strawberry etc.

Soil. Eight inches of light brown loam of excellent structure over fractured chalk. Fractures becoming less with depth and infrequent at twenty-three inches.

Rooting. The amount of sideways rooting was surprisingly small in view of the excellent medium for root production afforded by the loam. The transverse diameter of the root system in the loam was only ten inches, although the tree had had three growing seasons *in situ*. In contrast to this, a very strong downward development had occurred, several roots penetrating more or less vertically; two were lost after being traced down at a depth of twenty-three inches, or at a depth six inches greater than the height of the tree, which was seventeen inches. There was no evidence that the roots could penetrate *solid* chalk. All the penetration was via pre-existing cracks, although in some cases the cracks were so fine that on cursory examination it appeared as if penetration of solid chalk were occurring. When the chalk was split with a knife, however, along the line of the root, a tell-tale plane of weathering could always be found. No case of rooting into solid chalk could be found in any of the other soil pits dug subsequently. Abundant fibrous root material was produced in the fine cracks and a surprising quantity of fibrous roots was produced by very fine roots penetrating the cracks and continuing for distances which seemed disproportionate to their diameters. The roots of the weed vegetation were limited to the loam and the upper levels of the chalk, so that the pine roots suffered virtually no competition in the chalk.

Chlorotic symptoms were general in the plantation where the pit was dug. The tree whose root system was examined was one of the most vigorous in the area and possessed three- two- and one-year-old needles, all of which had yellow tips. Other individuals nearby had lost their older needles but there may have been an exposure factor operating also.

Soil Pit No. 2. Compt. 43, P.43. Experimental plots, block of pure Corsican pine. Aspect northerly, steep slopes, exposed to north and north-east.

Vegetation. Mainly mixed grasses, bramble, hawthorn.

Soil. About eight to nine inches of stiff clayey loam with some flints and chalk nodules. This soon gives way to soft, fractured chalk with characteristic horizontal and vertical fissures. Fissures were found at thirty-two inches depth.

Rooting. Frequent side roots occurred in the clay and continued horizontally in the top eight inches often at only two to three inches depth.

The average annual sideways root growth was found to be only about five inches, and in twelve growing seasons the farthest sideways spread of the root system in the upper soil layers was less than five feet. This provides a great contrast with such surface rooters as Sitka spruce, which would have a far greater sideways spread at this age. There was also a relatively small amount of fibrous root emanating from these upper horizontal roots. As far as the absorbing system of the root network was concerned, their main function seemed to be to provide a horizontal framework for vertical *droppers*, which in the case of this tree came off at intervals of twelve to fourteen inches. Three main roots were found to descend vertically from the base of the tree. These, like the secondary sinkers, quickly became reduced in diameter. Masses of fibrous material were formed in the cracks of the chalk, and it was very revealing how far down one thin sinker could ramify, and how much fibrous material it could produce. Cracks and fibrous roots were found at a depth of thirty-two inches, the limit of the pit. At this depth there was only little rooting and cracks were few, but there was no doubt that both rooting and cracks existed to some degree still lower down.

Chlorosis could be seen in this plantation also, both in the Corsican and in the Scots pine. No falling-off in height growth could be seen.

Soil Pit No. 3. Compt. 9, P.27. Corsican pine underplanted with beech. The beech for the most part are suppressed except for individuals which are in the lower canopy. Medium slope with northerly aspect just off the main Brighton-Eastbourne road. Severe exposure damage on the edge of the compartment which is on the brow of a hill. All species on the edge are affected i.e. Scots pine, Corsican pine, whin, *Cupressus macrocarpa*, but the exposure damage does not extend far into the plantation.

Vegetation. Mixed grasses, some bramble, nettle, *Galium* sp., but much of ground bare since tree canopy has closed.

Soil. About six inches of friable clayey loam of good texture over reddish brown clay with numerous chalk fragments. This clay is stiff and not conducive to free rooting, and contains numerous large flints. It is rather irregular in depth, pockets of it two feet deep occurring, but generally it gives way to fractured chalk at about nine inches. The chalk is well fissured both horizontally and vertically, the fissures becoming scarcer with depth, but present at 3 feet 7 inches.

Rooting. Numerous side roots were developed in the upper loam but they did not produce much fibrous material. Sinker roots were produced from them penetrating as near vertically as the cracks would permit. Beneath the stem three main roots penetrated vertically, flattening out and losing their identity at about 27 inches depth. All penetration was along fissures and almost every

fissure had roots. Fibrous material was very well developed in the chalk and was present to a small degree at 3 feet 7 inches, the limit of the pit.

A small number of dead trees are scattered through the plantation. A large number of trees exhibit general yellowing of the crown and loss of needles. Some trees had very thin crowns and reduced height increments. On the tree which stood over the pit examined, reductions in height increments had occurred during the last seven years. These averaged six to eight inches. Only the current year's needles remained and some of these had fallen. The remainder were yellowish and even brown.

Soil Pit No. 4. Compt. 54, P.48. Corsican pine and beech. On a steep slope with easterly aspect, badly exposed.

Vegetation. Thick grass cover with gorse and bramble.

Soil. Two to three inches of black, loose, humus-filled clayey loam over eleven to twelve inches of light brown stiff clay with numerous large flints. A pick had to be used to penetrate this layer. Broken chalk at about fourteen inches with fissures becoming less frequent until very few are found at twenty-inches. The chalk appeared to be softer than that in Compt. 9.

Rooting. About a dozen horizontal side roots were sent out in the first six inches. Sinker roots were well developed and appeared older and larger than the side roots. About four or five sinkers penetrated vertically through fissures and clay pockets, beginning to flatten out at about twelve to fifteen inches and to become small in diameter. No rooting occurred in solid chalk but advantage was taken of every washed down clay pocket and fissure to produce fibrous roots. Scarce small roots were seen at twenty seven inches. The rooting depth here appeared to be more limited than that in Compt. 9, due to a smaller depth of fractured chalk.

Chlorosis was general in the crop both in Corsican pine, Scots pine and Lawson cypress. Height growth and needle length were satisfactory.

Soil Pit No. 5. Compt. 12, P.28. Half Moon Plantation. Scots pine, Corsican pine, beech.

Vegetation. Ground mostly bare with some brambles.

Soil. Dug beneath one apparently healthy co-dominant. Fourteen inches of dark brown clayey loam of good structure and easily dug, with many chalk fragments merging into fairly solid chalk with few fissures and many flints, necessitating hard pick work.

Rooting. Side roots in the upper soil were very well developed, and there appeared to be more of them proportionally than in the other soil pits studied. Fairly large sinker roots up to 2½ inches in diameter emerged beneath the tree, but at fifteen inches these had flattened out and only small feeder roots continued. There was the usual tendency for fibrous roots to proliferate in the cracks, but because there were very few cracks the amount of fibrous rooting was small compared to that in other pits.

Slight chlorotic symptoms were present both on the Scots and Corsican pine, but on the whole the plantation was healthy and needle colour normal compared with other plantations visited at Friston.

Conclusions

The symptoms on the Corsican pine at Friston resemble those of lime-induced chlorosis seen at Allerston Forest, Yorkshire, on the oolite, and elsewhere on lime-rich soils. The symptoms occur on all ages of plants, but only one case of dying of trees was seen. This was in Compartment 9, P.27, and the dead trees and the dying ones nearby were in the final stages of chlorosis.

A study of the rooting habits of trees of different ages showed that the species tended to produce a deep rooting system in the chalk, with the bulk of the fibrous roots in the chalk. Rooting occurred only along cracks and fissures however, and was arrested when the chalk became solid. It is possible that the critical factor may be the proportion of feeding roots in the upper soil to that in the chalk. In the best plantation examined, the soil consisted of fourteen inches of clayey loam well colonised by roots and containing much fibrous rooting material over hard chalk, with very few fissures and comparatively few roots. The reverse conditions prevailed in Compartment 9, P.27, where trees were dying. Here the top soil consisted of about fourteen inches of stiff clay which was but sparsely rooted, over well-fractured chalk extensively rooted down to a least three feet seven inches. On this soil type, therefore, as far as the chlorosis is concerned, deep rooting in the chalk may be a disadvantage.

The Austrian type of pine appeared to suffer less than the Corsican type both from chlorosis and exposure, and is thus better suited to the area. Scots pine suffered as badly from chlorosis as Corsican, and far worse from exposure. From the survey it appeared that Scots pine was a very bad choice of species for this forest, but it has been used extensively.

As chlorosis is present in all ages of Corsican pine, the question to be answered, is why the trees should die when about twenty-five years old and not before then? One possibility is, that if a nutrient deficiency is involved, the crop may now be of such a size that the shortage has become chronic. Another is that a climatic factor such as drought may have entered the complex and tipped the balance against the trees.

I do not think we can answer this question until chemical analysis has shown whether in fact the nutrient uptake by the trees is abnormal, and with what elements the abnormality is concerned. This basis appears essential to any consideration of such matters as length of rotation or possible remedial measures.

GREY SQUIRREL ENQUIRY

By MONICA VIZOSO

Infestation Control Division, Ministry of Agriculture

In December 1953, at the request of the Committee on Grey Squirrels, enquiry forms were sent out to landowners, foresters, keepers, secretaries of Squirrel Clubs and others. The object was to obtain information about actual kills of grey squirrels and methods used for their destruction. By the following May roughly 400 forms had been returned; and although the majority were not completed in detail, many contained useful information.

The following questions were asked about the shooting of squirrels. For each nest destroyed—the height in feet, the tree species, the type (whether summer or breeding nest), the construction and lining materials used, the number of squirrels seen, cartridges fired, squirrels which escaped; and, for those squirrels killed, the number of each sex and whether old or young. Questions asked about methods of destruction other than shooting dealt with tunnel trapping (the month, the number of traps and trap positions, and the number of each sex caught); cage trapping (the month, the number of traps, the baits used, and the number of each sex caught); and other methods (method used, and number of each sex killed). On the last page of the form a summary was asked for; the place, acreage, time spent, number in team, weapons used,

cartridges used, number of nests poked out, number of nests occupied by squirrels, types of nests, average height of nests, species of trees, the number of squirrels which escaped, the number of old and young in the total killed, and the number of old and young of each sex killed. A space was provided for remarks, and for the name and address of the informant and the date.

The completion of this form called for much time and thought, and the organisers of the enquiry are grateful to all who sent in replies. Some interesting results which were compiled from the forms are set out below.

Distribution. New records of the presence of grey squirrels are periodically plotted on a map marked with the National (10 km.) Grid, and thirty-four new squares were included in the distribution as a result of this enquiry. In addition, the records confirmed that grey squirrels were still to be found in 215 squares where they had previously been reported. The most striking extension of range was shown in Cardiganshire, where the species appears to have spread northwards along the coastal region as far as Aberystwyth; there were new records also in Montgomeryshire, Shropshire, Derbyshire, Lancashire, Merioneth, Devon, Staffordshire, Sussex, Lincolnshire and Leicestershire.

Records of Nestlings. A litter of young "about a week old" was recorded at Slindon Forest on January 6th (this is the earliest record of a spring litter in this country) and on the same date seven pregnant females were recorded. "Young" squirrels were found throughout the period December-May but some of these are thought to have been half-grown young from summer litters, rather than nestlings.

Sex Ratios. There appears to be a common opinion that many more male squirrels are taken than females. The information given by the enquiry was compiled into monthly tables showing the sex-ratio present in samples killed during drey-poking and shooting, and during trapping. It was found that the first method yielded a total of forty-nine per cent males in a sample of 2,267 animals from over forty localities; among the young the males formed 50 per cent of the total, whereas among adults they represented 48 per cent. January was the only month from December to May in which more males than females were killed by this method. Trapping results from eleven localities showed a higher proportion of males killed: 59 per cent in a sample of 636 animals. Records covered twelve months, and only in April, July, and October did females predominate in the kill; of the eleven localities only two reported more females than males killed over the twelve months. The fact that in nine months out of twelve trapping yielded more males, and in five months out of six shooting yielded more females, suggests that the method of collection influences the sex ratio found. Nevertheless, the sexes are usually present in approximately equal numbers.

Trapping. The most popular method of trapping was by the use of the gin trap in tunnels; but on some estates squirrels were also taken in cage traps of unspecified types, and by the use of wires. Some squirrels were tunnel-trapped in every month of the year, but the kills were highest from June to December. Places where traps were set included covert fence bottoms, banks, holes through banks, the bottoms of walls, the flat tops of walls, planks over streams, river banks, the bases of trees, inside hollow trees, near dead fallen trees, and near pheasant feed stands.

Cartridges Used. Twenty-six records from the New Forest gave a total of 214 adult and 125 young squirrels killed for 420 12-bore cartridges expended: or 1.29 cartridges per squirrel killed. Results from six records sent in by Squirrel Clubs gave a total of 214 adult and 80 young killed for 298 12-bore cartridges and twenty rounds of .22 ammunition expended: or 1.02 cartridges per squirrel

killed. These samples suggest that the allowance of two cartridges per tail is adequate in most cases, even if it is assumed that only the adults in these samples were actually shot.

MONETARY RETURN FROM THINNING A THIRTEEN-YEAR-OLD JAPANESE LARCH STAND AT ALLERSTON FOREST

By T. JOHNSTONE
Foreman, North-East England

While the prices of pitprops were controlled it was generally accepted that first thinnings, in many cases, were not an economic operation. With the better prices in force in 1952, when this study was made, it is apparent that the monetary return from first thinnings in a good stand of Japanese larch shows a profit.

The area is situated on a hillside, elevation from 450-600 feet above sea level, with a south-easterly aspect. Geologically the area is in the lower limestone of the Middle Oolite series and Passage Beds; the soil profile is as follows:

0–2 inches	A mat of raw needles.
2–4 ,,	Black humus mixed with sand.
4–26 ,,	Greyish white fairly loose sand. The roots of the crop are well down in this layer.
26–32 ,,	Dark-brown compacted sand layer. The colour is due to leaching of the upper layer.
32–38 ,,	Yellowish brown clay (very compact) with stones of the oolite series.

The area of ten acres was planted in 1939 with two-plus-one transplants from Wykeham and Widehaugh nurseries. Planting was done by notching with a spade in previously prepared holes, spacing five feet apart each way. Prior to planting the vegetation was mainly bracken.

Brashing and thinning took place in 1952 when the crop was thirteen years old. The grade of thinning was C/D (moderate—heavy low thinning) reducing the crop to 730 stems per acre. This is equivalent to a spacing of seven feet apart each way, or about one-quarter of the top height, which was 28 feet.

The total volume production under-bark is 883 hoppus feet per acre, giving a mean annual increment of 68 hoppus feet under-bark. The thinning yielded 313 hoppus feet over-bark per acre. These figures indicate, in a general way, a stand of Quality Class I according to Dr. Hummel's *Revised Yield Tables for Conifers in Great Britain* (Forest Record 24).

The average height growth for the last three years was two feet. The spread of over-bark quarter-girth was from $2\frac{1}{2}$ to $5\frac{1}{2}$ inches. The average pole standing holds .86 hoppus feet under-bark, measured down to three inches diameter over-bark. The biggest pole had $2\frac{1}{2}$ hoppus feet in it, and the tallest trees were thirty-six feet to the tip of the leading shoot.

Thinning Costs

All operations except extraction were by piece work. The poles were stacked by the fellers in racks half a chain apart; the horses dragged downhill three chains, and the Fordson tractor and trailer hauled about $\frac{3}{4}$ mile to the dump. The hourly rates for the lorry, portasaw and Fordson half-track are exclusive of driver's time and are estimated from 1950 rates.

		£ s. d.	£ s. d.
Felling	6,278 poles (½ hoppus foot on average) 2/9 per 100 lin. ft.		
	Includes marking and measuring		184 0 5
Extraction	3,139 hoppus feet		
	Horses and men 20 days	39 10 4	
Tractor	85 hours at 6/-	25 10 0	
(Fordson Major)	Driver and labour loading trailer....	36 4 0	
Lorry	7 hours at 8/-	2 16 0	
(5-ton L.W.B.	Driver + labour loading	2 0 0	
Bedford)			106 0 4
Crosscutting Power	48 hours at 4/-	9 12 0	
(McConnell	Labour 1/6 per 100 lin. ft.	38 14 0	
Portasaw)			48 6 0
Peeling	Labour 3/- per 100 lin. ft. props, or 2d. per stake		76 19 2
Pointing	Labour 5/- per 100		10 14 6
(Power)	(Portasaw hrs. included in crosscutting)		
			426 0 5
	Plus 20 per cent for overheads		85 4 1
			511 4 6

Produce

The prices are taken in November 1952 free on lorry. The yield of 2,661 hoppus feet, converted material, compared with 3,139 hoppus feet (tape-over-bark) is a conversion loss of only fifteen per cent, which appears to be rather low. Pitwood is calculated from *Smith's Pitwood Tables;* boxwood and firewood at 35 hoppus feet per ton, rustics at .18 hoppus feet each.

List of Produce from Ten Acres of Thirteen-Year-Old Japanese Larch

Peeled Props	*Top Diam. Ins.*	*Hoppus feet*
	2½	305
	3	343
	3½	254
	4	302
	4½	33
	5	8
	5½	1
Larch stakes, peeled, pointed	2–3	777
Larch stakes, unpeeled, unpointed	3–4	28
Larch stakes, unpeeled, unpointed	4½–5½	10
Firewood, 10 tons	—	350
Boxwood	3½ up	70
Rustic poles 8 to 10 feet by 2 to 3 inch butt	1,000	180
		2,661

	£ s. d.
Income from above, free on lorry	878 11 8
Total thinning costs:	511 4 6
Balance of Income over expenditure, for ten acres	367 7 2
Per acre	36 14 9

HINTS ON THE CARE AND USE OF AXES

By Major-General H. P. W. HUTSON
Chief Engineer

The axe is traditionally regarded as the most important of the forester's tools, and the purpose of this article is to show how it may be used to the best advantage. A good axeman, handling a well-cared-for tool, will do the most work with the least effort; and what is more, he will do so with safety. This account shows how axes should be selected, handled, sharpened, and repaired; but it does not go beyond the initial stages of tree felling.

Types

Axes are made in a variety of shapes and weights. Fig. 3 shows the two types in most general use.

The axe shown at A is an English rounding axe used for felling hardwoods. It is also used for trimming and coppice cutting. Many English fellers would also use this axe for softwoods in preference to the American patterns. Other English axes, varying in pattern from county to county, such as the felling axes, the topping axe and the heavy side-axe used for roughly squaring logs, which were formerly used extensively, are now largely obsolete. Nowadays, many axeheads are made of good steel throughout, but formerly only the edge was of hard steel, the body being of softer steel or iron.

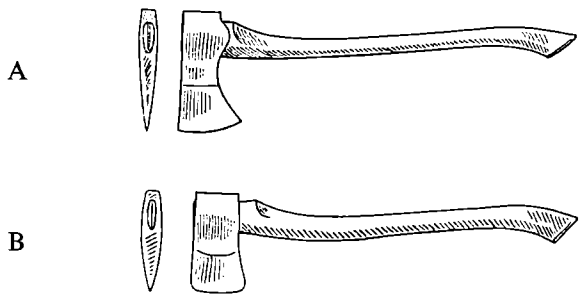

Fig. 3. Types of Axes: A. English Rounding axe;
B. American axe for softwoods.

The axe shown at B is the American felling axe, intended primarily for use on softwoods. It has a shorter and narrower blade than the English rounding axe, and the profile of the blade is rather more convex.

Both types of axe are made in various weights, and may be used with either curved or straight handles. The choice of type of blade, form of handle, and even the weight of the head, is largely a matter of local custom and individual preference. But in Britain axes of less than 4½ lb. are rarely seen and weights up to 6 and 7 lb. are common. The 4½ lb. axe is probably the most popular weight in Scotland: in the Dean and the New Forests, 6 and 7 lb. axes predominate. Outside Great Britain modern practice tends towards the use of light axes as being more economical of effort. In Sweden for example the standard axe seldom exceeds 3¼ lb. in weight and many are under 3 lb.

Qualities of a Good Axe

(*a*) **The Head.** Must be of good quality steel, properly forged and tempered. Heads of 6 or even 7 lb. weight are suitable for felling, but for trimming and

cording, 4½ lb. heads are often better. Where one axe is used for both purposes, as is becoming the general practice, a 5½ lb. head would be the most useful.

For axes used on softwoods slightly convex sides are advantageous as they are easier to withdraw from the wood.

The cutting edge must not be too thin or it will not stand up to the work. Knots in softwood, especially spruce, can turn the edge of an axe, as one cannot avoid striking them at right angles to the grain.

(*b*) **The Handle.** Should be of hickory or ash, straight grained, smooth and free from knots or other defects. The length most favoured is perhaps 33 ins., but to be perfect an axe handle should be made to fit the individual user. A rule which seems to work in practice is that the length of the handle from grip to shoulder should equal the length of the user's arm from armpit to tip offorefinger) (see Fig. 4).

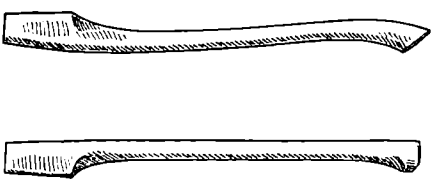

Fig. 4. Curved and straight axe handles before fitting.

(*c*) **Fit of Handle and Head.** (See Figs. 4 to 6.)

Points to note are:—

(i) Head well down on shoulder of handle.

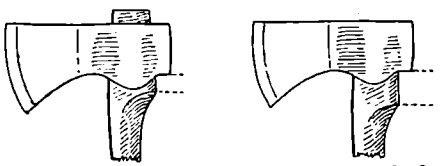

Fig. 5. *Left:* Head well down; *right:* wrongly fitted.

(ii) Head and handle in a straight line.

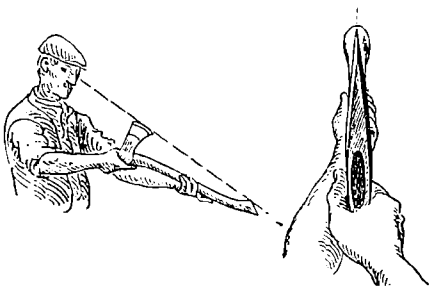

Fig. 6. Checking alignment of head and handle.

(iii) Head hung so that the middle of blade and end of handle touch a flat surface, so that contact is made about two-thirds of the way down the blade.

Hanging as in Fig. 7 helps to make the middle of the edge strike the wood first, thus ensuring even wear.

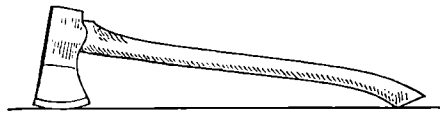

Fig. 7. Checking the hang of the blade.

Hanging an Axe

The steps in putting in a fresh handle are shown in Figs. 8 to 10.

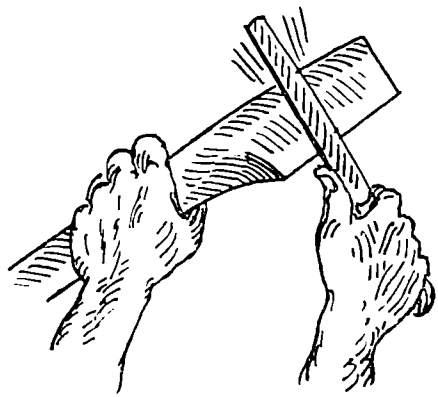

Fig. 8. Shape handle to fit eye of blade, using draw knife and wood rasp. Then assemble and test for alignment and hang, as shown in *Fig.* 7.

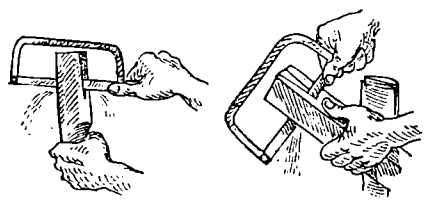

Fig. 9. *Left:* Take apart and make wedge slit with thin-bladed saw. Then, *right*, saw wedge from another piece of dry straight-grained hardwood. Saw roughness on edges is important as it helps to bind the wedge in the handle. Alternatively a metal wedge may be bought, or made from a bit of scrap metal.

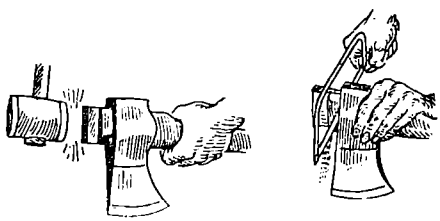

Fig. 10. *Left:* Assemble blade, handle and wedge, drive in wedge with a wooden mallet. *Right:* Saw off stub with a hacksaw.

When assembling, the best way to get the head well down on the handle is to hold the handle upright, with the head at the top. Then tap the butt of the handle on some firm surface, so that head works down under its own weight.

Photo. 1. Ramblers beside Loch Morlich in the Glen More National Forest Park, with the snowy summits of Cairngorm and Cairn Lochan beyond.

Photo. 2. Old established crop of stone pine, *Pinus pinea*, with understorey of Italian cypress, *Cupressus sempervirens*, planted on terraced limestone hillside. Trees about 60 feet high indicating the potentialities of such sites. San Martino alla Scala, near Palermo, Sicily.

Photo. 3. Plantation of Aleppo pine, *Pinus halepensis*, with some stone pine, on terraced limestone hillside, showing the enormous amount of work necessary to conserve the little remaining soil on these eroded mountains. The two forms of *Cupressus sempervirens*, erect and spreading, are seen in the foreground. Unreclaimed hillsides in background. San Martino alla Scala, near Palermo, Sicily.

Photo. 4. Terracing on steep eroding hillsides ready for planting. Terraces go right to the edge of the precipice. Monte Pellegrino, near Palermo, Sicily.

Photo. 5. Afforestation of very bare rocky limestone slope, showing good stand of stone pine and Aleppo pine, with some Italian cypress. All pit planted. About 20 years old. Monte Pellegrino, near Palermo, Sicily.

Photo. 6. Transplant section of nursery. One year seedlings of Aleppo pine recently planted in pots. Two year seedbed of *Acacia cyanophylla.* (*A. longifolia*) on left. Forest Station, foot of Monte Pellegrino, near Palermo, Sicily.

Photo. 7. Eighteen-year-old single line mixture of *Eucalyptus rostrata* and stone pine, with *Ailanthus* in foreground. Pines about twenty feet high pruned to ten feet. *Eucalyptus* 30-35 feet. State Forest Experiment Area, near Piazza Armerino, Sicily.

Photo. 8. Single-furrow Type F Cuthbertson Plough in action hauled by Fowler F.D.3 fitted with 26-inch wide tracks.

Photo. 9. Single-furrow Type F Cuthbertson Draining Plough. Note furrow slice completely inverted and being pushed clear of drain by trailing mouldboard.

Photo. 10. Double-furrow Type P Cuthbertson Draining Plough ready for action. Note furrow cut by Type P starting at main or cut off drain previously cut by single-furrow Type F machine.

Photo. 11. Typical example of work carried out by double-furrow Type P Cuthbertson Draining Plough on *Molinia* peat in ideal ground conditions. Note cut off or main drains running at an angle to furrows cut for planting purposes.

Photo. 12. A comparison. *Left:* Furrow Slice cut by Type F single-furrow Cuthbertson. *Right:* Furrow Slice cut by No. 3 Hill Type Begg Plough. Note different shape of Furrow Slice.

Photo. 13. The R.L.R. Plough hauled by a Class IV tractor in action.

Photo. 14. A good example of R.L.R. ploughing on sloping ground. Cut off drains have been sited to coincide with compartment boundaries and extraction routes; this will ease the problem of maintenance.

Photo. 15. Rear view of Begg No. 3 Plough in action hauled by a Class V Crawler Tractor

Photo. 16. Trix Twin Motor Cycle converted to carry two Knapsack Pumps, at Blandford Forest, Dorset.

Photo. 17. Sir Arthur Gosling, Director-General, inspecting the new Thinnings House at Santon Downham, Thetford Chase. Also in the picture are: Miss Joyce Priest (Utilisation Development Section), Mr. F. G. O. Pearson (Forest Products Research Laboratory, Princes Risborough); and Mr. J. M. Kennedy (Chief Sales Officer, Directorate for England).

Photo. 18. A view of the Thinnings House in course of erection. Among those inspecting it are: Captain J. Maxwell Macdonald (Home-Grown Timber Advisory Committee), Mr. G. W. Backhouse (Conservator, East England), Mr. J. L. Davidson (Utilisation Officer, Thetford), and E. G. Richards (Utilisation Development Officer).

Photo. 19. Two forest workers' houses built of Canadian red cedar (*Thuja plicata*) and roofed with cedar shingles, at Herodsfoot Forest, Cornwall.

Photo. 20. Four new bungalows for forest workers, at Inshriach Forest in Strath Spey, Inverness-shire. Framed in home-grown softwood, these houses have roofs and outside cladding of Canadian cedar shingle.

Photo. 21. Members of the Society of Foresters of Great Britain visiting Thornthwaite Forest in the Lake District, May, 1955.

Photo. 22. Protective burning beside the deer fence, at St. Fillans Forest, Perthshire. Looking towards Loch Earn from the braes of Dundurn, 1,000 feet above sea level.

Photo. 23. The morning break. A planting gang on Ben Ledi, in Strathyre Forest, Perthshire.

Photo. 24. The origins of turf planting. A "turf nursery" at the Loch Ossian plantations of Sir John Stirling Maxwell, Corrour, Inverness-shire, in 1933. Once the spruces were established they were moved, complete with turf, to their final stations, as in the foreground.

Re-wedging

Every axe will need re-wedging at some time. This is merely a matter of picking out the old loose wedge and cutting and fitting in its place a thicker one. The tests for alignment and hang used when hanging an axe (see Figs. 6 and 7) should also be applied to an axe which has been re-wedged.

Replacing a Broken Handle

The stub can usually be got out by sawing it off close to the head and then driving it out backwards with a tommy bar and hammer. Do not try to get it out by hitting the axe head itself, or even by burning, as that would upset the temper of the steel.

Sharpening an Axe

This is done with a smooth hard whetstone (see Figs. 11 and 12). Rub equally along the whole width of the bevel so as to keep the original convex shape of the blade. Give both sides the same attention so that the edge will remain parallel with the shaft.

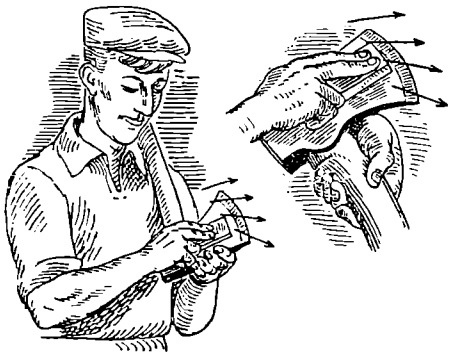

Fig. 11. Hone with a circular motion of the whetstone.

Fig. 12. Avoid cuts, don't let fingers overlap end of stone while honing.

Grinding

After many sharpenings the bevel tends to become curled over and re-grinding is necessary. This should be done on a wet, slowly rotating grindstone. (See Fig. 13.)

Begin 1 to $1\frac{1}{2}$ inches back from the edge of the blade and thin the latter down to the proper taper. The aim should be to shape the cutting edge like a long thin wedge—not chisel shaped. The taper will vary with the type of axe and with the kind of wood on which it is to be used. Gauges for testing whether the desired taper has been obtained can be made from scrap metal, using a new blade as a guide. Turn the grindstone *towards* the axe and move latter back and forth while grinding so as to obtain a smoothly tapering edge.

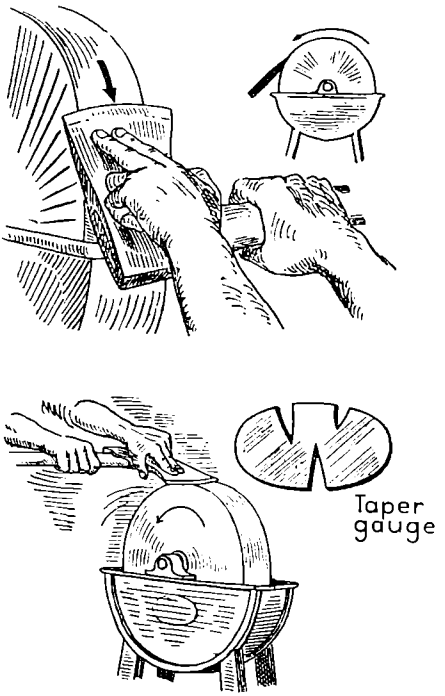

Fig. 13. Grinding the blade.

A felling axe should never be hollow ground. (See Fig. 14.) It should have a profile as in Fig. 14 *left*. If it is for splitting, the profile should be as in Fig. 14 *centre*. After grinding, the axe should be honed, first on one side and then on the other to take off the "wire edge".

***Fig.* 14.** Profiles for axe blades: *Left:* for felling. *Centre:* for splitting, *Right:* bad, hollow-ground profile.

Note. An axe ought not to be ground on an emery wheel as it might easily become hot and so lose its temper. Further an emery stone is too fierce and the edge given is likely to be too thin. Nor should the sharpening be done with a file as this gives a rough edge.

The "shoulder" of an axe blade can be removed with a file, but the latter must not follow up to the cutting edge.

If the grindstone is rotated *away* from the axe the effect is to cut more slowly and to create a bigger burr on the edge.

Splintering

If a chip with an *even* edge breaks off from the sharp edge of an axe the cause is likely to have been a too thin edge, a glancing blow, or insecure fixing of the handle to the head. When the edge of the chip is *uneven* the fault is probably in the steel.

Effect of Cold

An axe which has been out in intense cold should be warmed—either by holding it near a fire or by rubbing it against a coat—before being used. If this precaution is not taken the axe may break because steel becomes very brittle at low temperature.

Use of the Axe

No axeman is worthy of the name until he can make left-handed and right-handed cuts with equal accuracy. (Both left-handed and right-handed actions are shown in the illustrations.) Skill with an axe can only be acquired through practice.

There are two main types of stroke—the vertical stroke shown in Figures 15 to 17, the horizontal stroke shown in Figures 18 and 19. Both are used in the process of "setting up", and their combined effect is to cut out a wedge-shaped chip of wood.

Watch an expert at work. He stands loose and relaxed. He holds the axe with one hand gripping just above the bulge at the end of the handle, and the other hand lightly clasping the handle near the tool's point of balance (see Fig. 15).

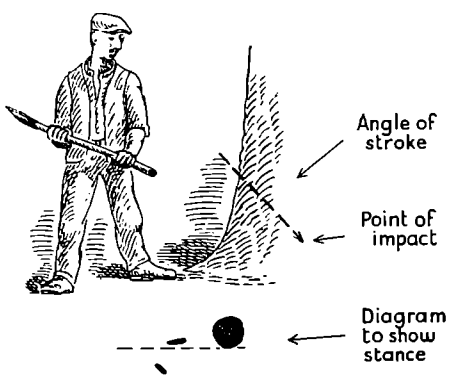

Fig. 15. Stance before upstroke.

On the upstroke this hand slides up the handle close to the head. (Fig. 16.)

Fig. 16. The upstroke.

On the downward stroke this upper hand slides back along the handle until, as the axe strikes the tree, it is close to the lower hand (Fig. 17).

Every blow lands where it is intended and with the proper force. There is no shock to the hands or shoulder.

Fig. 17. The downstroke.

The most difficult cut to master is the low horizontal cut, all-important in "setting up" (see Figs. 18 and 19). For this the legs should be spaced well apart and the axe swung so that the hand at the grip is brought down to a point between the legs, and at the same level as that at which it is intended to make the cut. A popular rule is that the back of the hand should be "low enough to brush the bootlaces". The guiding hand is used to ensure that at the moment of impact the axe is neither deflected up nor down from this level.

Fig. 18. Start of low horizontal cut.

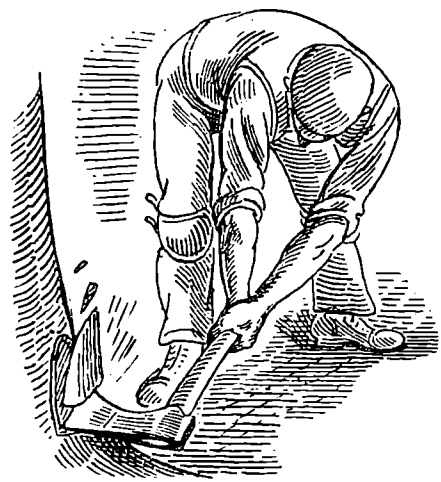

Fig. 19. End of low horizontal cut.

Some Other Grips

A number of other grips are used by experienced axemen, for such work as pointing or trimming stakes. (See Fig. 20.)

Fig. 20. Grips for pointing and trimming stakes.

Care of the Axe

Keep your axe sharp and use it with respect. Never use the head to drive in iron wedges, as this is sure to deform the eye and so loosen the head. For long distance carriage and when travelling in vehicles provide some simple form of sheath or box so as to preserve the edge, and avoid any risk of accidents.

Safety Precautions

Be careful where and how you lay your axe down and remember where it is. Many accidents have been caused by stumbling over a carelessly placed axe. A careful woodman usually "masks" his axe in a stump when not requiring it for a while (see Fig. 21).

Remember too, that if a falling butt or branch strikes an axe, it may fly through the air with the greatest of ease.

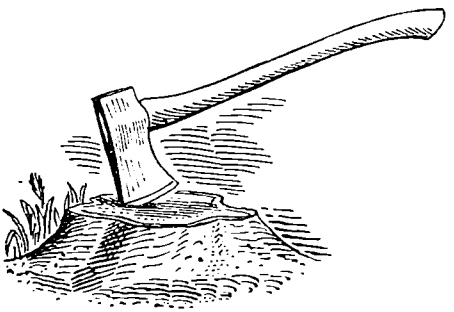

Fig. 21. Masking an axe.

When crossing rough ground or obstacles, it is better to carry the axe in one hand as shown in Fig. 22 (*left*), gripping it at the point of balance near the head rather than over the shoulder. Then, if you trip or stumble the axe can be thrown away from yourself easily and naturally.

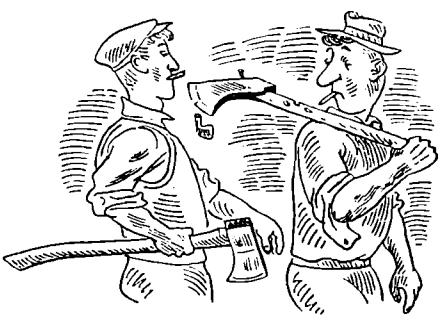

Fig. 22. "I always said it was sharp."

Never start felling until you are sure that there are no branches which could be struck as you swing your axe. Many bad cuts have been caused by an axe which has been deflected by some small branch or twig. (Fig. 23.)

Fig. 23. It's a hold-up!

Never put any part of the body in front of the axe in the direction of cutting. This applies especially to feet, e.g. never use a foot to steady a piece of cordwood which has to be axed through. (Fig. 24.)

Fig. 24. Weary, and about to become footsore.

Special care is required after rain when bark and wood are slippery.

Finally, *never* stand behind another man who is wielding an axe.

We are indebted to the Forest Service of the United States Department of Agriculture for permission to draw certain illustrations from their *Northeastern Loggers Handbook*, by F. C. Simmons. (Govt. Printer, Washington, 75 cents). Col. A. H. Lloyd, of the Imperial Forestry Institute, Oxford, has kindly assisted with the text.

MOBILE ACCOMMODATION UNITS

By R. R. MESTER

Conservancy Engineer, North-West England

Despite its name, a mobile accommodation unit is no more than a single-decked omnibus, withdrawn on account of age from normal stage carriage service, and converted departmentally to provide field or site accommodation to the design required. All such vehicles employed are retained as self-propelled units and are by no means on their last legs mechanically. Initially our engineer roadmaking operations involved a site establishment which consisted variously of hutting for offices, stores and shelters. Such accommodation was of necessity semi-permanent and static by nature and erection took time and frequently involved site preparation of some permanency. Bearing in mind removal costs and the condition of the huts, which imposed a definite limit upon the frequency of re-erection, offices and stores had to remain more often than not in the positions either initially chosen or available—a disadvantage which became more apparent as operations expanded, with roadheads advancing ever further from the centre of local administration. In addition to the needs of the major site, there arose a growing need for road and other engineer items of work to be undertaken at detached sites. It was therefore felt essential that our engineering resources be quickly re-established upon a mobile basis with offices, stores, shelters and combinations thereof, all on wheels.

Towards the end of 1949 consideration was given to the development of some mobile unit which could be cheaply and effectively adapted to meet with these requirements. The most effective solution appeared to lie in a modification of some existing vehicle, and thus was born the idea to purchase and adapt single-decked motor buses. A purchase was made on February 17th, 1950, from Crosville Motor Services Ltd., of Chester, at a cost of £51 apiece, of two 32-seater Leyland Lion buses. These were the last survivors of the famous petrol-engined Leyland Lion Type 29 PLSC 3 of 1927 vintage, still in possession of the original Leyland-built bodies. This type of body—front entry with rear emergency door and higher off the ground than any subsequent type—possessed an internal skeleton partition, which with glazing, had once provided two compartments within the bus. It was thus a simple matter to board up the skeleton partition and provide once again two compartments with a connecting door. Some seats were removed to allow the installation of tables, cupboards, safe and stove, the rest being retained in position. Both buses were provided with external shutters, locks were fixed to all external doors, and their bodies were repainted in the approved departmental dark green livery. In April, 1950, a third experimental vehicle was put into service as a shelter unit at Thornthwaite Forest in the Lake District. This vehicle carried perimeter seating and required no alterations apart from the fitting of locks and repainting. It had been originally ruled that the buses were to be rendered immobile by the removal of their engines, in which case they would have become trailers. This appeared to be quite unnecessary, as the vehicles were being sold as "runners" and in view of the relatively restricted mileage they would be called upon to operate, could be economically kept as such. We had in fact obtained the self-propelled vehicle required at the outset, and the upshot was that the vehicles were retained as self-propelled, registration particulars being amended accordingly to show change of ownership and change in taxation class from "hackney" to "goods", for as such were the bulk of our future purchases to be operated. The success of these early adaptations resulted in the acquisition of further vehicles, all Leyland

but of deliberately selected variation in body detail and by the end of 1951 a fleet of seventy-nine was in use throughout the English Directorate.

Improvements both in technique and conversion detail have been made in the light of experience gained, and in the North-West England Conservancy we now group our mobile accommodation units as follows:—

(*a*) Office Units

(*b*) Stores Units

(*c*) Shelter Units

(*d*) Composite Units which offer any combination required of the above

(*e*) Living Units

(*f*) Special Units, comprising vehicles allocated to special duty rather than to any particular adaptation.

As we have several sizes of bus so may we vary the capacity of the accommodation offered. This is also possible by the partitioning of a number of the larger vehicles. The internal arrangement of the offices usually provides for the use of some original seating, but stores units have all seats removed and may be fitted internally with protective window mesh and may in addition carry shelving if needed. Shelter units are now normally combined with labour units which consist of selected buses without internal adaptation which daily bring labour to roadhead and there remain as shelters if required.

Living vans were a later development and have been adapted to provide accommodation for plant operators and skilled workers in connection with mobile construction group activities, especially in remote areas where local labour is in short supply or entirely lacking. The living vans at present offer two compartments, a rear one with three beds—these are collapsible and removable —and items of furniture to a very simple scale, and a front one for cooking and eating. Calor gas appliances have been installed for both cooking and heating, and more recently independent light switches have been fitted together with built-in sink, cupboard and other domestic conveniences. Where the size of mobile group so warrants, it has been found sound practice to allocate a unit solely for messing purposes at roadhead, where cooking is done in the front compartment and food served for eating in the rear compartment.

As already mentioned, every vehicle moves under its own power but there is considerable variation in annual mileages run, ranging from several thousand to a purely token figure. All the buses possess good manoeuvrability and operate the many steep gradients which occur both on the public and on the forest road systems in the hillier parts of the Conservancy, with relative ease. To facilitate repair a stock of essential spares has been acquired for a very modest outlay, although the age groups of the vehicles range from 1927 to 1936.

When a new major roadmaking operation is started, the advantages of mobile accommodation units have been clearly demonstrated, as for example in 1950 at Spadeadam Forest in Cumberland when a stores unit carrying sleepers and essential stores arrived at the new site in the morning, followed by the mobile office unit in the afternoon. The latter immediately took up position on the sleepered stand laid with the materials carried in the first unit. Thus before the end of that day office and stores units were both in position and in use and these, followed by a shelter unit, completed the initial engineer site establishment; with the elimination of delays which would otherwise have resulted in the provision and erection of hutted accommodation on a wild, exposed and remote moorland location.

CONVERTING A MOTOR CYCLE TO CARRY TWO KNAPSACK FIRE PUMPS

By W. J. GREEN
Forester, South-West England

The pannier bag carriers on a motor-cycle of the Triumph make, type TRW.499 c.c., can readily be converted to take two knapsack pumps for fire-fighting, as follows:

Remove pannier bags, bolt a metal sheet the size of knapsack pump on the base of carrier with a two inch flange on the outside, with two eyes to hold straps taken from pumps. The straps will then pass up and over the top of pump and fasten together from each side above the mudguard carrier.

Remove foot plate from pump, this will give a proper setting in the pannier bag carriers. A sponge rubber fitted on the inside of the pump filling cover will give a water-tight seal, so that water will not splash out when the motor-cycle shakes.

Every effort should be made to keep the pumps full to capacity to get a good balance with the motor-cycle. The finished job is shown in Photo. No. 16.

A HANDY STAPLE EXTRACTOR

By W. F. STODDART
Forester, Education Branch

An item of equipment which is not included in the Forestry Commission Tool Sheet and which is an essential tool in fencing operations is the Staple Extractor. I made one from a broken garden fork some years ago and found it to be excellent for the purpose, combined with hard-wearing qualities. It is made as shown in Figure 25.

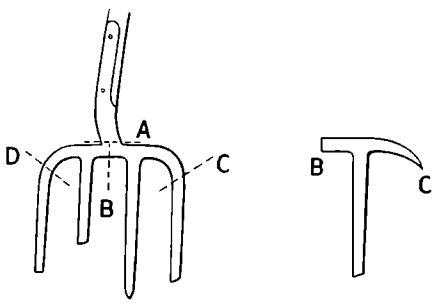

Fig. 25. *Left:* Cutting a broken fork to get two staple extractors. *Right:* Staple extractor with the point tapered at C.

The broken fork is cut at points A, B, C and D (Fig. 25) by heating with a blow lamp and cutting with a cold chisel. It is a waste of time to attempt the cutting with a hacksaw, the steel is much too hard. After cutting, points C and D are tapered to a point with a steel rasp or file. The prong which forms the

handle can be fitted with a wooden handle if desired but this is not really necessary. From the broken garden fork illustrated, two staple extractors can be made.

The quickest method of having the extractors made is of course by taking the broken garden fork or forks to the nearest blacksmith for heating, cutting and shaping and the job will be done in a fraction of the time taken by the first method.

In use, the sharp point C is inserted below the bend of the staple. The long handle gives excellent leverage, and the blunt end opposite C serves as a fulcrum. Thus the most obstinate staple quickly yields.

A CONE SPLITTER FOR SEED SAMPLING

By ANGUS MACDONALD
Forester, Research Branch

During seed extraction of some special small lots of lodgepole pine it was discovered that the yield of seed from a half bushel of one-year-old cones was six times that of a consignment containing a high proportion of old cones. It was therefore decided to get more data to establish whether it was in fact worth while collecting any but one-year-old cones. It was suggested, therefore, that one-, two- and three-year-old lodgepole pine cones should be collected and kilned separately, and that a separate sample of cones should be split lengthwise in order to see from the sections what proportions of seed they contained. No suitable tool for splitting the cones was available and a simple tool was made to carry out the work. The main purpose of this note is not to give the full results of this preliminary test, which indicated that yield of seed fell off fairly quickly with the age of the cones, but to describe this home-made cone splitter which was tried in 1954-55 with a high degree of success on various large conifer cones. The tool proved satisfactory for splitting medium sized (one and a half to six inches long) cones of a variety of species, and a description of how to make and use it may be of interest to foresters who, on occasions, wish to estimate probable yield of seed from particular stands.

Material requirements, which are generally available in most forests, are:—

2 pieces of hardwood 12 by 3 by 2 inches, for side blocks.

2 bolts 4½ inch.

1 Yorkshire billhook (some other types would be suitable).

2 pieces of tin 9 by 1½ inches, or thin galvanised iron sheet.

1 board 16 by 4½ by 1 inches.

A few screw nails.

The two lengths of three-by-two are grooved as shown in Fig. 26, so that when they are brought together the result is as shown in the figure.

Holes are then bored through the two three-by-two side blocks, and a Yorkshire billhook, which has been well sharpened, and through the "hook" of which a hole has been bored, is pivotted on one of the 4½ inch bolts. Finally the board is nailed to the bottom of the side blocks. To reduce wear and tear of the wood, the groove can be lined with tin or thin galvanised iron sheet.

In order to steady the cutter in operation it is an advantage if the tool is screwed down onto a rigid bench. In operation the cone is placed in the groove, near to the pivot and below the cutting edge of the cutter and the billhook pressed firmly through it.

Any handyman can make this tool in a very short time and the billhook can be detached easily when it is required for another job.

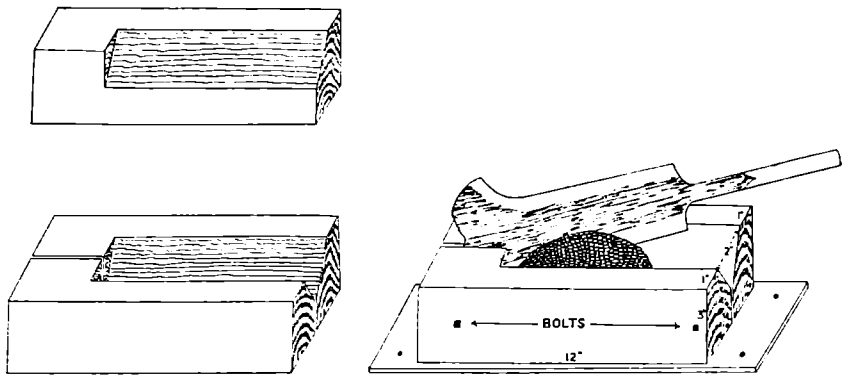

Fig. 26. The construction of a cone-splitter. *Top left:* One side block cut from a piece of hardwood. *Bottom left:* The two side blocks ready for assembly. *Right:* The cone-splitter in use.

A VANISHING CRAFT

This article, by a well-known timber merchant who writes under the pen-name of "Aesculus", is reproduced by the kind permission of the Editor of "Timber and Plywood".

Like every other operation carried out manually, there appears to be a great danger that felling will soon become a lost art. I have vaguely realised for some time as have no doubt a great many other people, that trees come into the mill these days looking very rough, with the sprun left on at the butt, and often with quite a lot of good-sized twigs left on the side of the tree nearest the ground when it fell. Indeed, on a few occasions I have even fetched the men into the mill and told them to finish the job.

This was done in the hope of trying to keep the standard to something reasonable, until circumstances made it possible to demand and get a really workmanlike finish. But the other day I really did have a shock.

A gang of timber fellers who were working in a neighbouring wood were described to me as "real craftsmen". Well, it was a long time since I had seen work that gave me real pleasure, and the man who described it has a high standard, although no experience before 1945. So on his recommendation I went to look. The stools were low, lower than is common today, but for the rest of the work, if it had been 1938 I would have sacked the gang at a moment's notice.

Misnomer

It was only the term "real craftsmen" that made me realise how far what passes today for good work falls short of what would have been very mediocre work fifteen year ago. The limbs of all these trees I was sent to look at had been cut off with a saw. At one time the only place where the marks of a saw were visible on a log was the butt; in good work, all the limbs were trimmed off with an axe until the surface was flush with the bark of the tree. Occasionally, a really serious breaking might have a limb cut off with the saw, but even here the work was trimmed up with an axe until no nasty lumps marred the contours of the trunk.

The sprun where the tree might have pulled out a little as it fell, was cut off, so that the butt presented a flat surface. That has to be done at some time, since if it is not done, every board or scantling which is cut from that butt has an unsightly and even, perhaps, a dangerous snag left on it. But this sprun is very rarely cut off by the fellers today and has to be done by millworkers. There is a disadvantage in axing all knots flush with the bark, in that quite a small knot will be made to look large by reason of the cutting away of the wood around it to get it well down; but the advantages in handling a well-rounded log more than far outweigh this.

It is doubtful if a big log with sawn-off branches could be led by horses at all; the stubs foul undergrowth and old stumps in the wood, and the packings of the wagon and other trees in loading, and it is, of course, much easier to get the trees to lie well together if they are trimmed smooth. None of this matters so much with tractors. Brute force will usually accomplish what once needed skill, and a broken rope or chain will be paid for by the boss. If he is stupid enough to want trees moved, he ought to be made to pay anyway.

In the mill the well-trimmed tree lies much more quietly on the bench than does one which slides all over the place on a lump of a knot. Indeed, it is almost impossible today to get some trees to lie on a rack bench table at all, so roughly are they trimmed. And the planks from a badly trimmed tree will have to go to a circular saw to have the lumps cut off their edges before they will look presentable.

I almost feel it would be worthwhile setting up an old fashioned sawpit so that a record could be made of the opinions of the sawyers on the work of the fellers. Whether the remarks would be classed as obscene literature or horror comics seems doubtful, but that they would be actionable, seems certain.

THE FUTURE OF HOME GROWN SOFTWOODS

By ANDREW WATT
Conservator, Headquarters

The substantial forestry programme on which this country is engaged is sufficient excuse for examining briefly the past and present status of home softwoods in the consumer markets, and for suggesting the possible future trends in production and consumption.

It is widely known that, before the 1939/45 war, home softwood met only a small part of the country's needs of timber and timber products. In Scotland, where most of the forest area was—and still is—devoted to the growing of

softwoods, the bulk of which consisted of the indigenous Scots pine, a fairly steady outlet for home softwood had long been established; the mines, the boxmakers and the railways met some of their requirements in home softwood; another important outlet was the agricultural market for fencing and farm building work. Elsewhere in Britain home softwood was of limited and intermittent importance. It should be remembered that the softwood produced in the pre-war period came largely from the bigger-sized trees and there was only an insignificant trickle of small-sized material such as is coming out in substantial quantities at the present day, not only in Scotland, but to a greater proportional extent in England and Wales.

The 1939/45 war bit deeply into the home softwood growing stock and at the present time, due to necessary restrictions on clear cutting, production from the thinnings of the younger softwood plantations contributes a substantial proportion of the total. The effect of the 1953 windblow in North-East Scotland has upset temporarily the general pattern that has been taking shape since the end of the war. It is difficult to assess accurately how much of the increased consumption over the past eighteen months or so in, for instance, the mining timber market, is due to the effect of windblow production, and how much is due to the growing scale of thinning operations throughout the country. It is significant, however, that before the windblow the consumption of home round mining timber in Scotland was steadily increasing, and elsewhere home production was being taken up in greater quantities by the mines. Other industries which use—or can use—relatively small-sized material are also at the present time providing a market: of these the building board and pulp industries are probably the most important, and are likely to become a key market.

Over recent years, and more so in the past few months, attention has been drawn in various journals to the relative importance of thinnings in our forest economy and to the need for finding additional and new outlets for small-sized softwood. It would be unfair to give the impression that neither growers, timber merchants nor consumers are giving attention to the problems posed. Indeed in some quarters the problems are being tackled vigorously and, without attempting a comprehensive survey of the work going on and projected, the general lines of approach may be briefly mentioned. Growers are constantly examining silvicultural techniques, particularly of the newer and less well tried species; converters of timber are developing sawing techniques for small-sized softwood; and consumers, such as pulp and board manufacturers, are steadily acquiring valuable knowledge about the possibilities of home softwood in their industrial processes. Of parallel importance is the work being done by the timber trade's own Timber Development Association, and by the Government's Department of Scientific and Industrial Research through the Forest Products Research Laboratory at Princes Risborough.

It is sometimes forgotten that a substantial proportion of the younger softwood plantations established since 1919 are of species relatively new to this country. There is a vital and continuing need to find out the intrinsic qualities of the timber being produced at home and more particuarly of species such as Sitka spruce, which is bulking even larger in the tremendous planting programmes now being carried out than was the case between the wars. The proposed introduction of grading rules for homegrown softwood is evidence of the appreciation by foresters, timber merchants and users of timber of the need to define quality if the best use is to be made of home production.

At this point an examination of the age-class distribution of softwood areas in Britain and of the probable distribution in the future, coupled with an estimate of current and future thinning production, may help to pose the

problems in perspective. Figure 27, and the following table indicate clearly the probable trend of softwood thinning production, and help to emphasize the comparative and growing importance of small-sized material. Although there are markets capable of using material of the type and size that will be produced, the quantity of such material will be so far beyond the current volume that expansion of existing outlets, and the establishment of new markets will be necessary.

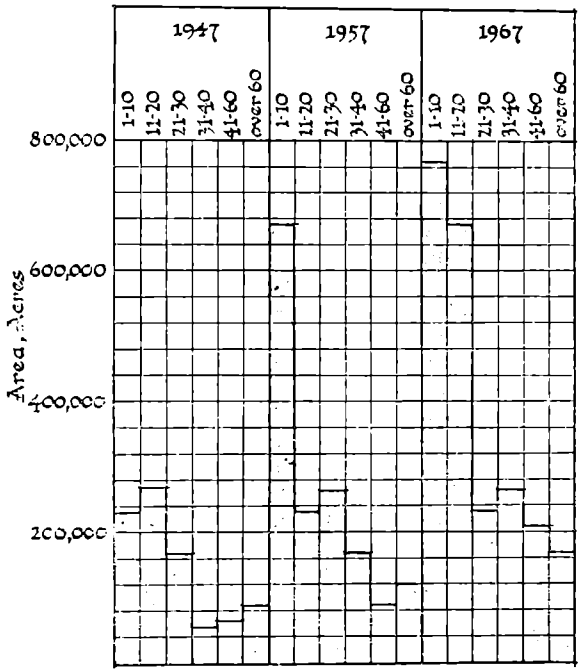

Fig. 27. The likely trend of age-class distribution in mainly coniferous woodlands in Great Britain, from 1947 to 1967.

TABLE

Woods in Great Britain. Mainly Coniferous.
Estimated potential thinning production
(Volumes in million cu. ft. (hoppus))

	6in. and under (Quarter girth at 4ft. 3in.)	*Over 6in. (Quarter girth at 4ft. 3in.)*	*Total*
1950	14.4	4.6	19.0
1960	18.9	5.1	24.0
1970	30.6	7.8	38.4
1980	53.5	12.3	65.8

Reference has been made earlier to the importance of the mining timber market for home softwood. While over the country as a whole home-produced round props are meeting less than a quarter of the mines' requirements, it is possible that the production of mining timber in certain regions could exceed the requirements of those pits which presently provide the outlet. Further, it may be impracticable, because of size or specification or of distance, to market the

surplus in other coalfields. It is in such production regions that the development of other markets will be of importance. The interest of the home building board industry will, it is hoped, expand, but its requirements are met largely from material unsuitable for mining timber. The box and packing case trade will probably take an increasing interest in home supplies as material of even grade is available in steady quantities, but here, as in the case of mining timber, geography and economics cannot be ignored.

Another, and potentially the most important, new outlet is the pulp market. As a country that imports pulp and pulp products on a vast scale, Britain has not in the past given much attention to the possibility of pulping home softwood, nor indeed has the home supply position warranted it. The question of economic supply and the general scattered nature of production have delayed until comparatively recently the proper examination of this form of utilisation. However, the outlook and the prospects are changing. It is highly unlikely that there could be established, in the foreseeable future, pulping plants of the size of those in use in the major timber producing countries, but it is not impossible to visualize smaller units in or near those areas where distance from existing markets will make it difficult, to say the least, for production to compete in, for instance, the mining timber market with supplies from nearer at hand. The main timber importing countries are all faced with the task of making more and fuller use of their own timber resources. Considerable advances have been made in recent years in the technique of pulping and there is no reason to expect that further advances will not be made in this field. The increasing use of pulp, paper and paper products in developed countries and the vast potential requirement in the under-developed countries are clear pointers to the future demand.

This article has concentrated, excusably, on the usage and the future use of the increasing production from thinnings of relatively small size, for that is clearly the major trend over the next twenty years or so. It would be unwise, however, to ignore other relatively new uses and what can be regarded as the more traditional uses. In the former category, plywood and laminated wood have a place, and no doubt as regular supplies of suitable material become available home timber may well find a useful outlet. In the latter category comes sawn softwood, the uses of which range from joinery and high-class structural work to other less exacting general purposes. Home softwood, even of the newer and virtually untried species now being planted extensively, is certain to find its due place in meeting the requirements of users of sawn softwood.

In considering the future pattern of production and consumption, little reference has been made to what may well be the most critical factor—the factor of economics. Timber and timber products are to some degree subject to internal competition; for instance, hardboard and chipboard are to some extent substitutes for sawn timber; paperboard packaging can in some cases be used in place of wooden crates. Timber and timber products are also open to competition from other materials such as steel in a fairly wide field, from underground supports in mines to building constructional works. Apart from these internal and external pressures which will undoubtedly persist and intensify, there is the competition to be faced by home timber and timber products from imported supplies. Without delving deeply into economic trends, it is clearly not enough to face the problem of the increasing home softwood production without appreciating that the benefits to the country of providing more of our own needs cannot be won unless the growers, merchants and the users realise that standards of efficiency in its widest sense must be constantly improved.

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THE THINNINGS HOUSE

Contributed by the Timber Development Association

The older forests planted by the Forestry Commission and a good deal of woodland in private ownership are now yielding considerable quantities of timber in the form of thinnings. The Forestry Commission has been giving a great deal of attention to uses for thinnings and some while ago its Advisory Committee on the Utilisation of Home-Grown Timber, on which are represented the home timber trade, private woodland owners, the Timber Development Association, the Forest Products Research Laboratory and other Government bodies, approached the Timber Development Association for an opinion on the practicability of using softwood thinnings in the construction of houses.

The Timber Development Association has accordingly developed a system of construction involving the use of thinnings. This permits plenty of latitude in design and could be used for a bungalow type dwelling, an upper storey on a conventional base or, with a different framework, a two storey house.

The system of construction is amenable to modular planning—that is to say standardised and interchangeable units can be used without restricting either the size or design of a particular building. It was deliberately planned to permit fabrication by very simple woodworking machinery, but mass production methods may be employed if desired.

A prototype building has been erected by the Commission at Santon Downham, in their forest of Thetford Chase in Norfolk, and will be used by them as offices. To measure the efficiency of the design, tests on the weathering and insulation values of the various components are being made; their strength is not in doubt. With the exception of the joinery timbers, which were cut from home-grown Scots pine, and the home-grown oak block floor, all the timber used in the construction of the offices is from thinnings of home-grown conifers. The diameter of the logs from which the timber was cut ranged from 4 to 12 in., in lengths of 43 in. to 15 ft.

The Load-Bearing Skeleton Framework. The prefabricated wall frames consist of horizontal and vertical members spaced to accommodate standard doors and windows, the panels which are not required for doors and windows having diagonal bracing inserted to provide the necessary stiffness. These frames may be constructed of softwood or hardwood.

The skeleton framework itself may be provided in prefabricated units running the full length and depth of a house. Framed together into one large unit 25 ft. long and 8 ft. high, they would weigh only about 5 cwt. and, for example, with a brick party wall three such units would enclose the whole of the plan of a semi-detached house up to first-floor level with a stiff self-supporting structure erected with the minimum of labour. The ends of the first-floor joists would be supported on the tops of the ground floor frames, the first-floor frames being superimposed and, in turn, carrying the roof structure.

External Cladding Units. The external cladding units are, in effect, large prefabricated wooden tiles made up from 1 in. by 3 in. or similar sections of preserved softwood thinnings. These tiles are hung on and nailed to the skeleton framework at the site with the joints between the boards vertical. They may be up to 3 ft. in depth and of widths corresponding to the vertical members in the skeleton framework, varying from 1 ft. 8 in. to 4 ft. 7 in. with a bias in favour of the standard module of 3 ft. 4 in. The 1 in. by 3 in. boards are nailed to a framework of similar section to form shallow trays.

Offices at Santon Downham. Three types of cladding unit have been employed in the experimental offices at Santon Downham, one without filling, one with a filling of sawdust cement and one cross-battened with timber slab filling.

The roof design is a variation of the Timber Development Association roof, with the trusses bolted to the tops of the vertical posts in the prefabricated wall frames. The roof covering is clay tiles over roofing felt.

In one room the floor is of oak blocks bonded to a concrete sub-floor and in the other of 1 in. by 4 in. softwood boarding laid over joists.

This article originally appeared in the magazine "Wood", and we are indebted to the Editor for permission to reproduce it. The Thinnings House itself is shown in Photos. 17 *and* 18.

NOTES ON HOME-GROWN TIMBER AND ITS USE ON THE FARM

By C. D. BEGLEY
District Officer, Research Branch

Timber is a traditional material for farm buildings and equipment. During and for some years after the war, however, the use of timber was strictly controlled and the use of substitutes was often encouraged in the national interest. There are no longer any restrictions on the consumption of timber. It is true that the heavy fellings of home-grown timber made during the war have necessitated the retention of control over the felling of growing trees, but production from thinnings is increasing yearly and the overall supply picture is one of an abundance of home-grown timber for use on the farm.

Most farms, certainly in the lowlands, have some place, however small, which could carry a few trees, and in many cases a small plantation could be made without encroaching on arable land or pasture. A farmer may however be discouraged from spending money on planting trees because he can see no early prospect of harvesting the timber, since it is not always realised how soon a plantation (particularly one of conifers) can provide material which can be sold or will be useful on the farm. Some broadleaved trees, notably sweet chestnut and poplar, also yield useful produce at an early date.

To give examples, a fast-growing conifer, Japanese larch, in very favourable site conditions, can yield useful timber after nine years, and even slower-growing conifers, such as Scots pine, can produce the same class of material in eighteen years, in equally favourable conditions. As conditions become more exacting, these times would be increased but generally not by more than a few years.

Here is a list, compiled for fast-grown European larch, showing the kind of material which could be manufactured from poles taken from the plantation in its early stages:

	European Larch
Age of Plantation	
12 years	Rustic Wood—for use in gardening. Light stake. Hay tripod or tetrapod.
15–25 years	In addition to the above:— Round Post. Sawn Post. Stack Prop. Clothes Prop. Fencing Strut. Intermediate Post.

In addition to these products, poles of comparable size can be used, round and half-round, to make a large variety of farm equipment, including shelters, poultry houses, tool boxes, etc. These items can be made quite easily by anyone with a reasonable skill in carpentry, and the only sawing required can be done with a portable circular saw driven by a power take-off from a tractor or Land Rover.

Minor woodland produce which can be sold from time to time, and in the early years of the plantation's life, includes decorative foliage from trees of the cypress type (Lawson Cypress and *Thuja plicata*), and Christmas trees from the tops of Norway spruce thinnings or young spruce trees planted amongst the main crops for this purpose.

All the products already described are made from poles removed in thinning operations in order to improve the growth of the trees which remain. The cash value of the trees which are left steadily increases, as does the range of uses for which the timber from them can be used.

Plantations have purposes other than the production of timber, which are no less important and which should make them attractive to the grower. High amongst these must come their sporting value. Furthermore valuable shelter for stock can be gained by wise siting and layout of plantations. In any event, a wood, whatever its main purpose, will always serve to enhance the appearance of a property.

One question has yet to be answered—what is the quality of the timber likely to be produced from these plantations? With traditional trees such as oak, beech, ash, Scots pine and European larch, many farmers and estate agents will feel able to answer this question with some confidence. In the case of certain other species such as Sitka spruce, Norway spruce, Japanese larch and Douglas fir, now being grown on an increasing scale in this country, their experience may be limited to the imported timber, and they may require some assurance as to the likely quality of the timber from the same species, when grown in this country.

The first point to be borne in mind is that, even with the well-tried trees, quality depends to a considerable extent on where the tree was grown (soil, exposure, drainage, etc.) and how it was grown. Too often is a timber condemned as rough, or misshapen, on the evidence of specimens sawn from open-grown, park or hedgerow trees, or from trees grown on unsuitable sites. If the tree has been planted well and tended during its growth, there are grounds for believing that in important characteristics the sawn timber of mature trees will compare favourably with imported timber of the same species. Where it is likely to differ it will do so in two respects, growth rate and the amount of denser-walled late wood or summerwood formed in proportion to the thinner

walled springwood. Both these features depend (amongst other things) on the climate, the site and the age of the tree. An equable moist climate and a fertile soil may encourage rapid growth and, in this country and in certain trees of a given size, a high proportion of less dense spring wood. This may adversely affect, (but not necessarily) the strength and working properties of the timber; with oak and ash, for example, the quicker grown material will be stronger. It must be emphasised however that there are limits (of growth rate, etc.) below which the deterioration in question, if present, is small or negligible, and that site factors and management techniques often result in keeping the growth of the tree within these limits. Recent research also has shown that as the tree grows older, the quality of the timber laid down each year tends to improve in these respects. This is a most significant point which must not be overlooked.

Where woods are properly managed then, and where there has been a wise choice of species for the site in question, the timber produced should be perfectly suitable for use on the farm. When one is purchasing timber for any specific purpose it may be important to obtain a certain grade for the job. In this respect home-grown timber has been somewhat at a disadvantage as compared with imported timber, in that there have hitherto been no grading rules for home-grown sawn timber. Grading rules for British softwoods have now been drawn up by a Committee on which timber trade interests were represented, and they afford a simple and reliable means of specifying a particular quality of timber as governed by the job for which it is required. It is intended to draft similar rules for home-grown hardwoods. This means that as stocks of home-grown timber become more plentiful the farmer, once he or his agent has decided on what is the right quality of timber for the job, can approach his local merchant and place his order by simply specifying the grade and species required. Should the merchant not hold graded stocks, or should the farmer himself hold stocks of timber, the rules can be used quite easily, to grade the timber.

Durability

A number of tree species provide timber which is naturally durable, that is resistant to a high degree to attack by wood-rotting fungi. This timber usually consists of the heartwood of these species. As a general rule the older the tree the higher the proportion of heartwood. The timber of younger trees, therefore, is likely to be less durable than that of older trees, and this is particularly so with the timber of trees taken out in early thinnings; with most species, these have a high proportion of sapwood. In short, timber cut from the same species of tree can vary in durability according to the age of the tree and the part of the tree from which the timber is cut.

Most timber is durable if conditions are favourable, that is, providing the moisture content of the timber is below a certain critical value (about 20 per cent of the oven-dry weight of the timber) and that the timber is sound and not exposed to damp conditions. Should it be necessary to use a timber in unfavourable conditions, for example, out of doors or in contact with a source of damp, the timber can be rendered resistant to decay by treatment with a preservative.

Some species of tree grown in this country yield timber which is resistant to preservative treatment, that is, difficult to impregnate with preservative; but as with natural durability this property of resistance varies with the age of the tree and the position in the tree from which the timber comes, the sapwood being rather easier to treat than the heartwood of *the same species*. Fencing material usually comes from young trees which may have a high proportion of

sapwood, therefore even with "resistant" species, such as the spruces, with this class of produce treatment with preservative is worthwhile.

There is a good deal of information on the durability of samples of timber containing a proportion of both sapwood and heartwood. The indications are that with well-creosoted Scots pine, which represents a timber that can be treated readily with a preservative, a life of fifty years or more can be expected. With the spruces, a "resistant" species, the degree of penetration by the preservative is less and one would not expect them to have so long a life. It should be possible however to obtain a life of twenty years or so. The degree of penetration does of course depend to some extent on the method used, but even with the simple open tank method using creosote a life of twenty years has been obtained with round fencing posts made from "resistant" species (including Norway spruce) and the final life of the test posts, which are still intact, may be even greater. Some species which are highly susceptible to decay, but which can be treated easily with preservative (an example is birch) can be given a very long life by such treatment.

To sum up, the life of all timber from species commonly grown in this country can be extended by effective preservative treatment. With properly seasoned timber this is only essential where it is likely to be exposed to dampness. With naturally durable timbers it is necessary where a long life is required or where conditions are likely to be exacting. Effective preservative treatment is possible with all non-resistant home-grown timbers, and with "resistant" timbers containing a fair proportion of sapwood (e.g. early thinnings) to a lesser degree, using the simple open tank system. The extended life varies with the degree of effective penetration but it is reasonable to expect, using the correct techniques and creosote (other preservatives have not yet been fully tested) a life of twenty years even for "resistant" timbers of the kind already described.

A list of possible uses of home-grown timber follows. It is by no means comprehensive but it indicates the kind of thing for which home-grown timber has been used successfully. No distinction has been made between round timber and sawn timber but in most cases where there is a difference this will be obvious.

Conifers

The timber of these is known as softwood

Scots Pine

Fencing posts and rails, harvest poles, rustic furniture, carpentry, joinery (except fast-grown material), carcassing and siding for wooden byres, etc., boxes.

Spruces

Fencing posts and rails, harvest poles, rustic furniture, ladder poles (selected) rick poles, indoor joinery (except fast-grown material).

Douglas Fir

Fencing posts, cleft fencing (useful for shelter in market gardens), useful substitute for sweet chestnut when creosoted because of the ease with which it can be cleft, carcassing, siding, heavy structural timber (except fast-grown material), rustic furniture.

European Larch

Fencing posts (round and sawn), rails, gates, implement sheds, poultry houses, pig shelters, etc.

Weather boarding and water troughs, hurdle stakes, barn posts, rustic furniture.

Corsican Pine

Fencing posts and rails, harvest poles.

Japanese Larch

Most of the purposes for which European Larch is used.

Broadleaved Trees

The timber of these is known as hardwood

Oak

Posts round and sawn, gates, gateposts, wheelbarrows, wheelwrights' work, wagon scantlings, barn posts, doors, flooring, standing boards in stables.

Ash

Cart shafts, handles for various agricultural tools and implements, wagon work and coach building (e.g. framework for loose boxes), handles for wheel barrows, bean sticks, posts and rails. For uses involving resistance to impact, fast-grown timber is needed.

Elm

Bullock cribs, sheep troughs, weather boarding, waggon bottoms, wheel barrows, farm furniture (trestles, work benches) mallet heads. Any job where a tough timber (one that resists impact) is required.

Sweet Chestnut

Posts sawn and round, gate posts, close-board fencing, hop poles, standing boards in stables, useful substitute for oak in some joinery work.

Sycamore

Dairy furniture and implements—also a useful timber for general joinery.

Yew

Sawn posts, rails, gate posts.

Beech

Joinery, farm furniture, fence posts (when creosoted).

Birch

Joinery (from well grown, large trees), fence posts (when creosoted), handles.

Poplar

Brake blocks, bottoms for carts, trailers and wheelbarrows. Bean sticks, clothes props, fencing stakes (when creosoted).

Cherry

A strong timber useful for joinery purposes. Fence posts, rails.

THE PRESERVATIVE TREATMENT OF TIMBER

Foresters are naturally much concerned about the methods of prolonging the service life of timber used in their operations. Moreover, they are frequently asked questions of a more general character by members of the public faced with some problem of preventing decay in, for example, building timbers or furniture, whilst our estates staff are closely concerned with these matters in their daily work. We are indebted to The British Wood Preserving Association, of 6 Southampton Place, London, W.C.1, for permission to reproduce the following papers giving guidance, in general terms, on this subject. The Association will gladly supply copies of these papers on request, together with further information on appropriate preservatives.—Editor.

The Case for Preservative Treatment of Timber

(*Wood Preservation Leaflet* 3)

Many of those softwoods and hardwoods which are readily available in quantity and reasonable in price are not resistant to decay and to attack by animal organisms. It has long been realised, however, that effective preservative treatment will render such timbers immune to attack by these destructive agents. For many purposes durability is very necessary, and arguments in favour of preservation will therefore rightly be based on economic considerations. Obviously each case must be considered on its individual merits.

The basic questions to be answered are as follows:—

1.—What are the risks involved and what is the severity of possible attack?

2.—What preservative should be used?

3.—How should the preservative be applied?

4.—Will treatment of the timber save money?

The financial balance sheet should take into account not only initial cost, but also the annual cost.

Wood-Destroying Agents

There are a number of ways by which timber may be rendered unsuitable for its normal purposes and the destructive agencies vary in character and also in the method in which they work.

The more common wood-destroyers are:—

(*a*) Fungi which cause decay,

(*b*) Insects which attack freshly felled timber or partially dried timber,

(*c*) Insects which attack timber in use,

(*d*) Animals which attack timber in water, particularly sea water, and

(*e*) Fire.

The Nature of Decay

Decay in timber is due to the action of certain fungi which live on dead organic matter. Fungi are really plants growing from spores or seeds which, individually, are microscopic and are so light in weight to be easily windborne. In favourable conditions these spores can germinate to produce new growths of fungi. For germination and growth, air, moisture, suitable temperature and food are required, and the absence of any one of these will delay or prevent decay.

In Great Britain the rainfall and the atmospheric humidity provide sufficient moisture, particularly in timber exposed out-of-doors, and the normal temperatures are suitable for the rapid growth of fungi.

Timber, particularly sapwood, which contains starches and sugars, is an ideal food unless it is treated with a preservative which is toxic to fungal growth. Some species of timber contain a greater proportion of these food substances and are, therefore, more liable to attack; whilst others, such as western red cedar, oak, etc., naturally contain a toxic chemical which accounts for their durability even when not treated with preservative.

Fungi differ in their requirements and there is a wide variation in the rate in which they attack timber. Wood-destroying fungi live not only on the food in the cell cavities, but also the food in the cell walls. It is the attack on the cell walls that causes the loss in strength associated with decay. On the other hand, sap-staining fungi that cause, for example, Blue Stain, live mainly on the contents of the cells, and attack by these staining fungi does not result in any appreciable weakening of the timber.

Insects attacking freshly-felled timber

Insects that attack timber may be divided into two classes, first, those of the Pinhole Borer type. The adult beetle of these insects bores a hole in which to lay its eggs; the larvae hatching from the eggs do not make any fresh attack on the timber, but emerge through the hole bored by the adult. In doing so, the larvae live on fungi which line the bore tunnels.

Timber attacked by these insects is certainly disfigured by the holes, but the attack will not spread any further during subsequent usage of the timber.

Another class which causes more serious attack is the Powder Post beetle. These generally prefer timber relatively freshly felled and in this country the main species is the Lyctus beetle. This insect only attacks timbers with large pores and the adult female lays its eggs in the open ends of these pores. The larvae, on hatching, then proceed to work in the sapwood.

Insects attacking timber in use

Much has already been written of the Death Watch beetle which attacks mainly oak in old buildings. The common Furniture beetle has not received this attention, but its occurrence has increased to such an extent that it is now

responsible for the destruction of much structural timber as well as furniture. This insect can attack both hardwoods and softwoods, and timber commonly used for building purposes is, therefore, quite vulnerable.

Recently, another species, the House Longhorn, has caused serious damage to structural timbers in at least one area in the southern part of England.

For all these insects, the damage to the timber is caused by the action of the larvae, which live in the timber for periods which vary according to the species of insect concerned.

Animals attacking timber in water, particularly sea water

In coastal waters it is quite common to find timber, such as is used in piles, jetties and groynes, attacked by various animals such as Limnoria and Teredo. Limnoria is responsible for the peculiar hourglass shape of old piles, and attack is easily seen, but Teredo, which cause even greater damage, work beneath the surface of the timber, completely destroying the timber whilst superficially it is apparently sound, until the surface is broken by the action of shingle or other means.

Fire

Wood is commonly used for kindling fires and for this reason it is regarded as being one of the most flammable of all structural materials. In small sizes most timbers burn readily, but large members, even subjected to high temperatures, are consumed relatively slowly.

No material is completely fireproof and the fire-resistance of any structure depends not only on the resistance of the materials, but also on the method of construction.

It is now generally agreed that it is more important to have materials for which the rate of spread of flame is low, and the object of any treatment is now to provide extra time not only for the occupants of a building to escape, but for fire-fighting appliances to be brought into use.

Choice of Preservative

The ideal preservative should prevent attack by all the destructive agencies that have been mentioned. There is, however, no single compound which is equally effective against all these agencies. On the other hand, in any situation where timber is used there is rarely the same degree of risk from fungal attack, animal organisms or from fire. Timber in a house that is well designed, properly built and adequately maintained will be more likely to be infested by the Furniture beetle or the House Longhorn than by fungi, and there will certainly be no risk from marine borers. Untreated woodwork in piles and jetties will be more liable to attack by Limnoria and Teredo than by fire. It follows, therefore, that the choice of the preservative and the method by which it is applied must be governed by the magnitude and the type of attack that may occur.

Timbers in contact with the soil will mainly be exposed to wood-destroying fungi and a preservative should be selected, therefore, for its fungicidal properties and permanency. In old buildings the Furniture beetle and, in some cases, the Death Watch beetle, will probably sooner or later put in an appearance. In these old houses less attention was paid to the provision of adequate damp-proof courses and there is a bigger chance that maintenance has not been maintained and, therefore, fungi will also be a hazard. In laundries, dyehouses and in other

industrial buildings in which the relative humidity of the air is higher, the risk of decay is correspondingly greater and the preservative should again be selected mainly because of its fungicidal properties.

The Main Types of Preservative for Use Against Decay and Insects

Substances used for the preservation of timber against fungi, insects and marine borers are usually classified under the following three headings:—

1.—Coal tar creosote and heavy tar oils,

2.—Chemicals soluble in water, and

3.—Chemicals soluble in oils.

For preservative against fire, many of the substances covered under these three classifications are useless and a number of them, if anything, tend to increase the fire hazard. Fire-retardant chemicals must, therefore, be considered separately, but the majority of them are soluble in water.

Coal Tar Creosote and Heavy Tar Oils

The most widely used preservative is coal tar creosote, an oil obtained by the distillation of coal tar and having a boiling range within the limits 200°C. (392°F.) and 360°C. (680°F.).

Creosote, as used in wood preservation for well over a century and defined as above, is a highly complex mixture of various substances, but it has been found in practice that its composition is sufficiently controlled by British Standards Specification No. 144, which defines the limits for specific gravity, the relative quantities of the various fractions distilling in defined ranges of temperature, and other properties.

The compounds present in creosote, if extracted in pure condition, possess satisfactory toxicities in laboratory tests, the killing power depending upon the fungi used in the test. The oily portions possess lethal power, but also serve as solvents for the highly toxic compounds and ensure that they are permanently retained in the timber. A century of practice has shown that, when the timber is adequately impregnated, protection for long periods is given against all the common forms of fungal and insect attack.

From the heavy fractions of creosote oil a number of proprietary preservatives are obtained and several of these are on sale in this country.

Creosote and some of the proprietary Tar Oil Wood Preservatives are readily obtainable. They can be applied by impregnation, steeping, brush coating or spraying. They are generally very efficacious, but are not suitable for use on surfaces which are subsequently to be painted. Tar Oil Preservatives have a longer record of effective service than any other types of wood preservative and are by far the most widely used preservatives throughout the world. Some of the proprietary types give a pleasing and harmonious brown colour to wood and are also obtainable in colours other than brown.

For some interior work the odour of creosote is objectionable and another disadvantage under these conditions is the liability to stain adjacent plaster or paper. Creosoted timber should not be brought into contact with food products.

Chemicals soluble in water

A large number of water-soluble chemicals have been used during the past century for the treatment of timber, but many of the preparations to the early formulae were liable to be washed out if the treated timber were exposed to the

weather. The tendency, therefore, has been to use combinations of chemicals which become fixed in the timber and, therefore, usable for a wider variety of purposes. In the U.S.A. and in Europe, a number of water-soluble preservatives have been used with varying success. In Great Britain the number of preservatives is more restricted and those most widely used are proprietary. Information on the available preservatives can be obtained from the British Wood Preserving Association.

These preservatives are now widely used for a number of purposes ranging from railway sleepers, structural timbers, horticultural timbers, timbers used in ship-building and for a wide variety of articles required by the various Service Departments. The main advantages are that they have no smell and that with a number of them the treated timber can be painted or varnished, glued, while they do not discolour or taint adjacent articles.

Since these preservatives are water-soluble, the treatment causes the wood to swell, but accuracy of dimension can be maintained by careful attention to drying before and after treatment.

In general, these preservatives are used mainly for pressure impregnation although some concentrated preservatives are available for application by brushing or dipping.

Chemicals soluble in oils

This type of wood preservative includes various metallic naphthenates or else organic compounds, usually chlorinated naphthalenes and chlorinated phenols. Most of the oil-soluble preservatives are proprietary, but again information can be obtained from the British Wood Preserving Association.

Being soluble in oil, they are seldom soluble in water to any extent.

Advantages of this type of wood preservative are that they can be applied without causing change in dimension in the wood and when the solvents have evaporated the surface can be painted. Application is normally by brushing, spraying or dipping. They can also be applied by impregnation, but the cost would be appreciably higher than that of pressure treatment with either creosote or water-soluble preservatives. Most of them are available for use on the site and can be bought in relatively small quantities.

Fire-retardant chemicals

No known treatment is capable of entirely preventing the destruction of wood by fire and the main purpose of applying fire-retardant chemicals is to check the spread of fire. This can be accomplished in two ways: first, by treating the wood so that ignition is delayed, or secondly by preventing the treated timber from flaming. To achieve the former object, fire-retardant paints are often used and these contain chemicals which melt at low temperatures and run over the surface of the wood, forming a plastic cover which excludes the air that is necessary for burning.

To prevent flaming, the most commonly used chemical is monammonium phosphate which is generally applied by pressure impregnation. With this treatment the wood may be carbonised if the temperature is high enough, but there will be little or no flaming. With some of these salts there is a further advantage in that when flames from other material have died down, the treated timber immediately becomes inert and does not glow.

The main purpose of these fire-retardant treatments is to delay the spread of the fire long enough for occupants to escape and also for effective measures to be taken for the extinction of the fire before it has grown to unmanageable proportions.

Methods of Application

The methods of applying preservatives range from full impregnation using special equipment to give complete penetration of all sapwood and partial penetration into the heartwood, to brushing, spraying and dipping, the penetration with which is naturally more limited.

The method that is required will depend largely on the amount of protection that is necessary and will also be influenced by the type of preservative that is used. Where the hazard is high the maximum protection is essential. Where the risk of insect attack or of decay is slight or only persists for a very limited time, adequate protection may be obtained by the more simple methods of brushing, spraying or dipping.

Financial considerations

From the point of view of the user of timber, the financial considerations are probably the most important. To obtain a true indication of the benefits, financial and otherwise, of preservative treatment it will be necessary to know the life that can be expected if untreated timber is used. Taking the price of timber as approximately £120 per standard, if the untreated life is 2 years then the annual cost of the timber is £60. To this must be added the cost of machining and installation which will probably be not less than £80 per standard. The total annual cost will, therefore, be £100 per standard.

If adequately treated timber is used the cost of treatment will be about £10 per standard, but the life will be at least double—in most cases 10 times the life can be expected. The initial cost will be £120 per standard for the timber; £80 per standard for machining and installation; £10 per standard for treatment, giving a total initial cost of £210. With only twice the life the annual cost will therefore be only £55 per standard—a saving of 45 per cent.

This is the order of saving that would be made in laundries, dyehouses and places where decay hazard is high. In areas where the House Longhorn is prevalent the untreated timber life can be estimated as 12 years. In this case the annual cost of untreated timber would be £16 per annum, whereas the annual cost of treated timber would be £9, giving a saving again of approximately 45 per cent.

In a normal house built to-day only a limited amount of timber is used. If all this timber were treated it would cost about £16, which is less than 1 per cent of the initial cost of the building. This treatment, even in the very worst case where repairs and maintenance were neglected, would prevent decay and insect attack throughout the life of the house. The cost of preservation would be considered to be one premium paid for insurance against wood-destroyers.

Compare this with the normal premiums for fire insurance, which would be about £2 paid annually and would ultimately amount to not less than 10 per cent of the initial cost.

Preservative Treatment of Timber for Estate, Farm and Garden Use

(*Wood Preservation Leaflet* 2)

Introduction

Timbers have many advantages as materials, being strong for their weight, light to handle and relatively easy to work. They vary greatly in their ability to withstand decay and insects which live in or feed on wood. Even non-durable

timbers, properly seasoned, will remain sound for many years provided that conditions are unfavourable for the germination of the spores of fungi, which require moisture, air, and a suitable temperature for growth. In the absence of any one of these there is no risk of decay.

Timber used on estates or in gardens is, however, generally exposed to the weather and possibly is in contact with the earth and, being hygroscopic, although previously well seasoned, its moisture content will be affected by atmospheric conditions and soil moisture. Atmospheric humidity varies considerably and frequently, so the moisture content of timber used outdoors constantly tends to change, diminishing in dry weather and increasing when wet conditions prevail.

In the soil, moisture conditions change less quickly than in the air and so, after prolonged rain, they are more favourable for the absorption and retention or water by timber in contact with or buried in it. When soil is water-logged the spaces between the soil particles are filled with water and air is excluded. Hence fungi cannot grow in continually water-logged soils. Further the amount of water depends on other factors such as the size of the soil particles and the amount of humus present. Very fine particles, like those in clay, leave little room for air and soil water, while the coarse particles of gravels and sands have larger spaces between them for air and water although they allow water to drain away more quickly. Humus is retentive of moisture and humus soils are inclined to remain damp for long periods.

It is obvious, therefore, that the risk of decay will vary in different districts for in the first place the rainfall is below 20 inches per annum in the driest parts of Britain and exceeds 100 inches in some wet districts, while soils may be very permeable in one place and very retentive in another. In some districts soil acidity must be considered for the fungi which cause decay cannot live in very acid soils and so fence posts in boggy areas are likely to remain sound for far longer than in neutral or only slightly acid soils. On the whole, however, there is no ground for assuming that timbers, except those which are highly durable, can be relied upon in any part of Britain to resist decay when used for outdoor purposes unless given adequate preservative treatment. Such treatment is now more necessary because of the high price of timber and labour, making replacement more costly, and because timber of a particular species is not always readily available even at the advanced price.

Apart from this, preservative treatment efficiently applied adds very considerably to the useful life of timber, particularly the sapwood, which, untreated, may decay in a few months or at most a few years, whereas after treatment it will outlast the untreated heartwood of such a durable wood as oak. The cost of the preservative treatment should be regarded as an insurance premium against decay. It will be offset by longer life and the saving on new material and labour for replacement.

Purposes for which Preserved Timber may Profitably be used

The use of timbers having very great natural durability is often uneconomical. The heartwood of oak, for use for outdoor work, would, for example, cost more than a softwood efficiently treated with a reliable preservative although the latter would most probably have a longer service life. Timber used for the following purposes should, therefore, receive a preservative treatment which can be relied upon to give the protection necessary in the particular circumstances:—

(*a*) Wooden farm buildings, garden sheds, poultry houses, pig shelters, glass houses and garden frames.

(*b*) Standing boards and similar fittings in stables where the air is likely to contain ammonia.

(*c*) Bottoms and sides of vehicles which are used for carrying vegetables, green fodder, or other damp materials, and which may become very wet in rainy periods.

(Note: Suitable preservative treatment is more effective in preventing decay than ordinary paint.)

(*d*) Wooden gates, gate posts, fencing and garden stakes.

(*e*) Sheep hurdles and hurdle stakes. Bullock hurdles and cribs.

(*f*) Wooden parts of farm implements.

(*g*) Woodwork in hot-houses and green-houses in which atmospheric conditions are conducive to fungal growth.

(*h*) Wooden cold frames, the frames of Dutch lights, bulb trays, seed boxes, etc.

(*i*) Wooden path edging and other timber permanently exposed in gardens.

(*j*) Wooden store sheds, coal-houses or bunkers.

Types of Preservatives

Preservatives suitable for use on estates and for horticultural purposes are of three main types:—

(1) Tar oils, including creosote.

(2) Water soluble preservatives.

(3) Oil solvent types of preservative.

Most of these are sold under trade names, being proprietary articles, but will give satisfactory service if used according to the manufacturers' instructions. Many have been tested in laboratories and outdoors in this and other countries. The depth of penetration of a preservative is affected by its viscosity, "thicker" liquids penetrating less deeply in a given time and under a specific pressure than "thinner" ones. Since viscosity varies with temperature, the stickier types are best applied in warm weather. Tar oil preservatives generally have a pronounced odour and are therefore less suitable for use in houses than other types which are inodorous. For outdoor purposes they are very widely used and have proved reliable in service.

Water soluble preservatives are suitable for use for both indoor and outdoor purposes and this also applies to oil solvent types. The efficacy of any preservative depends on its toxicity to fungi and therefore all preservatives contain poisons. For this reason they need a little care in handling but when this is exercised the risk in applying them and afterwards is negligible.

Methods of Application

Preservatives may be applied to timber by one or other of the following methods:—

(*a*) spraying (*b*) painting

(*c*) cold steeping (*d*) hot steeping

(*e*) hot and cold steeping (*f*) pressure impregnation

Tar oils, other than creosote, are usually sprayed or brushed on to the wood. In cold weather deeper penetration is obtained if the preservative is warmed

before applying it. In hot weather when the wood is warm the preservative should be applied as cool as possible. When the preservative and timber are at different temperatures deeper penetration follows.

Cold steeping may be carried out in any suitable vat. The more prolonged the steeping the more effective will the treatment be, but penetration is slow. Hot steeping gives quicker penetration, and either method is usually more effective than spraying or painting.

Still better is the method usually known as the hot-and-cold open-tank treatment, in which the timber is placed in cold creosote in a tank which can be heated. Some tanks have steam pipes at the bottom for heating the contents. In other cases the tanks are heated by fires underneath. Whichever heat source is used the temperature of the liquid and timber is gradually raised to about 180° Fahrenheit and kept at that level for one to four hours according to the width and thickness of the timber. A constant check on the temperature should be maintained by means of a suitable thermometer. At the end of this period the liquid is allowed to cool with the timber in it. **It is during the cooling that penetration takes place.** It is advisable, when the tank is a permanent one, to have a light gantry erected over it to facilitate loading and unloading.

When considerable quantities of timber are to be treated time may be saved by transferring the timber at the end of the heating period to a second tank filled with cold liquid. In such a case a gantry over both tanks will expedite the transfer and save much time. There is no specified size for the tanks for this method. On some estates, tanks large enough to accommodate assembled field gates are used, but this, while convenient, is not essential provided that no mortices, tenons and bore holes are cut later.

The hot-and-cold treatment is much used for fencing and fence posts, and for the butt treatment of posts and poles a cylindrical tank in which the posts can be kept upright has advantages. An old oil-drum serves admirably for such a tank if it is set on a brick fire-box connected to a flue to carry away the smoke. This type is very convenient on a farm for treating fence stobs, hurdle stakes, etc., and can be built at small cost. After the butts have been treated the posts should be inverted and a second treatment given to prevent decay in the upper parts.

Such hardwoods as alder, beech, birch, horse-chestnut, hornbeam, lime and sycamore absorb creosote and water-soluble preservatives readily when the hot-and-cold method is used. Without treatment these timbers would rapidly decay but have a satisfactory life if treated as described above. Small trees of these species are almost unmarketable but may be economically employed on the farm or estate after suitable preservative treatment.

It is necessary to season timber before treatment, particularly when tar oil preservatives are used as these do not penetrate wet timber readily. A high moisture content is undesirable even when water soluble preservatives are employed since the water present in the wood tends to reduce the concentration of salts in the preservative. When for any reason green posts or fence rails are creosoted by the hot-and-cold method temperatures higher than 180°F. are sometimes employed. Since creosote does not begin to boil until the boiling point of water (212°F.) has been exceeded, it is sometimes suggested that the temperature of the liquid should be raised to slightly above 212°F. in order that the water present may be boiled out. This course is attended with an added risk of fire, for the excape of the steam causes excessive frothing of the creosote. Unless the tank is deep, adding to the labour of loading and unloading, the froth is liable to over-spill down the sides of the tank and ignite. If this happens the fire may spread up to the liquid in the tank and cause a conflagration difficult to bring under control. Further such high temperatures are liable to cause

deterioration in the strength of the posts through the development of large shakes or other defects.

A modification of the method may be employed with water-soluble preservatives. The timber to be treated is first heated to about 140°F. by immersing it in boiling water for an hour or until bubbling ceases, or steaming it in a steam chamber. It is then transferred immediately to a tank containing **a cold solution of the preservative.** In using water-soluble preservatives the instructions issued by the manufacturers must be followed exactly.

Pressure treatments require more elaborate and costly plants (from £2,500), including cylinders capable of withstanding pressures of 250 lb. per square inch or possibly more, storage cylinders or tanks, air pumps which are capable of being used either for exhausting the air in the pressure cylinders or increasing the pressure, and a source of steam for the heating coil in the treating cylinder. It is often desirable to add a weighbridge for determining the weight of preservatives absorbed and to have a narrow gauge rail track by means of which charges of timber can be run into the treating cylinder on bogies.

Such plants have been in use for many years for pressure creosoting timber and are also employed for impregnation with solutions of water-soluble salts. Very few estates are equipped with such plants, however, and therefore details of treatment will not be described here. Such plants in Britain mostly belong to contractors who operate economically by keeping them in constant use. Many timber merchants are now able to supply pressure-treated timber from stock or at short notice.

Choice of Treatment

The choice of treatment will depend on the preservative used, on the purpose for which the timber is to be employed and the length of life desired. Pressure impregnation with the more costly types of preservative is not economical; for this reason it is generally employed either with creosote or one of the water-soluble salts. Any timber which is to be used on or in the earth or in water, e.g. permanent fences, landing stages and floats, should receive an adequate pressure treatment. The added life of the timber will more than compensate for the cost of impregnation. Permanent wooden structures exposed to the weather, e.g. bridges, wooden buildings, pig shelters and poultry houses, remain sound much longer and cost far less for maintenance if the timber has been pressure impregnated. Less permanent fencing may be treated by the hot-and-cold method. Brush and spray treatments may be reasonably effective for some outdoor purposes if repeated at intervals of a few years and all of the above mentioned types are quite regularly so employed. In the absence of facilities for pressure or hot-and-cold treatment it is far better to apply one or more coats of a tar oil, water soluble or oil solvent type of preservative than to allow the timber to go into use in an untreated condition. Repetition of the application every two or three years usually proves effective in preventing decay except in timber in damp conditions. Repeated treatments of this kind may, however, in the long run prove more costly than pressure impregnation. Replacement of the timber through using it without treatment would nevertheless be far more costly.

Dry Rot—Causes, Remedy and Prevention

(*Wood Preservation Leaflet* 1)

Decay or rot is, at the present time, very widespread in the woodwork of houses and other buildings, yet existing decay and prevention of its occurrence are too often neglected.

Decay of timber in buildings results from the attack of certain wood-destroying fungi, amongst which are *Merulius lacrymans*—dry rot; *Coniophora cerebella*—often called cellar fungus, and several species of *Poria*. Dry rot is by far the most important and causes the largest proportion of damage to house timbers.

Growth Characteristics

The microscopic spores of wood-destroying fungi are produced in millions from mature fruiting bodies developed on wood already decaying. These spores carried by the air may be dispersed over large areas. If they fall on unprotected damp wood (at a moisture content higher than 20 per cent) they will germinate and form mycelium which sometimes looks like cotton-wool or felt, and eventually develop fruiting bodies which, in turn, will liberate more spores for air dispersal.

The growing fungus breaks down the timber, which darkens in colour, develops a characteristic cracked appearance, with cracking across the grain, becomes brittle, and loses its strength.

Occurrence

The dry rot fungus, as its scientific name implies, carries its own moisture and "weeps" on to timber, raising the moisture content to a point suitable for the spread of the fungus. Strands of specialized mycelium are able to pass over plaster, brickwork, concrete or stone, and even penetrate crevices in these materials to reach further supplies of timber. It is, therefore, possible for dry rot to spread from cellar to roof or from house to house. Although the occurrence of decay is more common in districts where the atmospheric humidity is high, and the rainfall fairly abundant, it is not confined to any particular locality. It is always most active where timber remains in a damp condition for any appreciable period of time.

Source of Infection

In houses which are well built and which have been maintained in a state of good repair, there is little likelihood of the timber ever reaching the critical moisture content of 20 per cent except through lack of proper maintenance or accidental damage.

Common causes of decay are burst pipes, particularly waste-pipes cracked in frosty weather, roofs that are not weather-tight, and, on the ground floor, stopped air-vents, or soil which is banked up above the damp-proof course.

Neglect of precautions in the building of houses and poor workmanship are also responsible for dry rot attack. Damp-proof courses may be inefficient or may be bridged over in cavity walls. Under-floor spaces may be inadequately ventilated so that the air is stagnant and the air-flow insufficient to keep the under-floor timbers dry.

Other cases of dry rot may be traced to war damage, and particularly to damage by fire. In such cases, first-aid repairs did not allow time for the drying out of the water used by the fire brigades, and in the subsequent period, during which the houses were frequently left unoccupied for weeks and even months, the timber remained in a suitable condition for the growth and spread of fungus.

Any cause that results in timber becoming damp without the opportunity of drying again fairly quickly is liable to lead to an attack of rot.

Common Causes

As dry rot cannot occur unless the timber is unduly damp, it is obvious that the first procedure, after discovering the incidence of decay, is to make a careful inspection to find out how and where the water is entering. *The source of supply of the moisture must be located and further entry prevented.* Some of the common causes may be listed as follows:—

i. Blocked gutters, especially in hidden valleys of the roof.
ii. Cracked or broken pipes, both water pipes and waste-pipes.
iii. Blocked air-bricks.
iv. Broken roof tiles.
v. Faulty flashing round chimneys.
vi. Faulty or missing damp-proof course.
vii. Faulty flashing round window frames.
viii. Solid stone or concrete floors with wooden skirtings.
ix. Solid floors covered with timber where the impervious membrane is punctured or of poor quality.
x. Unlagged steampipes, especially under floors.
xi. Steam condensate, particularly in wet process factories.
xii. Bridging over the damp-proof course by soil in flower beds, etc.
xiii. Trapping of flood water in under-floor space and over the concrete.
xiv. Condensation from old type gas geysers.
xv. Old water closets, either from fracture of the porcelain or, more commonly, from deterioration of the lead and sacking joint connecting the flushing water pipe to the pan.
xvi. Deterioration of mortar in brickwork joints.
xvii. Continued over-flow from cisterns.
xviii. Close fitting linoleum laid over unventilated or imperfectly ventilated wooded floors.

Symptoms

The signs of attack are not always obvious except after considerable experience. Where any of the following are observed thorough inspection is essential:

1.—Water stains on brickwork, plaster, etc.

2.—Crinkled or cracked surface of boards.

3.—The characteristic odour, recalling that of toadstools.

4.—Flaking paint—not always a sure indication but should be regarded as calling for careful inspection.

5.—The presence of lichen—is again not in itself proof but is a possible indication.

6.—Fruiting bodies of an orange to deep rich brown colour.

7.—Efflorescence of salts from the mortar is sometimes an indication of excessive dampness.

8.—The accumulation of a thick layer of red-brown spores on floors, ledges. furniture, etc., is the sign of a very heavy fungal attack.

Treatment

In locating the cause, some architectural knowledge is very valuable.

Badly decayed wood should be removed and burnt on the site, every care being taken to prevent spore dispersal. In cutting out the decayed wood, it is essential to allow a margin of safety by cutting well beyond (not less than 2 feet) the portions in which the rot is obvious. Plaster which shows signs of fungus should also be cut out, again with a margin of at least 1 foot round the obviously infected area. Following this, any walls showing traces of fungus mycelium or of fruiting bodies must be scraped clean and sterilized by heating with a blow-lamp, miniature flame thrower, or other convenient means. The heating should be continued until the brickwork is heated through and too hot to touch. Whilst still warm the brickwork should be given a liberal application of an efficient fungicide. This treatment not only kills the hyphae on and near the surface of the brickwork, but provides a toxic barrier against later attack.

Sound timber that is not removed from the vicinity should also be treated *in situ* by liberally brushing or spraying with a preservative. Timber used for replacements should always be treated with an efficient preservative, preferably applied by pressure methods. Pressure impregnated timber is today obtainable, without difficulty, through most timber merchants.

In buildings where the source of moisture cannot be removed, as in the case of old houses lacking damp-proof courses, it is *essential that the maximum protection be given to all replacement timbers.*

It is of the utmost importance that dry rot repairs should be as complete and efficient as possible as failure in this is most likely to result in a recurrence of the attack.

Prevention

Although good design and construction are the best preventives against decay, these can be nullified by bad maintenance. There are, however, some parts, even in a modern house, in which any timber used should be treated with a preservative. Wooden floors on concrete are usually nailed to battens set in the concrete. It is essential that the battens should be pressure-treated with a preservative, or, if this is not practicable, by an efficient surface coating of preservative: and although a layer of bitumen may be poured over the concrete to act as a moisture barrier or damp-proof course, it is still desirable that the boards themselves, or at least the undersides, should also be treated. Tiled roofs should be constructed with a layer of tarred felt or similar water barrier to prevent access of snow or of rain. The ends of joists and other timbers should be kept out of contact with the brickwork of the outside wall, or, if for any reason this is impossible, the ends, at least, of the joists should be treated with a preservative. Timber already pressure-treated can be obtained, obviating the need of work on the site.

Where there is any possibility that dry conditions cannot be maintained, it is essential that all timber should be pre-treated. In exposed places where rain is likely to be driven by wind between brickwork and window- or door-frames these latter need preservative treatment.

Inspection of Buildings for Conditions favourable to the Development of Dry Rot
A: The Outside of the Building

(1) The Roof

(*a*) Look for missing, broken, displaced or loose tiles or slates.

(*b*) Examine flashing around chimney, roof lights, etc.

(*c*) Inspect gutters and cornices.

(2) The Walls

(*a*) Notice the mortar of brick- or stone-work to determine whether repointing is necessary.

(*b*) Inspect damp-courses to insure that they have not been fractured, covered with earth or bridged by brickwork carried out at some period subsequent to the original work.

(*c*) Examine down-pipes from roof gutters: they may be cracked or leaking at joints or the water carried by them may be discharged into the earth near the foundations instead of drains or properly sited and constructed soak-aways. If there are outside service-pipes notice whether they are attached to walls or otherwise placed where water dripping from taps will wet the brickwork.

(*d*) Ivy or other climbers on walls may hide leaky pipes, faulty mortar, etc., and roots may undermine foundations causing breaks in damp-courses. Roots of nearby trees may cause similar damage to foundations and damp-courses and may penetrate into and eventually choke drains. Poplars have roots which may extend for many yards and robinias, too, spread underground, even when young, for considerable distances. They are best kept at least thirty yards from buildings. Willows sometimes form masses of root fibres in drains, completely choking them.

B: The Inside of the Building

(1) The Roof

(*a*) A sagging roof-tree may be due to loss of strength in itself or in supporting girders.

(*b*) Wall plates may become very damp through gutters becoming blocked or down-pipes choked.

(*c*) The ends of trusses are likely points of attack and built-in beams should be inspected.

(2) The Rooms

(*a*) Examine skirting boards, surrounds of windows and woodwork of shutters, where these exist. If any signs of rot are observed uncover lintels. Bulging plaster may cover bonding timber and should be removed.

(*b*) Lift floor boards and examine joists, looking particularly carefully at any built into brickwork.

(*c*) Inspect door-frames and lintels.

(*d*) Woodwork in water-closets and lavatories should be examined thoroughly.

(*e*) Timber in bathrooms, laundries, etc., may become dangerously damp though condensation of steam and should therefore be looked upon as more than usually liable to attack.

(*f*) All plumbing should be examined.

(*g*) Lift floor-boards of ground floors, inspect joists and sleeper walls and make sure that ventilation is adequate in all parts of the space below the floor. Dead-air pockets favour infection.

(*h*) Water pipes, especially those carrying cold water, cause vapour to condense on their surfaces. If these are in contact with timber it may become damp enough for fungus to obtain a footing in it.

(*i*) Examine the undersides of staircases where ventilation is sometimes inadequate.

(*j*) Solid floors are not infrequently attacked. If there is any sign of failure strip the boards or blocks for examination of water-proof coating over the concrete, the state of the fillets, etc.

(*k*) Wall plates, built-in beams and other structural timber in cellars should be carefully inspected and the adequacy of the ventilation ensured.

Preservative Treatment against Wood Borers

(*Wood Preservation Leaflet* 6)

Insect Pests of Standing Trees

Standing trees, particularly if unhealthy or damaged, may be attacked by a number of types of insects.

Certain moths, including the Goat Moth, Leopard Moth and some clearwing moths, breed in trees. Oak, ash, elm and other hardwoods may be attacked by the first named, pear and other fruit woods by the second and willow and alder by the third. The injury is not to be seen until the trees are felled and it is too late to take action. Poplars are often damaged by the large poplar longhorn beetle, the larvae of which bore more or less vertical galleries about the size of a pencil, from near the base of the tree upwards to a height of 8 to 12 ft. or more.

Sickly conifer stems, e.g. larch and spruce, are frequently found on examination to be the breeding grounds of either the giant wood wasp or the steel blue wood wasp. Occasionally adult insects of these species emerge from scaffold poles, ladders and even wood in buildings.

These are examples of insects which breed in standing trees and which may emerge from newly felled wood. They are the enemies of the forester and their larvae are rarely seen except when infested logs are being converted and the galleries in which they are feeding are exposed.

It is seldom that any insect pest of standing timber will cause anxiety to the householder.

Insect Pests of Converted Timber

The more important pests, the larvae of which attack felled and converted timber, are beetles of the order Coleoptera. They are very numerous and extremely varied in their general appearance and feeding habits. They include some of the largest and some of the most minute of living insects, but relatively few species infest converted timber in Great Britain.

The larvae of some beetles, such as Lyctidae and Bostrychidae, derive their nourishment from the starch or other carbohydrates which are present in the sapwood cells for some time after the trees are felled. Others, such as the common furniture beetle of the genus *Anobium* and the death watch beetle, genus *Xestobium*, of the Anobiidae, actually feed on the wood substance, consuming the cellulose and other constituents of the cell walls.

Preventive Measures

Attack by any of the wood-destroying beetles found in Great Britain can be prevented by adequate treatment, with a suitable preservative, of the wood before use.

The vacuum and pressure method gives the maximum protection with any timber. Permeable timbers may be effectively treated by the hot-and-cold open tank process or by prolonged soaking for several days in suitable preservatives.

Dipping, brushing and spraying with a suitable preservative can give effective protection if the preservative is thoroughly applied.

For pressure treatments and for the hot-and-cold process creosote or waterborne preservatives are used. For surface treatments, creosote, tar oils, suitable waterborne or oil soluble preservatives may be used.

Common Furniture Beetle—Anobium punctatum

The common furniture beetle naturally inhabits dead stumps and fallen branches in woods and hedgerows, but at the present time is found far more abundantly in the woodwork of buildings and furniture than in its original habitats. To-day it is exceptional in some parts of the country to find a building dating back more than 20 years which is entirely free from infestation, and in Great Britain most of the damage is found in timber which has been in use for 10 years or more. It is seldom found in furniture manufactured for less than that period, although attacks sometimes occur in the osiers used in basket work of less than that age.

Description of the Beetle

The adult beetles are 1/10 in. to 1/5 in. in length and are reddish to blackish-brown in colour. The first body segment (prothorax) is hood-shaped and when viewed from above almost completely hides the head. The upper parts of the body are clothed with a fine covering of short yellow hairs, and rows of small pits or punctures on the wing covers are well defined.

The females lay eggs in grooves on the surface of the wood, in joints which have opened slightly, or on the surface where the grain has been torn up in planing. The eggs hatch into white grubs having 6 minute legs and when mature are about $\frac{1}{4}$ in. long. The terminal segment of the grub is rather bulbous and the whole grub is bent into a crescent shape.

As the larvae feed on the wood they bore galleries which become partly filled with granular wood dust which feels like very fine sand. When fully developed, after 1 to 3 years, the grubs or larvae approach the surface of the timber and pupate. After the pupation period has been completed, the adult beetles bore small round exit holes about 1/16 in. in diameter. The adult beetles are capable of flight and this enables them to travel and infect other timbers.

In the period from May to September, beetles may frequently be found on the window ledges of houses containing infested wood.

Treatment

1. Furniture and small articles may be treated by fumigation, but this must only be carried out by specialist firms, since the fumigant is poisonous.
2. The most convenient way of treating infested timber whether in furniture or in buildings, is by the application of an insecticide solution to all parts showing signs of infestation, as well as to the adjacent timber.

Special attention should be paid to the undersides of drawers or tables, unpolished ends of legs, and to both the inside and outside surfaces of the backs of cabinets. All joints or cracks, whether in furniture or in structural timbers, should be well treated.

With structural timbers, dust and dirt should be cleaned off and surface covers such as carpets and linoleum should be removed so as to give access to the timber.

The insect does not lay eggs on painted or polished surfaces but may use old flight holes. This can be prevented by the *regular application* of furniture polish.

3. Where the attack is so severe that the strength of the timber is affected it may be necessary to replace the infested parts with new wood or plywood *which should be treated before being used.*
4. The most effective time for application of insecticides is early Spring to the late Summer. Whilst a single treatment may be sufficient, it is normally advisable to give two treatments during the period stated above and also as a precautionary measure to treat again in the following year.
5. The insecticide may be applied by brush, but where the timbers are not very accessible a spray may be required. The atomizer type of spray is not suitable. In addition it is advisable to inject the insecticide into exit holes with an injector or oil-can having a fine nozzle. This assists in eliminating insects which are still active inside the timber.

Death Watch Beetle—Xestobium rufovillosum

The natural habitat of the death watch beetle is in decayed parts of old trees, especially willows and oaks. In buildings, timber which is free from decay is rarely, if ever, attacked, the eggs being laid almost invariably in more or less decayed parts of the timber. Laboratory research tends to show that the duration of the larval period is affected by the extent of decomposition resulting from fungal activity. Thus, although the average length of the larval period is approximately 3 years, it is reduced very considerably by breeding the beetle in wood which has already been decayed by selected fungi, the temperature and humidity of the air being controlled. The condition of the wood appears to be important both to the common furniture beetle and the death watch beetle, for sometimes the infested wood will be deserted by the beetles on account of some change in the condition of the timber or because of the action of predatory insects.

The preference of the beetle for hardwoods (although softwoods are not immune) may account for the total damage by death watch beetle in the country being smaller than that due to the furniture beetle. The larger larval size of the grub and the long larval period may, however, result in the actual damage being more serious in the areas infested. In circumstances favouring attack, structural timbers may be so weakened that replacement is essential. In old churches and other buildings damage by both death watch and furniture beetles may be present in the same piece of wood. The timbers of old barns and old wooden ships may also be attacked. The "Victory", Nelson's old flagship, has been very seriously infested for a number of years.

Description of the Beetle

The death watch beetle, the largest of the British Anobiidae, measures from $\frac{1}{4}$ in. to 1/3 in. in length. Its colour is dark chocolate-brown with patches of short

yellowish hairs, which give the insect a variegated appearance. In old specimens these hairs may have been rubbed off, in which case the mottled appearance is less obvious.

The eggs, which are white, lemon-shaped and measure about 1/40 in. in length, are laid in open joints between adjacent timbers, in cracks or crevices in the surface of the wood, and sometimes within old tunnels and exit holes.

The larvae are curved white grubs covered with long fine yellowish hairs and are over $\frac{1}{4}$in. in length.

The phases of the life cycle are the same as for the furniture beetle, but the beetles commonly emerge in April, May or June, leaving a round exit hole about $\frac{1}{8}$in. in diameter. Attack by death watch beetle can easily be distinguished from that of other wood-boring insects by the presence of small bun-shaped pellets in the bore dust produced by the grub.

Treatment

Timber infected by the death watch beetle should be very carefully inspected, preferably by a competent entomologist, before any treatment is undertaken. Such inspection should, if possible, take place during the period April to June in which the beetles emerge.

Treatment with an insecticide by brush or spray during the emergence period of the beetle in spring or early summer is useful in destroying eggs and young larvae before they enter the wood, but it is doubtful whether such treatment will kill older larvae working below the surface at any appreciable depth.

The following is a summary of the recommended stages of treatment in an infected building:—

(1) Removal and replacement of actively infested timbers, the strength of which is deemed by an architect to have been seriously affected. Strengthening of such timbers to avoid their removal involves a risk of continued activity and spread of attack unless insecticidal treatments are also given, not only to the infested timber but also to timbers used for replacement.

(2) Removal of the superficial bore dust and debris from timbers by scraping and the use of a vacuum cleaner before treating with an insecticide.

(3) Two applications of an insecticide by brush or spray during the period April to June. Annual applications during this period for at least four consecutive years are desirable.

(4) Search for and destruction of death watch beetles on floors or beneath infested timbers during the above period.

(5) Inspection of timbers each spring for a period of years after treatment to detect any evidence of continued activity in the form of fresh exit-holes or bore dust, in which case further insecticidal treatments will be necessary as long as any activity remains.

Wood showing evidence of even slight damage ought not to be re-used unless sterilised by heat or given an effective insecticide treatment.

New timber should be sound, adequately seasoned and free from sapwood which is particularly liable to attack by fungi and insects. When oak heartwood is used, treatment with a preservative is not necessary, but softwoods (coniferous timbers), which are much less resistant to decay, should be given at least a surface coating with a good preservative having both fungicidal and insecticidal properties. If replacement timbers are pressure-treated with an approved preservative it is unnecessary to remove sapwood.

Powder Post Beetles—Lyctidae (Lyctus) and Bostrychidae

Lyctidae

Of the Lyctidae, two species namely *Lyctus brunneus* and *Lyctus linearis* occur in Great Britain and Northern Ireland. The former is slightly the larger and by far the more numerous.

Lyctus beetles are found in unseasoned or recently dried hardwood timbers, the pores of which are large enough to admit the ovipositors of the females for egg laying. Oak, Ash, Elm and Sweet Chestnut as well as some imported timbers are commonly infested.

Only the sapwood is attacked as it is the starch in this portion of the wood which provides the food for the larvae. In timber which has been cut for some time the starch may be so depleted that the grubs are unable to feed. Hence these pests are never found in old wood, but may be encountered in timber yards, fencing and also in comparatively new furniture if any sapwood has been included. Many cases of infestation have been reported by merchants holding stocks of susceptible timbers, and the presence of the pests is often revealed by small piles of fine powder on boards in the stacks. Kiln drying the timber before use will sterilise it if it has been infested, but whilst any starch remains in the sapwood cells renewed attack is not impossible.

Description of the Beetle

The beetles are of slender form, distinguishable from the Anobiidae and from the Bostrychidae by the thorax which does not protrude over the head.

Lyctus brunneus is 1/5 in. to $\frac{1}{4}$ in. long and is of a brownish colour. The widest part of the thorax is almost as wide as the abdomen. *Lyctus linearis* is slightly shorter, the wing cases are more definitely marked by parallel ridges and the thorax is distinctly narrower than the abdomen.

The eggs are spindle shaped and usually several are laid in a single pore. The larvae are curved white grubs with a yellowish head and dark brown jaws and when fully grown measure approximately $\frac{1}{4}$ in. in length. The exit holes are about 1/16 in. in diameter and are usually filled with a fine flour-like bore dust.

Treatment

Treatment is perforce very largely preventive, directed toward discouraging the female beetles from laying eggs in wood containing starch. This is achieved by spraying with an insecticide which is either repellent to the adult female or toxic to the larvae as they emerge from the eggs, or both. The grubs are similar in shape and size to those of the common furniture beetle, but are less bulbous at the ends and have more prominent breathing pores along the sides. A solution of benzene hexachloride containing the gamma isomer has given promising results when sprayed on timber. D.D.T. has also been employed in spray form. If the larvae are found in wood which has been taken into the factory or workshop, all sapwood should be cut away and burned. Until recent times Powder Post Beetle damage was absent in furniture because, when timber was far less expensive than it is to-day, sapwood was never included. It may appear wasteful to cut away the sapwood, but if pieces of furniture are returned to the manufacturer because they have active larvae in them, the cost of replacement may more than outweigh the value of the sapwood which might, on the grounds of safety, have been removed. It is not advisable to use sapwood for furniture or interior woodwork such as panelling, unless it has been effectively treated with an insecticide and is known to be free from infestation.

Bostrychidae

Bostrychidae are more prevalent in warm countries and are of minor importance in Great Britain, but may be found in some timbers imported from tropical countries, particularly West Africa.

Description of the Beetle

The adult beetle may be from $\frac{1}{8}$ in. to 1 in. long, usually dark brown or black in colour. The body is cylindrical, the antennae fairly short ending in a three-jointed club. The upper part of the thorax or second segment of the body projects over the head and is rough with short spines.

Both the male and the female adults bore into the wood, preferring the sapwood of ring-porous and large-pored hardwoods, but by far the greatest damage, however, is caused by the larvae.

Treatment

Any severely infested timber should be destroyed, but infestation can be controlled by sterilising the timber with a heat treatment in a kiln.

Preventive measures are the same as for Lyctus beetles.

House Longhorn Beetle—Hylotrupes bajulus

This was originally a forest insect, breeding in dead branches of conifers in Southern Europe. As climatic conditions changed the insect gradually spread northwards, at least as far as the countries bordering on the Baltic, and at the same time spread into the timbers of buildings to breed and feed.

The larvae are most active in the sapwood of softwoods, but although it was formerly a general belief that hardwoods were immune, recent cases of infestation of oak and other hardwoods have been reported from the Continent. Serious outbreaks in Great Britain were virtually unknown until recent years, and at present are restricted to certain localities.

It is known that, in England, the larval period may be as long as 11 years, in which case the damage caused in a roof member or piece of joinery may be so extensive that only a thin shell of sound timber is left. There is very little external evidence of infestation except that sometimes the course of the borings may be detected by an unevenness of the wood over them.

Description of the Beetle

The house longhorn beetle is somewhat flattened, measures from $\frac{1}{3}$ in. to 1 in. in length and is brown or black in colour. The head and prothorax, the first body segment, are thickly covered with grey hairs except for a smooth central line on the prothorax, on each side of which is a shiny black prominence. On each wing cover the grey hairs are grouped in patches which are often fused to form two transverse bands.

The larvae are straight-bodied fleshy white grubs, clearly divided by deep transverse folds into a number of rings or segments. The head is sunk in the prothorax segments so that only the dark brown jaws are visible. When fully grown the larvae are commonly $\frac{3}{4}$ in. long but may attain a length of about $1\frac{1}{4}$ in. The grubs feed for a relatively long time, which, however, varies to some extent as in the case of other longhorn beetle larvae, with the moisture content of the wood and with the temperature.

Treatment

Eradication of the pest is not an easy matter, as will be obvious from what has been said. On the Continent, roof timbers have been treated by sealing the roof space and blowing in steam. It is claimed in France that benzene hexachloride preparations containing 1 per cent of the gamma isomer are efficacious. It has been suggested that the preservative should be forced under pressure into holes bored in the infested timber. It is not advisable for a householder to attempt any treatment for exterminating this pest himself; he would be well advised to call in an expert who will supervise the work. To ensure immunity from attack the timber must be given treatment with a suitable preservative resulting in complete penetration of the sapwood by the preservative prior to its installation.

Pin-Hole Borers, Scolytidae and Platypodidae

Pin-hole borers are beetles which attack freshly felled logs and possibly, in some cases, sickly standing trees. They are found chiefly in tropical and sub-tropical forest regions, and appear in a matter of a few days or even hours when felling in an area begins. These beetles do not continue working or extend the damage in seasoned timber in use.

The adults of these insects are responsible for the bore holes which are used to receive the eggs, which are deposited in niches along the galleries. The beetles carry into the borings the spores of certain fungi from which mycelium develops in the galleries and provides the food for the grubs. The growth of fungus in the galleries often causes staining in the surrounding wood, seen on the surface in the form of dark rings round the openings or bore holes. The peculiar feeding habits of the larvae of pin-hole borers have given rise to the name "Ambrosia Beetles". It is characteristic that the tunnels seldom contain any bore dust.

Various types of galleries are made by different species of borers and they do not usually follow the grain, but after penetrating the wood radially for a short distance, change direction and often take a course at right-angles to the original one and possibly following the boundary of a growth ring. This change of direction may be repeated two or three times.

The beetles vary in size, the smaller species making galleries of the diameter of a fine needle, whilst those of the larger species may be 1/16 in. or more across. It is important to be able to recognise these peculiarities because the adult beetles do not appear in converted seasoned timber, manufactured wood or furniture. Although the borings are regarded as a serious defect by the merchant it is quite safe to use timber having ambrosia beetle damage, i.e., pin-hole borings, for purposes where the surfaces marred by the pin-holes are not visible. It is unusual for the damage to be sufficiently extensive to reduce the strength of the wood to any significant extent.

NEWSPRINT PRODUCTION AT SITTINGBOURNE, KENT

By J. R. B. MARSHALL
District Officer, North-East England

There are very few paper mills in Britain which commence manufacture from the timber stage; and the only large one is at Sittingbourne in Kent; it is owned by the British firm of Bowaters.

Pulpwood is received at the mill in pieces 37 to 42 inches in length, up to 10 inches in diameter and reasonably knot-free and straight. Spruce is the most suitable wood for pulp, but other conifers are accepted and a very small quantity of the softer broadleaved timbers. Resinous woods tend to clog up the machinery. It is of interest to note that the required moisture content for pulping is 35-45 per cent; fresh-felled timber has a higher content, but by the time logs reach the mill they are usually naturally seasoned to this figure. Wood drier than this produces a pulp of poor quality unless steeped in water before treatment.

The pulping process used for newsprint is mechanical as opposed to the various chemical processes, which are used to produce better quality but more expensive pulps for other types of paper. Newsprint pulp does not have the lignin removed, and this ingredient causes newspapers to turn yellow after a period of a few years.

The bark is removed from the logs in a mass process by means of a revolving cylinder—or "drumbarker"—which is slotted with angle iron and carries four tons of pulpwood in the bottom half of the drum. It is the size of a railway engine boiler. Each piece of pulpwood moves independently and the bruising effect of the logs against each other, and against the circumference, knocks off the bark. Water is sprayed into the drumbarker and pulpwood is fed in at one end by conveyor belt. Water is a very important ingredient in pulping and for some uses it is softened beforehand. As each piece enters the drumbarker it pushes out a barked piece at the other end which is taken away by conveyor belt.

Pieces incompletely barked are fed back into the drumbarker again. It can be seen that the greener the timber the more efficient becomes the bark removing process. The smallest piece of bark in the newsprint causes imperfection.

The second stage is the reduction of wood into fibres or the constituent wood vessels; tracheids or groups of tracheids. A grinder similar to a large millstone carries this out. The stone is constructed of either carborundum or basalt cement and measures 49¼ inches in length by 59 inches in diameter; it is six tons in weight. Pulpwood is fed onto this, like meat into a mincing machine, being either forced against the surface by hydraulic pressure or else by vertically descending endless chains like caterpillar tracks. The pieces of pulpwood are adpressed against the grinder lengthwise i.e. the axes of the pulpwood and grinder are parallel.

Grinding is the operation which materially alters the wood structure and a lot of energy in the form of heat is dissipated at the grinder. Water is applied to the grinder for cooling and some comes off in steam.

Next, fibres that are too large for newsprint are filtered off through a series of screens, some flat, some rotary. These larger fibres or "shives" as they are called go to the Board Mill for manufacture into the familiar fibre-board used for internal construction. After this the mechanical pulp is reinforced by 12 per cent of a chemical pulp prepared by the sulphite process. Various technical treatments follow, to condition the wet pulp for paper making, such as the control of its specific gravity.

The paper-making machine, to which the prepared pulp is then fed, is the largest equipment in the mill. A battery of grinders is required to keep one paper-making machine employed.

The machine used for newsprint is essentially the same as that for other kinds of paper. The width of a big machine is such that it can turn out newsprint up to 260 inches (say 22 ft.) wide, while its length from end to end is 82

yards. A one per cent concentration of screened fibres, or stock, in water is poured out of a receptacle (known as the head box) at one end, onto an endless wire gauze which carries the stock for 35 feet along the length of the machine. It is on the wire that the suspension of wood fibres in water is transformed into paper.

At the beginning of the wire the stock is vigorously agitated so as to assort the fibres in all directions for greater strength of the newsprint. Meanwhile, throughout the length of the wire, water is dripping through out of the stock. The removal of excess water is assisted by suction boxes. These are devices placed under the wire in which, by running water, a vacuum is created, thus withdrawing water from the stock. Some water is lost through steam.

Now at the end of the wire the newsprint is "couched" away from it onto the first drier. A drier is a very long cylinder four feet in diameter; the newsprint passes round the outside of the drier, which is steam heated at 110°C. There are 64 driers to each paper-making machine, as the newsprint has to pass over a whole series of them before it is dry and firm. An endless felt carries the newsprint around the driers.

After leaving the last drier the dried paper is rolled round a steel core ready for transport; but before reaching that core it is subjected to a fine spray of water to prevent the action of static electricity at the printing stage. The final operation is that of putting a gloss on the paper; this is done by the calender. On this machine the paper is unrolled and passes vertically downward through several steel rollers, some power-driven and some free, which impart gloss by an ironing action. The newsprint is now almost ready for the printing press; the only further step is to slit the wide rolls into narrower widths.

Sometimes a break in the paper occurs when passing through the paper-making machine, or the calender; and this causes a spell of intense activity by the operating staff. A break in the roll of paper is marked by a ticket inserted in the roll for the benefit of the re-reelers, who make good the breaks with strips of gutta percha.

This mill's daily consumption is some 500 tons of pulpwood, weighed at the air-dry stage. About 94 per cent of this is imported, mainly from Newfoundland and Finland, but the proportion of home-grown raw material is expected to rise as more and more of our forests reach the thinning stage. A good deal of pulpwood is already being supplied from Thetford Chase. All other newsprint mills use imported mechanical pulp, which is shipped after being ground; the water is squeezed out of the stock which is then baled in flat sheets, which look rather like crude cardboard. On reaching the paper mill these sheets are broken down in water.

DISTRICT OFFICER HOME FORESTRY COMMISSION; TO BE OR NOT TO BE?

By J. B. TEASDALE
District Officer, South Wales

When trying to decide upon their future, almost all prospective forestry graduates consider, to a greater or a lesser extent, service as a District Officer in the Forestry Commission. Now, although not all forestry students are *forestry*

students for the same reason—some being nature lovers, others merely wanting an open air job, and still others of course being fascinated by the science and business of forestry—few have embarked upon a forestry degree course as a road to the Civil Service. Yet the fact that a District Officer is a Civil Servant (even though a professional one) cannot be denied.

Because of this, it is often difficult for the student to reach a satisfactory decision. It is the Civil Service trappings hung on to the job of "forester" that makes the post of District Forest Officer such a difficult one to appreciate, and it is this perplexing combination of brown boots and black coat that has turned many good foresters away from the Commission. Nevertheless it is this confusion that I, although admittedly with only a few months' experience as a forest officer, will try to clear.

Because of my short experience, and because I am stationed at Brecon and all stations are not equally acceptable to all people, I cannot presume to speak for all cases. Even so, I am sure that my introduction to the Service has not been unique, and its record ought, therefore, to be of some value to coming graduates. Let me mention some of the criticisms of the forest officer's lot, and try to parry them.

The most frequently heard complaint is that the District Officer is tied to his desk with red tape and paper work. Often one hears the older officers themselves uttering this very cry and reminiscing of the by-gone days when they had time to "know" their forests. It seems, then, that the statement must contain an element of truth. And it does.

According to Forestry Commission diary statistics, a District Officer in South Wales spends an average of two full days in the office to every four days in the field, and these field days are usually shortened slightly by the regular 9 to 10 a.m. sorting through of the morning mail. For the man with such a wide range of work (and it is this which makes it interesting), it is impossible for him to keep all details in mind. He needs files; and therefore an office. And these office hours, spent unearthing past aspects of some present problem, are probably as intriguing as any.

True, this is not the only side of the office work. There is the routine, the forms, and the weekly, monthly, quarterly returns! Here one must be reasonable. The Forestry Commission is a massive organisation (later, I shall try to show that this, in itself, is an asset to the professional forester). Consequently, uniformity and a certain amount of standardisation are essential for efficiency: hence the need for the drudgery. In passing, however, it is interesting to note that a recent omission to fill in the appropriate form caused eighty otherwise unnecessary letters and telephone calls to be exchanged. How great, therefore, would be the clerical work without forms! The crux of the matter is that this form filling should be routine. If it demands more than a little energy, then it is not routine, and the officer concerned obviously does not know part of the job for which he is being paid. A District Officer must know his forms as well as he knows his trees; but once he knows them, he can forget them; not so his trees!

To summarise: the time spent in the office is not excessive; the greater part of it is interesting and the remainder should not be burdensome.

One often hears practising foresters and landowners claim that Commission Officers would fail to make their pay out of *commercial* forestry if they had to live by it. Such professional scorn is hard to stomach and may have deterred several ardent forestry students. This is unfortunate, because although, in the past especially, forest officers were not acquainted with the life and death problems of private owners, they were, nevertheless, authorities in their own right—undisputed masters of large scale waste-land afforestation. Often the

owner would defeat the officer in eye-estimates of volumes, weights, and stems per acre. Although this is understandable, there is, nevertheless, no excuse for the officer neglecting such practical forestry exercises: he has plenty of time to practice them.

Moreover, today the Forestry Commission is taking an ever-increasing interest in private woodlands. In Wales now, and also in parts of England and Scotland, each territorial forest officer concerns himself both with the Commission Forests and the private woods (from scrub to dedicated estates) in his district. The proportion of Commission to private forestry will vary of course from district to district. In South Wales, however, the original districts have mostly been divided into two to accommodate the new responsibilities. It looks, therefore, as if the ultimate expectation is for most forest officers' time to be divided equally between private and Commission Forestry. What better blend could any forestry student wish for?

Sometimes one finds the impression that the District Officer is an unwanted piece of flotsam tossed about on the wash that swirls between Conservator and Forester. Overall policy, and frequently its smaller details, are formulated by the former with the aid of his senior officers. At the other end of the scale, each forest is in the charge of a Forester, who usually takes a considerable amount of pride in the working thereof. The District Officer comes somewhere in between, and occasionally Foresters have been known to suggest that they could manage far better without him! What then does a District Officer do? Is he merely a glorified messenger boy or Conservator's watch-dog?

To some extent this is true; he does relay instructions and he does watch. It would be kinder probably to call him the trained hands and sensory organs of the Conservator working in some specific section of the Conservancy, not only ensuring that instructions are carried out, but interpreting those instructions according to the circumstances of his forests, guiding his foresters, and keeping an intelligent forestry eye upon everything that happens in his district. Fire plans, and planting, weeding, brashing, and thinning programmes are all drawn up by the officer with the help of the Forester's specific local knowledge. He would find them very difficult to compile without this, but it is he, the officer, who makes the decisions, and the errors if so they be! His also, for instance, is the responsibility for deciding in the field just what work will be suspended and what will be maintained in face of a shortage of funds. Thus, far from being a piece of floating officialdom, the District Forest Officer's lot is one of responsibility almost to the point of regional preoccupation.

A District Officer seldom sees the results of his work, as a sales manager does, in the rise or fall of his sales, or as a timber agent, in the rise or fall of his prices and turnover; and the private woodlands work is fundamentally that of *suggesting* ideas and of trying to *persuade* owners to do something sometime. For such work one must essentially be an enthusiast for academic forestry; one must not require to see one's own ideas put into effect immediately; and it should be possible for one's interest to be fully maintained by contemplating what could and should be done in answer to a certain problem, while knowing that in nine instances out of ten, it never will be done! All this is heightened by the fact that one is liable to be posted at short notice to another station, thus making it impossible to mislead oneself into believing that the local woodlands are one's personal and everlasting concern. They are the concern of the Forestry Commission, and a District Officer is its agent.

On the other hand, I must not suggest that one can enjoy no sense of achievement as a District Officer. The success of one's species selection, underplanting and thinning prescriptions will always be a great satisfaction; to

meet a forestry-minded owner is a delight, and to convert an indifferent owner to forestry is an achievement indeed! Moreover, the District Officer has the advantage that at the end of his service, he may have enjoyed all these achievements in many and varied parts of the country: his silvicultural experiences can be boundless. I do believe, however, that unless a person has a fundamentally *academic* interest in forestry, he will not be happy as a District Officer. He will be an uncomfortable cog in a merciless machine. If, however, he has that necessary sort of mind, he will be happy, because although some of his time will be spent as a watch-dog, he will be a *forestry* watch-dog!

Frequently students are inclined to favour work as a District Officer in the Colonial Service in preference to that at home because the latter, with most of its practices standardised, seemingly offers far less scope for originality. Also, at home where there is, for instance, an Engineering Section, any ability that one has in that field is not exercised. Similarly, one's knowledge of silvicultural systems, yield regulation and finance is neglected, and working plans of the Continental and Indian type are almost non-existent. How unsatisfactory it is, therefore, after being introduced to these subjects, to find there is no use for them!

This impression is quite out of perspective. Certain aspects of a comprehensive forestry education are necessarily omitted from any work. The Commission's forests in many areas are almost entirely of young and middle-aged, pure, even-aged, coniferous crops, and only silvicultural problems relating to that type are met. But there are problems, many of them; and more will always arise as this task of afforesting Britain, which is still very much an exciting venture of forestry exploration, proceeds. Consequently, no part of that comprehensive university introduction to forestry must be allowed to atrophy. Today's young District Officers will see the Commission plantations mature for the first time, and will have to decide what to do with them. For this same reason, members of the Forestry Commission are given every encouragement to develop their technical knowledge. The Commission itself is the main research body in this country—probably the main one in the English-speaking world—its findings are more and more respected by the old Continental forestry countries, and all these findings are circulated for the information of District Officers. Thus the easiest way to keep abreast of forestry knowledge is to become a Home District Officer, and now that the Forestry Commission is becoming increasingly concerned with private forestry, the information it supplies is likely to be very nearly all-embracing.

There are one or two general points which are not really answers to criticisms.

The Forestry Commission is a massive organisation and it is treated as a part of the Civil Service: it suffers from the faults of both. Although by no means always, employees are frequently treated like parts of a machine, and not like people. And even when some attempt is made to introduce the personal touch, government control usually makes it impossible to treat individuals according to their deserts in the way that makes good private firms such attractive employers.

Again, as a District Officer, one is liable to be moved at any time throughout one's career. There is no choice in the matter of where one lives and has one's work. It may be in the North Conservancy of Scotland or it may be in Savile Row!

Further, in the very matter of getting a home, the District Officer is at a disadvantage. In the first place, finding accommodation "to let" is very difficult everywhere today; and in some places it is impossible. The District

Officer cannot choose where he should start looking. Further, if he *can* obtain accommodation to rent, it is an added financial burden to that of eventually buying a house on retirement. On the other hand, if he decides to buy and sell throughout his career, there is every chance of his losing heavily on the deals, as the Forestry Commission, not he, decides when the moves, and therefore the transactions, must be made.

Lastily, there is the question of marriage. If the young wife wishes to work for the first few years—and that is very often the way these days—there is no possibility of choosing a district mutually satisfactory to both careers, nor even of moving at a time convenient to both. The District Officer is a public servant and as such has much of his private life ruled for him. These points may often be overlooked by students, but they are vitally important nevertheless.

There is, however, another aspect that it is equally important not to overlook: the Forestry Commission is a brotherhood. Through it one meets many people and makes many friends throughout the country—both inside and outside the service. Such an experience is one of the great satisfactions in life, and is closely connected with the professional satisfaction of having a share in the afforestation of a considerable part of the British Isles.

(*This article originally appeared in Y Coedwigwr, the magazine of the Forestry Society of the University College of North Wales at Bangor, and is reproduced by kind permission of the Editor.*)

PRELIMINARY WORKING PLAN REPORTS

By G. D. KITCHINGMAN
District Officer, Research Branch

In the Forestry Commission's Code of working plan procedure no mention seems to be made of Preliminary Working Plan Reports. I wonder why! In India, where a code of working plan procedure was gradually evolved from years of experience, the Preliminary Report was a most important document; it invariably shortened the time taken in getting the working plan itself written and sanctioned, and it nearly always saved a lot of money. Now that the Forestry Commission is beginning to get interested in working plans, I thought that a note on Preliminary Working Plan Reports might prove useful. I shall base my remarks on my experience, over several years, in the Punjab Working Plan Conservancy where working plan work was (I have no hesitation in saying) —of a high standard.

What sort of report was this Preliminary Report? Perhaps I can best describe it by saying that it settled, once and for all, all matters of doubt which the officer eventually appointed to make the plan had to know before he started work. Thus it settled all matters of principle, leaving him to work out the details in the working plan.

One of the first matters of principle to decide was the working plan area. If more compartments are added, or some taken out, when the plan is half-written, many of the lists and calculations already made will have to be altered. This I feel is going to be important to us in Great Britain where the area of our new "groups of forests" (if I may call them so) is constantly changing. Working plans will never get finished if new acquisitions are being constantly added to the working plan area, and so, during the period of the plan, new acquisitions will

either have to be alloted to an Acquisition Working Circle as they come along, or left out of the plan altogether. The Preliminary Report therefore should contain a list of the compartments comprising the Working Plan area, and this list should not be altered.

The Preliminary Report settled the number of working circles and what compartments should be alloted to each. This may sound rather absurd but there are few things more maddening to a working plan officer (W.P.O.) than to be told, very late in the day, that a compartment or two must be moved to another circle; it meant having to change many tabular statements and totals wherever the relevant figures occurred—and the maps too!

In a shelterwood working circle the allotment to the non-regeneration blocks did not matter so much, but if it fixed the regeneration block (Periodic Block No. I, or P.B.I.) work became much easier. P.B.I. usually had to be enumerated, and if a compartment was put into P.B.I. at a late stage, its enumeration could be costly and awkward if the enumeration party had been disbanded. In the Punjab the allotment to P.B.I. was the special duty of the Conservator, and so W.P.O's. always tried to get him to settle this allotment very early on in the work, preferably in the Preliminary Report.

I would say then that three of the points for the Preliminary Report to settle are:—

(*a*) The compartments to be included in the working plan area.

(*b*) The allotment of compartments to circles.

and (*c*) The P.B.I. allotment in a shelterwood circle.

Questions of policy influence choice of species, rotation and thinning grades etc., and so the W.P.O. was provided, in the Preliminary Report, with a statement of policy (usually called "Objects of Management").

Choice of species cannot be left to the sudden fancy of a working plan officer but must be based on past experience, markets, etc. The preliminary report therefore gave precise decisions on the species to be grown in pure crops or mixtures and, after fixing the exploitable sizes, usually fixed the rotation. Thinning grades, thinning cycles (and felling cycles in selection working) were not of primary importance, but they all came up for discussion in the Preliminary Report, with the result that the W.P.O. worked out his felling and thinning programmes without the fear of having to alter them very much later on.

Another matter on which the W.P.O. needed guidance was the amount of money he could propose for capital works. He was wasting his time if he worked out a big programme of road construction, buildings, drainage, fire protection, etc., if money for them would never be available. The Preliminary Report therefore fixed roughly what capital expediture could be proposed.

One more point the Preliminary Report included (preferably began with) a short summary of past working and some of the lessons learnt. This summary was required by those who had to consider and pass orders on the report and were possibly not familar with the working plan area. This summary may be troublesome in Great Britain where there are so few working plans to refer to for past history.

Who was responsible for preparing the Preliminary Report, and who sanctioned it? In the Punjab the rule was that the officer authorised to sanction the working plan itself was also the authority for approving the Preliminary Report. This stands to reason, of course, for otherwise there might be more changes. This was usually the Chief Conservator, who in Great Britain would be the Director. The usual procedure was this. When a working plan was to

be made (or revised) it was the duty of the District Officer to submit a draft report to his Conservator. The Conservator played about with it, discussed it with, or sent it to, men who knew the area well, and then sent it to the Chief Conservator for sanction. If things went well the Chief either approved it then and there, or made a tour of the area and approved it after hearing on the spot the views of the local officer. If things went badly . . . well, we had to start all over again. Then, when at last the Preliminary Report was sanctioned, it was sent to the Conservator in charge of working plans who was then responsible for the production of the working plan proper. In the words of our Code: "From this time on no change may be made in any matter settled in the Preliminary Report except by the Chief Conservator in writing."

I hope I have shown that a good Preliminary Report, sanctioned by authority so that it cannot easily be altered, is an important link in the chain of working plan procedure because it makes the task of the Working Plan Officer so much more straightforward. May I end by mentioning that sometimes the Preliminary Report (excluding the statements showing allotments of compartments to circles and periodic blocks) was only two or three pages of foolscap in length and that I don't think I ever saw one of more than a dozen pages.

NEWCOMERS TO NORTHUMBERLAND FOREST VILLAGES

By B. J. ALLISON

District Officer, North-East England

This article originally appeared in the "Newcastle Journal", under the title "The Long-term 'Farmers' Won't See Harvest"; it is reproduced by kind permission of the Editor.

The creation of large new forests in the Border hills has meant not only the planting and tending of trees, but the settlement of people in the forest. What is the story of these forests in human terms?

Foresters are able to see a nice analogy between growing trees and settling people to work and live in the forest.

At first there were a few trees growing in the area, notably Scots pine and Norway spruce. These could safely be used for afforestation, but it was necessary to supplement them with trees from elsewhere—Sitka spruce, Japanese larch and Douglas fir.

Some grew and some did not. It is not enough to plant a tree and leave it. The ground must be drained and perhaps fertilised, and each tree must be weeded to give it the best chance of development.

More Work

How does this compare with the story of the forest worker so far as it has gone? Often, when a farm was bought for planting, the shepherd stayed and changed his job. But a forest calls for much more labour than a sheep farm, a call which, starting low, builds up to a peak between 20 and 30 years after the last land has been planted.

Help was to be found from the villages and small townships which are scattered and widely spaced in the forest area and this help was sufficient for the early years.

So at first we had the local men. But soon, as with the trees, it was necessary to go further afield. Three groups of houses were planned and built—Kielder, Byrness and Stonehaugh.

Into these houses came people from all parts of the country to be faced with the dual task of adapting themselves to forest work and of creating a social life which would make a village community of the bare streets and buildings. How were they chosen? How have they fared?

"Rugged"

The houses were in remote places with few services and amenities; to a man used to factory work the bare, windswept hills and hefty hand tools would be strange.

At times it seemed that the panel of interviewers were doing their best to scare people away with the tales of hard work and rugged conditions. In fact on two occasions when the person for interview was called it was found that he had already fled!

But mostly the interview was a frank discussion between two parties and more weight was given in the decision as to whether the people would find themselves contented with the new life than to their initial suitability as workmen.

So there came a day in each village when, for the first time, smoke from domestic fires rose from the chimneys. At Stonehaugh on this day early in 1954 the snow was lying thickly on the ground. It was undoubtedly bleak. Perhaps in the summer it would be better; but all summer it rained.

Pantomime

At last, just before Christmas, the village hall was ready to be opened. While this was going on, committees formed to build up the social life. A pantomime was run and committees for the village hall, the library, the gardens association, the village club and football team appeared. The village now has its own band.

At Kielder and Byrness the story is much the same. Most people found themselves taking part in village life.

There were some who left the villages. Why? Among the reasons for leaving there seems to be a general pattern.

First to go are the ones who, having failed to heed what they were told at their interview, immediately realise they are unsuited to the work or the village life.

More gradually some people, particularly wives, begin to feel discontented. Perhaps it is the absence of some special amenity such as a Roman Catholic School, or such things as pictures, local pubs, choice of shops and frequent public transport.

In both these cases the results are serious for the family as they have the expense of moving to and fitting out a new home, then a spell of unhappiness and afterwards the cost of moving away again.

"All Mine"

Thirdly, some of the villagers find jobs with perquisites or chances of personal advancement and they leave to better themselves.

To those who stay, life grows daily more attractive as the forest work becomes customary and by their own efforts a social life is created in the village.

Later these people will have the intense satisfaction of being able to say: "This is my forest, I have planted and cared for these trees", and "This is my village. I was here when it started and my efforts helped to form the life it now leads".

GLENMORE LODGE

Contributed by the Scottish Council of Physical Recreation

Glenmore Lodge lies within the Queen's Forest of Glenmore, a National Forest Park some seven miles from Aviemore on the main London-Inverness railway line. It stands 1,000 feet above sea level, beside Loch Morlich and within view of the Cairngorm plateau only four miles away, as shown in Photo. No. 1. What was formerly a shooting lodge belonging to the Dukes of Richmond and Gordon is now a residential centre for education and recreation out of doors, rented from the Forestry Commission by the Scottish Education Department and administered by the Scottish Council of Physical Recreation.

The Cairngorms constitute the largest wild expanse left in Great Britain and provide what is perhaps the finest high level tramping area in the whole country. Despite the high altitude, the annual rainfall averages only 35 inches and the district has a well deserved reputation for sunshine and a dry atmosphere.

The British have always appreciated the countryside and open-air pursuits. Industrial life and sedentary occupations are absorbing more and more of the population and their recreational needs cannot be wholly met by urban playing fields. Many are, therefore, turning to the great natural playfields of hill and mountain. A course at Blenmore Lodge in its magnificent setting forms an ideal introduction to such outdoor recreation. In season, there is much to offer the tramper, climber, skier and field naturalist. The tramper has a wide range of safe but interesting routes to choose from; for the would-be climber there is a variety of rock faces, including gully, ridge and buttress, on which to practise the techniques of rock, snow and ice climbing, and the use of rope and ice axe. The skier will find pleasure in the corries of Cairngorm below the plateau where the snow lies deep long into early summer. The naturalist will find much to interest him in the varied plateau and glacial features and the contrasting natural zones. In addition, he can observe here many species of wild life long banished from other areas, together with rare plants and birds. All can enjoy the pleasures of Loch Morlich with its sandy beaches and facilities for swimming, rowing and sailing.

Accommodation. The Lodge is a large rambling building admirably situated for its present purpose. Forty students can be accommodated in the five dormitories equipped with double-tier beds, and in the dining-room and lounge they have comfortable amenities for meals, classwork, lectures, film shows and dancing. Other accommodation includes hot showers, a drying room, a dark room for photography and a workshop for instruction in the maintenance and repair of sports equipment. Transport to and from Aviemore is provided by truck and Land Rover.

Staff. The Staff of the Lodge consists of the Warden, a trained physical education specialist and two full-time instructors, assisted by voluntary instructors drawn from universities and well-known climbing, ski-ing and sailing clubs.

Equipment. Much of the equipment required for participation in the courses is owned by the Lodge and is made available free to students. This includes ropes, ice-axes, tents, camp equipment, four sailing dinghies and a canoe. Windproof clothing, ski-ing equipment and sleeping bags may be hired from the Lodge at moderate charges. Students must, however, provide themselves with suitable footwear.

Fees (*Payable in advance*)—

Adults	£6, 16s. 6d. per week
School pupils	£22, 1s. per monthly course

Hire Charges—

Windproof Clothing	5s. per week
Ski-ing Equipment	£1 per week
Bed Linen	2s. 6d. per week

Owing to rising costs, the Committee reserves the right, if necessary, to increase the fees.

All enquiries should be addressed to the Secretary, Scottish Council of Physical Recreation, 4 Queensferry Street, Edinburgh, 2. (*Telephone*— Edinburgh 32533).

Holiday Training Courses

At Glenmore Lodge people gathered from all walks of life come to spend their holidays, and in small groups are introduced to the pleasures of the Highland countryside. Courses are of a week's duration; at Christmas and Easter the emphasis is on winter sports, in the summer high and low level tramping, climbing, bivouacking, and sailing and canoeing on the loch. Although every effort is made to let students concentrate on their main interest, map reading, wayfinding and a general knowledge of the hills are included in all courses. The social side is not neglected. The ceilidh ("kaylee") in the evening preserves a fine feature of the old Highland way of life, with singing, story-telling and Scottish dancing.

Hill Walking. A graded series of expeditions, for strong and moderate walkers, is arranged to give the fullest opportunities for exploration of this region of mountain, forest and loch.

Rock, Snow and Ice Climbing. Several rock and corrie exposures convenient to the Lodge provide opportunities for a sound introduction to the fundamentals of rock climbing. The Cairngorms offer excellent experience in snow and ice climbing for beginners.

Ski-ing. Snow conditions during a normal winter give opportunities for ski-ing for a period extending from Christmas to the end of April. In a mild winter, however, skiers must be prepared for a tramp up to the snow line.

Sailing and Rowing. Instruction is designed to give confidence in the handling of boats with safety. Sailing is limited to those able to swim.

Camping and Bivouacking. Two days of the summer courses may be spent under canvas or in one of the Cairngorm mountain shelters including the famous Shelter Stone of Loch Avon. Most students by the end of a week feel fit for these optional expeditions. Those who wish may also go out on bivouac at Christmas and Easter.

College, University and Industrial Courses

Courses for Students of Physical Education. These courses have been established in co-operation with the men and women's colleges in Scotland and England. The courses provide the students with further experience in the informal approach to physical activities and demonstrate the value of the training of young people in the natural sports and pastimes of the countryside.

Courses for Teachers' Training Colleges. The scope of education is now wide and varied. This is especially true at the Junior Secondary stage where there is a growing demand for a variety of courses, particularly those with a practical relevance. Teachers who take part in a course at Glenmore acquire additional techniques for stimulating and maintaining interest in the practical aspects of geography, biology, mathematics, crafts and self expression in the written narrative.

Courses for University Students. Several University Field Science Departments, recognising the value of local and regional studies on an intensive scale, have arranged courses at the Lodge which included practical projects to supplement lectures and laboratory study in such subjects as geography, geology, ecology, high level meteorology, ornithology and forestry. In addition, students of geology and biology have unrivalled opportunities of studying their respective subjects in the field.

Courses for Industrial Concerns. The Scottish Industrial Sports Association has held two conferences at Glenmore Lodge, and boys and girls drawn from industry have taken part in the Holiday Training Courses. Courses specially designed to meet the particular needs of industrial concerns can be arranged.

School Courses

The current Education Acts in Scotland and England permit education authorities to provide educational facilities in residential establishments and to take advantage of such facilities provided by other bodies. So far, the Lodge has been used by three Scottish authorities—Edinburgh, Glasgow and Lanarkshire—for groups of forty children from their areas for periods of up to four weeks and it is hoped that other authorities will similarly avail themselves of the facilities of the Lodge. Parents contribute towards the cost of the courses and the balance of the authority's expenditure is recognised for Government grant. The children, whose ages range from 14 to 18, are mainly in their last year at Junior Secondary schools. Instruction and supervision are provided by the staff of the Lodge, augmented at times by school staff.

The theme of instruction is exploration, appealing to the children's imagination and stimulating physical effort, endurance and fortitude in overcoming the difficulties of weather and rough country. Increasing physical fitness and skill in wayfinding are related to a gradual progression from shorter expeditions beside river and loch and through the forest to longer and more arduous expeditions on the mountains. For the latter, the Lodge is used as the base camp from which, using tents or huts, forward bases are established.

Observations made on these expeditions are recorded each day in individual log books by narrative, sketches, diagrams and maps. Outdoor instruction is given in wayfinding, mapping, camping, hillcraft, field studies and field sketches. This is supplemented indoors by practical work on maps and by lessons designed to provide background material.

Glenmore Lodge is an official weather station for the Meteorological Office, which has provided full equipment for measuring and recording barometric

pressure, wind velocity, humidity, rainfall and sunshine. Since weather is such an all-important factor in life at Glenmore Lodge, interest in the deductions which may be made from weather observations are readily appreciated by the children, who learn to take readings and to interpret the weather maps.

By all these experiences the critical faculties of the children are sharpened, and their studies and records bring together in active relationship many school subjects.

The community life at the Lodge and in bivouac helps to develop a social sense and consideration for others. All have to share in the household duties; and there are jobs to be done in the garden, in cutting timber for fuel, and maintaining the outdoor equipment—tents, skis and boats. In the evenings there is music, singing and dancing; and films are shown, both for entertainment and instruction. On Sundays, the children attend church or chapel in Aviemore.

THE WORK OF THE NATURE CONSERVANCY

By A. R. P. HAYDEN

(*Assistant Administrative Officer on the Staff of the Conservancy*)

It is now some 4,500 years since, with the introduction of agriculture, man first began to interfere systematically with the pattern of nature in this country; and the growing complexity of life during the succeeding centuries—and particularly since the Industrial Revolution—has led to an attendant increase in the forms his interference has taken. While early agricultural developments enriched rather than improverished the countryside, the effect of other and more recent of man's activities has been far from beneficial. In the present century the continual new demands of industry, housing, agriculture, forestry, transport and the armed services have made essential the most careful planning of the limited resources of these over-populated islands, and among other things the need for a systematic nature conservation programme has been officially recognised. Continued losses of areas of some interest to natural historians are unavoidable, but since the establishment of the Nature Conservancy by a Royal Charter in 1949, the case for protecting the areas of greatest scientific importance is at least given full and sympathetic consideration.

The functions prescribed for the Nature Conservancy in its Charter are to establish and manage Nature Reserves; to promote and stimulate research; and to give advice on nature conservation. Excellent work had already been done by such bodies as The Royal Society for the Preservation of Birds, the National Trust, the Society for the Promotion of Nature Reserves and the Councils for the Preservation of Rural England and Wales, and much is owed, too, to the sympathy and understanding of many private landowners. An account of these early efforts appeared in the reports of the Wild Life Conservation Special Committees (Cmd. 7122 for England and Wales, and Cmd. 7235, Part II, for Scotland—both published in July, 1947), and these publications provided the Conservancy with a very valuable guide during its early days to those areas most worthy of protection.

The most effective protection the Conservancy can give an area is to make it a National Nature Reserve and this it is trying to do with the really outstanding places. It is hoped that there will eventually be about 100 National Nature Reserves representing a wide range of natural and semi-natural habitats and a

number of classical geological sites. So far 27 have been declared and these range in size from the 5 acres of the National Geological Reserve at Swanscombe to an area of 39,659 acres in the Cairngorms. A short description of each of these areas will illustrate the range of the Conservancy's interests.

The gravel pit at Swanscombe, which was generously presented to the Conservancy by the Associated Portland Cement Manufacturers Ltd., has yielded thousands of flint hand-axes of the Old Stone Age and the remains of elephant, rhinoceros, deer, bison, horse and extinct voles. It owes its international fame, however, to the discovery there by Mr. A. T. Marston in 1935-36 of fragments of a human skull which date from the Acheulean phase of paleolithic culture and which are at least 100,000 and perhaps even 300,000 years old. By studying the finds, scientists are able to learn a great deal about the natural environment and the material culture of our early ancestors, and it is hoped that other finds may yet come to light, for some of the gravel is still unworked.

The Cairngorms Nature Reserve is not only the largest in Great Britain but one of the largest in Europe. Only part of the area is owned by the Conservancy and the remainder was included in the Reserve by agreements with the owners. It is an excellent area for the study of pine growth, since it contains remnants of the Forest of Rothiemurchus, and it also provides exceptional opportunity for the study of the ecology of mountain birds, plants and insects, and high altitude meteorology. Among the birds to be seen in the area are the golden eagle, ptarmigan, dotterel, snowbunting, greenshank, Scottish crossbill and crested tit, while the animals include the wild cat and roe and red deer. Public access to the area is not affected by its management by the Nature Conservancy*.

There are, of course, many more interesting areas in the country than could possibly be managed as Nature Reserves, but The Nature Conservancy is able to safeguard the best of the remainder by reporting their scientific interest to the local planning authority—usually the Planning Departments of County Councils—and this is then taken into account if any new development is proposed there. The Conservancy has no powers over these Sites of Special Scientific Interest, as they are termed, but the advice it gives the Planning Officers of the local authorities is often instrumental in protecting them from encroachment.

The Conservancy does not try to protect all these areas merely for protection's sake. By studying the composition of the plant and animal communities found in them much ecological information should be acquired, while the Nature Reserves in particular will be the scenes of many interesting research projects and have been aptly called "open-air laboratories". The two main centres of research are the research stations at Merlewood in Lancashire and Furzebrook in Dorset. A number of interesting schemes are already being carried out, and the introduction and spread of myxomatosis have given rise to two of these. A team of botanists are studying the effects that diminished rabbit grazing is having on the vegetation, and another study is being made of the effects of the reduction of the rabbbit population on the diet of the buzzard. Much consideration has also been given to the herbicidal spraying of roadside verges, showing that while the preparations used have only a limited effect in controlling roadside weeds, they are much more harmful to a number of interesting wild flowers. Among other interesting research being conducted by the Conservancy is a detailed study of soil conditions in relation to a wide variety of species of trees,

* The public have access to a number of other Nature Reserves, but in some cases only the holders of special permits can be admitted.

and work on the technique of stabilising shifting coastlines by means of suitable vegetation. Most of this work is being done by the Conservancy's own scientific staff but other scientists are making valuable contributions as well. The Conservancy is also encouraging research along ecological lines in universities by making grants for approved projects to members of university staffs and by awarding scholarships to outstanding students. It is largely from the latter that the Conservancy's own Staff are recruited.

The Conservancy's third function—the provision of advice—follows naturally from the second. Guidance is frequently sought by local planning authorities when they receive development proposals affecting the Sites of Special Scientific Interest mentioned earlier; and less frequently they look to the Conservancy for advice on the selection, establishment and management of Local Nature Reserves*. Government Departments may also expect help on ecological matters, and the results of the work on myxomatosis, for example, should be of assistance to the Ministry of Agriculture, Fisheries and Food. Everything is done, too, to help individual members of the general public requiring information and advice. As the Conservancy's experience lengthens and as the results of its research are formulated, the amount and value of the advice it can give, and the national significance of its work, will increase accordingly.

(This article is reprinted from 'The Starfish', July, 1955, The Journal of the Association of School Natural History Societies, by kind permission of the Editor).

BIRD NOTES FROM LYNFORD HALL

The following items have been extracted from the 1954 *and* 1955 *Reports of the active and enthusiastic Bird Club at the Lynford Hall Forester Training School in Norfolk, and are contributed by Mr. N. W. Tulloch.*

1954 REPORT

Observation of Species and Natural Nests

The following first dates of migrant species were recorded by members, all in the vicinity of Lynford Hall:

1954		1954	
23.3.	Redshank	26.4.	Sand Martin
27.3.	Chiffchaff	26.4.	Tree Pipit
5.4.	Swallow	27.4.	Unidentified Harrier
13.4.	Common Sandpiper and unidentified pair of Terns	29.4.	Grasshopper Warbler
		2.5.	Yellow Wagtail
17.4.	Nightingale	2.5.	Redstart
22.4.	Willow Warbler	3.5.	Sedge Warbler
22.4.	Cuckoo	8.5.	Swift
23.4.	Wheatear	9.5.	Red-backed Shrike
23.4.	Stone Curlew	13.5.	Whitethroat
23.4.	Woodlark	17.5.	Blackcap
24.4.	House Martin	29.5.	Turtle Dove

* Local Nature Reserves have been established by the East Lothian County Council at Aberlady Bay, by the Lincolnshire County Council at Gibraltar Point and by the Cumberland County Council at Ravenglass Gullery.

1953

8.11. Solitary male Siskin observed on Swaffham Road.
14.11. Great Grey Shrike—Lakenheath.
15.11. Two Whooper Swans on Stanford Water.
15.11. Black-headed Gulls on Stanford Water.
22.11. One House Martin, Melford Bridge, Thetford.
6.12. One Bittern at Didlington Lakes.
20.12. Four Whooper Swans on Stanford Water.

1954

14.3. Wigeon, Teal, Gadwall, Mallard and Tufted Ducks on Didlington Lakes.
23.3. One pair of Canada Geese—Didlington Lakes.
9.5. One Red-backed Shrike near Mundford Cross Roads.
28.7. One Hobby Hawk.

Three Canada Goose eggs were hatched out by a broody hen. The young birds grew successfully and eventually left the School Lake.

Natural Nests

Nest Record Cards issued by the British Trust for Ornithology were compiled for the following natural nests found by members:

Dipper	1	Spotted Flycatcher	1
Song Thrush	1	Swallow	3
Robin	2	Ring Dove	1
Hedge Sparrow	2	Woodcock	1
Wren	2	Tawny Owl	1
Greenfinch	2	Goldcrest	1
Pied Wagtail	1	Mallard	2
Reed Warbler	1	Kestrel	1
Grasshopper Warbler	1	Long-tailed Titmouse	1
Sedge Warbler	2	Jay	1
Willow Warbler	2		

In addition cards were completed for occupied nest boxes as follows:

Coal Tit	79
Great Tit	47
Blue Tit	17
Willow Tit	2
Tree Creeper	1
Wren	6

Young Birds Ringed in Natural Nests

Coal Tit	10	Stock Dove	1
Blue Tit	10	Cuckoo	1
Dunnock	11	Redstart	1
Linnet	12	Kestrel	5
Whitethroat	3	Chaffinch	4
Yellow Hammer	7	House Martin	44
Blackbird	4	Reed Warbler	4
Starling	9	Meadow Pipit	13
Robin	5	Lesser Whitethroat	1
Greenfinch	2	Spotted Flycatcher	4
Jackdaw	4	Grasshopper Warbler	5
Tawny Owl	1	Sand Martin	4
Swallow	33	White Wagtail	4
Sedge Warbler	11		

The white wagtail, which rarely nests in Britain, was recorded after considerable pains had been taken in its identification. We feel reasonably sure that we are correct. Altogether 213 young birds were ringed in natural nests.

1955 REPORT

Observations of Species and Natural Nests

Below are the dates on which migrant and "not so common" species were observed by members in the vicinity of Lynford Hall.

1954

10.10. Great Crested Grebe on Didlington Lake.
7.11. Teal and Gadwall on Didlington Lake. Nuthatch.
7.11. Fieldfares and Redwings.
7.11. Tufted Duck on Lynford Hall Lake.
10.12. Buzzard at Foulden.
11.12. 7 Whooper Swans. Teal and Tufted Duck at Stanford Water.

1955

13.1. Pair of Great Grey Shrikes at Decoy, Didlington.
18.1. Jack Snipe at Decoy.
19.1. Lesser Spotted Woodpecker, Sparrow Hawk.
30.1. Wigeon (20) at Didlington Lake.
20.2. Bramblings at Didlington.
20.2. 1 Green Sandpiper at Didlington.
20.2. Shoveler, Pochard and Tufted Duck at Fowlmere.
23.2. 1 Bullfinch, 1 Nuthatch.
6.3. 20 Whooper Swans at Thompson Water.
20.3. Bittern at Lynford Hall Lake.
24.3. Pair of Canada Geese at Lynford Hall Lake.
31.3. Stone Curlew at Battle Area.
1.4. Chiffchaff, Curlew.
11.4. Swallow.
16.4. Redstart at Lynford Hall. Willow Warbler at Brandon Park.
17.4. Spotted Flycatcher.
19.4. Grasshopper Warbler, Sedge Warbler.
20.4. Kingfisher at School Lake.
20.4. Cuckoo.
22.4. House Martin.
23.4. Nightingale.
27.4. Sand Martins.
27.4. Whitethroat, Blackcap, Garden Warbler at High Lodge.
3.5. Turtle Dove, Swift.
24.7. Nightjar.

A pair of Canada Geese, presumably the same pair that visited us last summer, nested on the island on the School Lake. Three young were hatched, one disappeared, and the remaining two were successfully reared.

A pair of Mute Swans also selected the Lake for breeding operations. Six cygnets were hatched but unfortunately not one reached maturity. Other water birds which nested on or alongside the Lake included Moorhens, Coots, Mallard and one Dabchick.

Other Activities

At the end of April four members spent a very interesting and enjoyable weekend at the Blakeney Point Bird Observatory. Accommodation was

provided by the Norfolk Naturalists Society in the form of a well-equipped hut situated out on the Point. The spring migration had commenced, which presented an opportunity to use the Heligoland traps and indulge in some early season "ringing". The extent of everyones' enthusiasm may be judged from the fact that a Whitethroat was trapped and ringed at 6.10 a.m. Unfortunately the wind was a strong westerly, which did not facilitate the arrival of large numbers of migrants. Despite this five Whitethroats were trapped and ringed and a pair of Willow Warblers were the subject of a near miss. Amongst the many birds observed during the visit were: Sandwich, Common and Little Terns, Oyster Catchers, Dunlin, Ringed Plover, Redshank, Shelduck and Wheatears.

BRITISH BRYOLOGICAL SOCIETY FIELD EXCURSION, ARNSIDE, WESTMORLAND

By I. G. HALL
Foreman, Research Branch

The April, 1955, meeting of the British Bryological Society was held in Westmorland, with headquarters on the coast at Arnside. Except on Monday, 18th April, when Ullswater was visited, the areas studied lay to the south of the Lake District proper. Most of the country visited was on Carboniferous Limestone and inlcuded limestone pavement, a type of terrain new to me and therefore of special interest. The main exceptions were Beech Hill Wood and Glencoyne Wood, which are on acid Silurian fine sandstones or shale. Even in these localities, however, the presence of more basic conditions locally is betrayed by such calcicolous bryophytes as *Neckera crispa*, *Tortella tortuosa*, and *Ctenidium molluscum*. Many of the sites visited are classified as Sites of Special Scientific Interest under Section 23 of the National Parks and Access to the Countryside Act, 1949. Notes on the localities seen and the main species of bryophytes follow. The full list of bryophytes recorded is not, however, included in these notes.

Wednesday, 13th April: Arnside Knott and Middlebarrow Wood. (Between Arnside and Silverdale)

Arnside Knott, a Carboniferous Limestone hill which rises to 522 ft., is only moderately sloping on the north side, but falls away steeply on the south side in a notable scree slope. The lower slopes, and also more locally the upper slopes, are tree clad with a variety of species. Of these European larch, Scots pine, and sycamore are most abundant. Some of the wooded areas on the upper slopes were evidently planted 50 years or more ago, but have lacked silvicultural tending. Generally the larch and Scots pine were not impressive in height growth or form, though this is not surprising in view of the limestone rock and the exposure to the winds of Morecambe Bay nearby. In addition to the areas presumed to have been planted there are also small patches of sub-spontaneous origin. These have been augmented by natural ash and yew, the latter locally dominant.

The scree slope mentioned falls at about 30°-40° to the road 300 ft. below. Apart from scattered larch, which on such an exposed, hot and dry slope are stunted and malformed, there are few trees. The lowermost slope, however, is dominated by almost pure yew.

Bryophytes of Arnside Knott are not of special interest and such species as occur are mostly calcicoles which grow on limestone rocks. On the scree slopes *Ctenidium molluscum*, *Tortella tortousa*, *Fissidens cristatus* are quite common. Where tree cover is available species rather more demanding as to humidity are seen, such as *Neckera crispa* and the uncommon *Rhytidium rugosum*. It was hoped to find *Funaria calcarea*, *Tortella nitida*, *Metzgeria pubescens* and *Nowellia curvifolia*. I should not be surprised if the first two proved to occur, but the latter two species are more likely to be found at higher altitude and under more humid conditions. On the north side certainly, climatic conditions are less rigorous and many bryophytes occur, though they are mostly commonplace. *Orthodontium lineare*, fruiting profusely on the boles of old larch, was of interest, but this species is now less of a rarity than was once thought.

Middlebarrow Wood is a gently rounded eminence rising to 297 ft. The southern half of the wood, is on limestone pavement. Most of the pavement woodland is of open and scrubby nature with hazel, yew, and ash locally dominant or co-dominant. The evidence suggests that it represents a late stage in the succession to woodland. At the same time the deeper soils to the north, where the pavement gives way to an ordinary soil, have been planted with European larch and Scots pine, which is now up to 50 ft. in height. With these are also older oaks, possibly planted, possibly remains of the natural woodland. Some of the larch and Scots pine have succeeded in establishing themselves on the limestone pavement, though not at a great distance from their presumed origin. *Rosa spinosissima*, a not uncommon species of limestone pavement, was noted, and other woody plants occasionally observed were birch, hawthorn and sycamore.

The limestone pavement bore a complex of bryophytes in which the grikes or cracks were colonised by calcicole species such as *Neckera crispa*, *Tortella tortuosa*, *Ditrichum flexicaule* and *Fissidens cristatus*. On the surface of the pavement, where acid humus had been formed, pronounced acidiphiles included *Pleurozium schreberi*, *Polytrichum piliferum*, *Frullania tamarisci* and even locally *Rhacomitrium lanuginosum*. Species of intermediate status included *Camptothecium sericeum* in great quantity, *Thuidium tamarascinum*, and *Atrichum undulatum*. *Orthodontium lineare*, again fruiting abundantly, was seen in the planted woodland to north. Most notable of the hepatics seen was *Riccia beyrichiana*, a species which in Britain is of northern occurrence.

Thursday, 14th April: Foulshaw Moss and Whitbarrow. (North Side of Kent Estuary, between Grange-over-Sands and Kendal)

Foulshaw Moss is an extensive area of deep peat, most of which is now being drained and afforested by the Forestry Commission though much yet remains to accomplish. Maximum height above sea level is only 20 ft. and the very slight fall makes drainage a difficult though necessary task. Much of this moss is devoid of tree cover, being dominated by *Molinia*, with such species as *Eriophorum vaginatum*, *Juncus* sp., *Myrica gale*, *Calluna*, and *Sphagnums* generally present or locally dominant. Where drier conditions prevail there are extensive, though not continuous, tracts where birch (*B. pubescens*), sometimes with Scots pine, has played the pioneer, with *Calluna* and *Molinia* as ground vegetation. It seems likely that large scale mechanised drainage as practised elsewhere by the Forestry Commission would prove worthwhile, as the natural plants are, on the whole, not unpropitious to tree growth.

A large proportion of the bryophyte species are hepatics and include such genera as *Cephalozia* and *Cephaloziella*, where the species are minute and require

expert examination under the microscope. I am not competent to list these, but paid special attention to the *Sphagnum* species, of which seven were found. The less common species were *S. tenellum*, *S. quinquefarium*, and (quite a find) *S. fimbriatum*. These were not seen often enough to form any conclusions as to their ecological affinities. The commoner *Sphagnums*, however, have fairly clear cut habitats and afford some guidance.

S. cuspidatum grows in deep pools and is frequently submerged. Where drainage is satisfactory this species is absent. I was told that it has a low mineral requirement, is tolerant of a wide range of acidity, and that in the hollow-hummock bog types it occurs in the pools between the hummocks which occur in the first stage of the cycle. *S. plumulosum* avoids the deep pools and bogged places but does not occur on the drier ground. It is perhaps intermediate between *S. cuspidatum* and *S. palustre*, which affects drier ground as a rule. To judge from its associates this species is most plentiful where acidity is marked.

S. palustre is not easy to distinguish from *S. capillaceum* in the field, but, allowing for mistakes, was less common than the latter species. It occurred in the drier places and appeared to have a wider range of associates than did *S. plumulosum*. *S. recurvum* appears to be a species more common in the wetter parts and to have a fair tolerance as regards acidity. *S. cuspidatum* was an associate in some cases.

The other mosses were commonplace, though the prominence of *Tetraphis pellucida*, a species which hitherto I have associated with rotting wood, surprised me a little. It was common on dry peat and the sides of drains. *Campylium polygalum* and *Fissidens incurvus* were looked for without success.

Whitbarrow Woods are very extensive, and their exploration would require far more time than was available. Limestone pavement, crag and scree are all represented, so that the terrain is varied. Added to this there are a number of eminences, variations in slope and aspect, small valleys, and precipitous rock faces. On the lower slopes in particular there has been planted a fair amount of larch, which is now, in places, up to 60 ft. in height. Other species planted are oak and Scots pine. On the higher slopes, screes, crags, and limestone pavement natural hazel, yew, and juniper are most evident. Over relatively large areas, hazel, especially on the limestone pavement, has formed a complete cover. Large single ash are frequent with hazel, and locally there is a superabundance of sapling ash growing in the grikes. A part of these woods has recently been acquired by the Forestry Commission for replanting.

The list of bryophytes seen is a long one and includes those of pronounced acidiphile character as well as calcicoles. Thus at the former end of the range *Pleurozium schreberi*, *Hylocomium splendens*, and *Dicranella heteromalla* were commonly noted, and at the other end of the range *Neckera crispa*, *Ctenidium molluscum*, *Ditrichum flexicaule*, *Tortella tortuosa* and *Campylium chrysophyllum*.

Friday, 15th April: Beech Hill Wood, Longsleddale. (North of Kendal, near Shap Pass)

Beech Hill Wood, on the sandstones and shales of the Silurian system, rises steeply from the floor of a valley trending N.N.W.-S.S.E. to a height of some 1,300 ft. On the opposite side of the valley a height around 1,700 ft. is reached. The name of this wood naturally suggests that beech was once an important constituent. Nevertheless the only beech seen was of a very scrubby nature, suggestive of coppice origin. Apart from the beech, which form an inconsiderable proportion of the present wood, there is a fairly well marked band of hazel

associated with the scree slope, whilst ash and oak occur more often in the blocky and massive rocks above the scree. There are also a few birch and hollies. Below the wood, but above the valley meadowland, bracken is locally dominant, reappearing on the steeper slopes above the tree line. At these higher treeless altitudes, however, a *Festuca-Agrostis* sward is dominant, with *Calluna* appearing chiefly on rocky slopes and in gullies.

As evidence that some basic rocks must be present the frequency of the following calcicole mosses appears conclusive: *Neckera crispa, Tortella tortuosa, Ctenidium molluscum* and *Fissidens cristatus.* A number of interesting bryophytes associated mainly with alpine or sub-alpine districts, were also seen such as *Anoectangium compactum, Amphidium mougeotii, Rhabdoweissia denticulata, Plagiobryum zeirii, Bartramia halleriana,* and *Campylostelium saxicola.* Five *Rhacomitrium* species were also seen, as well as the expected rupestral species of *Andraea* and *Seligeria.*

Saturday, 16th April: Hutton Roof Crag and Farleton Knott. (Between Milnthorpe and Kirby Lonsdale)

Hutton Roof Crag, on the Carboniferous Limestone near the new Dalton Forest, is an area of comparatively gentle all-round slope while Farleton Knott has a much steeper all-round slope. Both, however, appear from a distance of bleak and forbidding aspect with comparatively little vegetation. In sheltered hollows and on the north side of eminences, large or small, there are small tree or shrub communities, which contrast markedly with the arid pavement. In the grikes of the limestone pavement by far the commonest woody species is hazel, which evidently plays a leading role in the course of natural succession. On the flat pavements there is virtually no vegetation until some cover has been formed by the growth of trees and shrubs rooted in the grikes. Obviously the absence of a soil, the exposure, and the marked seasonal and diurnal ranges in temperature of the limestone pavement combine to offer a singularly exacting habitat. In addition to hazel the small woody communities include juniper, hawthorn, ash, sycamore, rowan and holly. The absence of larch, Scots pine and oak was noted in relation to the absence of nearby planted woodland such as is found at Middlebarrow and Whitbarrow.

As might be expected the bryophyte communities were confined chiefly to the deeper grikes where the usual calcicole species previously mentioned occur, or to the ground layer of wooded areas. Under tree cover, the acid humus fosters acidiphiles such as *Pleurozium schreberi* and *Campylopus flexuosus.* Rarer species associated with limestone included *Rhytidium rugosum, Grimmia orbicularis* (?), *Tortella crispulum* and *Funaria calcarea.*

Monday, 18th April: Glencoyne Wood, Glenridding. (Ullswater)

Glencoyne Wood, the property of the National Trust, is on the western side of Lake Ullswater, which at Stybarrow Crag is about 500 ft. above sea level. From the lake the steeply sloping valley side rises to over 2,000 ft. The lower slopes, to about 1,000 ft., are fairly well covered with a variety of older naturally regenerated trees, including oak, birch, ash, sycamore, beech, European larch, and Scots pine. Above 1,000 ft. and up to about 1,500 ft., may be seen the remains of formerly extensive larch and Scots pine plantations. There is still a fair proportion of larch reaching to 40-50 ft., but Scots pine were evidently felled in quantity some years ago. Stumps of one foot in diameter were seen just below the sheep wall at 1,500 ft.

The ground surface is characterised by numerous Silurian rock outcrops, big and small, but elsewhere a soil of moderate depth has been developed. It is a

rather fine somewhat silty red-brown loam, though to what extent a leached A2 horizon was present could not be determined. Some windblow was seen among birch and larch.

The cool eastern aspect, high rainfall and humidity, presumably long continued open woodland environment, and the numerous transitions between a developed soil and bare rock outcrop have combined to make Glencoyne an area of exceptional bryological interest. There is space here only for the choicer species, of which *Ptilium crista-castrensis* was for me of greatest interest. By comparison with its luxuriance in some of its Scottish localities *Ptilium* was here a miserable representative. Other mosses seen were *Thuidium deliculatum* among short turf, *Rhabdoweissia crenulata*, *Grimmia donniana*, *Orthotrichum* spp., *Andraea* spp., and *Ortothecium rufescens* growing on rocks or in the clefts between rocks. Hepatic species were especially numerous, including such good finds as *Anastrepta orcadensis*, *Leptoscyphus taylori*, *Bazzania tricrenata*, *Cololejeunea microscopica*, and *Lejeunea patens*. More basic rocks or perhaps flush conditions were evidenced also by the presence of pronounced calcicole mosses or closed ash communities of local occurrence. In the rills flowing down through the short *Festuca agrostis* turf that fine moss *Scorpidium scorpioides* was found in abundance, together with such as *Dicranella squarrosa* and *Sphagnum* species.

Tuesday, 19th April: Barbondale. (Near Barbon Village, north of Kirby Lonsdale)

Barbondale, on the east side of the River Lune, is an east-west valley which rises with moderate steepness to a height of about 2,000 ft. The floor of the valley and the northern slopes up to a height of 800 ft. are clad with straggling woodland, some planted and some relict from the natural oak woodland of former years. A good proportion of the oak has now been felled, those remaining reaching a height of approximately 50-60 ft. Young plantations established are now in the thicket or pre-thicket stage and include European larch and Sitka spruce as the chief species. Where these have been planted in alternate six-row European larch, six-row Sitka spruce mixture, the superiority in height growth and absence of failures in larch was marked. Other species which had been more sparingly used were Scots pine, sycamore, and ash. Among the semi-natural woodland, which was of open character, ash, birch, hazel, hawthorn, and *Rhododendron ponticum* are general or locally abundant. There are also occasional specimens of *Picea glauca* which reach to 80 ft. or more.

Bryologically the Silurian rocks and beck side of Barbondale were not really noteworthy, though a good selection of the expected finds were made such as *Amphidium mougeotii*, *Hookeria lucens*, *Rhabdoweissia* spp. and among hepatics *Cononepholum conicum*, *Metzgeria conjugata*, and *Pellia* spp. On the sandy stream side detritus the moss *Barbula spadicea*, identified by Dr. Warburg, was a nice find; locally it was abundant in fruit.

The gill running down from Barbon High Fell was examined briefly, members evidently feeling less actively disposed on this last sunny afternoon of the foray. There are few trees in the gill, except where extra deep incisement in the rock has been made. Ash, sycamore, rowan, holly, *Salix* sp., and hawthorn were all that were seen.

Apart from the absence of purely woodland bryophytes the species are much the same as in Barbondale. The only one deserving a special mention was *Tetraphis browniana*, whose capsules by comparison with the minute plants are reminiscent of a moored airship. *Plagiobryum zierii*, also in fruit, was obtained sparingly in shady wet rock clefts deep in the gill.

A NOTE ON THE ECOLOGY OF THE LIMESTONE PAVEMENT IN WESTMORLAND

By I. G. HALL

Foreman, Research Branch

The three limestone pavement areas visited in April 1955 were—Middlebarrow Wood (300 ft.); Whitbarrow Crags (c. 500 ft.); and Hutton Roof Crags (c. 800 ft.). At all three, the limestone pavement occurs on level, or at most, very gently sloping ground. At Whitbarrow Crags and Hutton Roof Crags, as the names suggest, the pavement is more diversified and interrupted by "crags", scree slopes and eminences of varied height and shape. There was no significant difference in the depth of the "grikes" or gullies which, rarely, reached a depth of about eight feet; or in the width, which at the maximum was scarcely more than one foot.

The least mature area, in terms of development towards a woodland or scrub woodland community, was at Hutton Roof Crags, which is at the higher altitude and most exposed to westerly winds; it has comparatively little planted woodland adjacent—and this to east—and is probably grazed by sheep. By comparison the best developed area, Middlebarrow Wood, is at the lowest altitude, with north-westerly aspect; it is protected to west by higher ground, is not grazed by sheep and has closely adjoining planted woodland. Whitbarrow Crags at the intermediate altitude (c. 500 ft.) is at an intermediate stage of development. Here the limestone pavement is surrounded by either planted or subspontaneous woodland and there is no grazing by sheep; the aspect is predominantly easterly.

The proximity of planted woodlands of European larch, Scots pine and oak to the Middlebarrow Wood limestone pavement has resulted in these species being established among the natural scrub. This is so to a greater extent than in the other two areas visited. Of the shrubs, hazel is by far the commonest and locally has formed dense thickets, effectively preventing the entry of other woody species, or, indeed, of much natural ground vegetation. Yew is the commonest naturally occurring tree, but although their average age is around fifty years, their height is not often over 20 feet. Other species are ash and birch (*Betula verrucosa*), both fairly common, and sycamore. A characteristic small shrub, though probably confined to the more open places, is the Burnet Rose (*Rosa spinosissima*). Juniper, another pioneer species, is of local occurrence; hawthorn is also present. Here, as at Whitbarrow Crags and Hutton Roof Crags, the ground vegetation includes species of pronounced acidiphile character as well as calcicoles. As examples of this contrast, the two mosses *Pleurozium schreberi* and *Neckera crispa*, the flowering plants *Teucrium scorodonia* and *Mercurialis perennis*, and the ferns *Dryopteris austriaca* and *Asplenium ruta-mararia* may be cited. The calcicole species occur mostly in the grikes, whilst acidiphiles are commonest on the pavement itself. It may be noted here that woody species appear almost always to grow in the grikes and not on the pavement.

At Whitbarrow Crags also hazel is the dominant shrub, whilst ash, sycamore, birch (*Betula verrucosa*) and hawthorn are common woody associates. The larger ash are more common on the massive, blocky limestone of the crags than on the pavement. Small seedling and sapling ash, however, are to be seen locally in the grikes in great abundance, though it is evident that they experience a high mortality rate, due to shading out by hazel.

Yew is locally dominant, though not to the same extent as at Middlebarrow. It appeared to be more common on the lower scree slopes than on the

pavement. European larch and Scots pine have become established in places, but not to anything like the same extent as at Middlebarrow. On the whole, though the tree species are the same here as at Whitbarrow, they less frequently form local concentrations, so that there is an appreciably larger area of bare limestone pavement.

Hutton Roof Crags, where development to a woodland community is still in the early stages, presents a far bleaker aspect. Hazel again is dominant, but there are wide expanses of limestone pavement, where practically no other shrub or tree is yet growing. There are also scattered ash, sycamore, rowan, hawthorn and holly and even, in the lee of sheltered knolls or hollows, a fair number of these species. On the whole, however, colonisation of the level, windswept pavement proper is not far advanced. One shrub which is much commoner here than at Whitbarrow or Middlebarrow is juniper, of which there is an erect and a prostrate form. The latter type is commonest in the open where shelter is absent.

Having briefly outlined the salient vegetative and topographic features observed in these three areas and drawn attention to such phenomena as the acidiphile-calcicole complex, it is convenient to consider the possible course of natural development and the ecological factors operative. The information obtained is necessarily very scanty and accordingly some of the suggestions are conjectural.

One assumes that development towards a woodland community is conditioned to a large extent by the altitude, aspect, exposure, and incidence of grazing and this is borne out by the evidence so far adduced. It would also appear that the nearness of planted woodland and its direction is of some importance. Though colonisation is largely initiated fortuitously, particularly by birds, the planted woodland affords an important reserve of potential further colonists. Thus, although the commonly-planted European larch, Scots pine, and oak, play little part as pioneers on the limestone pavement, they are able, once a nucleus of natural hazel has become established, to enter into the developing woodland. In this way, there is enrichment by species normally absent in less fortunately placed areas and, consequently, a speeding up in development.

I cannot pretend to give an accurate description of the actual course of development, but *mutatis mutandis* the broad outlines appear to be as follows. On the flat areas between the grikes there is little colonisation initially except by rupestral bryophytes such as *Grimmia* spp., *Barbula* spp. etc., which grow in crevices. It is not until some time after the grikes have been colonised by shrubs and trees, providing shade and some humus enrichment to the pavement, that the non-rupestral bryophytes and higher plants become established. Hazel, and to a lesser extent juniper, are the outstanding pioneer woody species; hawthorn appears to be rather later. Looking down on an area of limestone pavement at this stage, the impression given is of a flat, austere looking, white expanse of limestone with discontinuous lines of hazel and occasional junipers of prostrate type growing out of the grikes; rarely there may be an occasional ash or sycamore.

Where the limestone pavement is interrupted by eminences there occur local colonies of woody species, with a more diversified composition including holly, rowan, and *Salix caprea*, the goat willow. Almost invariably, especially under the most exacting climatic conditions, the northerly side of such eminences will support some woody vegetation in sharp contradistinction to the south side, which for long remains devoid of trees or shrubs. Such eminences frequently have blocky masses of limestone between which ash is sometimes common,

occasionally reaching large dimensions before many other woody species are present. Similarly, sheltered hollows frequently support a comparatively vigorous and continuous cover of trees and shrubs.

On the limestone pavement proper, the gradual increase of hazel (in particular) leads to the shading of the once almost bare pavement. Root exploration and the decay of hazel leaf litter have, at first, greatest effect in the shallower grikes, where a soil up to a foot in depth is developed. In such soils *Mercurialis perennis* may be abundant. On the pavement where a very thin skin of, as yet, unleached soil particles has developed, calcicole mosses such as *Neckera crispa* and *Ctenidium molluscum*, previously confined to the grikes, are enabled to grow under the shade and higher humidity afforded by the hazel. The carpet of vegetation which forms is at this stage dominated by bryophytes and not until the soil has become deeper do flowering plants achieve more than local prominence. Their establishment as a continuous carpet appears to wait until, by the death and decay of the moss carpet and further weathering of the limestone, a thin soil has developed. The depth of soil, exclusive of the black mor (or, more correctly, in Kubiena's terminology, Limestone Moder), is slight and, in my experience, did not exceed an inch or so on the limestone pavement proper. What appears to be a highly characteristic feature of the Moder is the great frequency of small Collembola faecal pellets, which cover the lower surface and impart an almost granular texture to it. Earthworms appear to be very rare, but Enchytraeids (small worms) are abundant. As already mentioned, both acidiphile and calcicole plants occur, sometimes together and sometimes as local dominants. The grass *Sesleria caerulea* var. *calcarea* is very widely present, perhaps more so than any other species, with the possible exception of *Festuca ovina*. The widely ramifying root system of *Sesleria caerulea* binds the mat of vegetation and promotes further weathering of the limestone.

With the slow increase of woody species, a type of scrubby woodland is achieved, as at Middlebarrow Wood. At this stage, yew, ash, sycamore, hawthorn, and rowan have been cited as the species most commonly present, either in mixture or in small locally dominant communities. Planted woodland nearby allows such trees as European larch, Scots pine and oak to be represented. Even in this late stage, however, the woody species, so far as my experience went, were still confined to the grikes.

The manner in which acidiphile and calcicole bryophytes and higher plants grow together is worthy of some comment. Doubtless, the degree to which a soil has developed and hence the existence of acid and alkaline soil strata play an important part. During the initial stages of weathering, only calcicole bryophytes can gain sufficient foothold to grow. On the limestone pavement proper, especially where the developing bryophyte communities are subject to desiccation and removal by wind and water, these early stages of weathering may be long continued. Ultimately, with the death and decay of bryophytes, a thin mor or Limestone *Moder* develops, on which such acidiphile plants as are satisfied by a soil without much mineral matter are enabled to grow. Contemporaneously the thin underlying stratum of now weathered limestone affords sufficient soil depth for calcicolous plants; thus we have acidiphile and calcicole plants side by side. Subsequent development towards a woodland climax must often be towards a calcicolous woodland, in which ash is dominant. In the three areas described, the limestone appears to be of very similar type. Elsewhere, however, as at Barbondale, there are small outcrops of a harder, less pure limestone, approximating to a calciferous sandstone. Here the evidence suggests that the richer ash woodland type would yield to that in which oak and birch

are dominant. The development postulated would seem feasible since the harder and less pure limestone would be weathered more slowly and the shallower, coarser soil developed be more easily leached.

REFLECTIONS

By JOSEPH F. DUNCAN

What strikes one very forcibly in visiting other countries in Europe, is the difference in the attitude of farming folk to forestry. In this country we tend to stress the conflicting interests of agriculture and forestry, and, in the hill country of Scotland, it is not unusual to find antagonism. In general our farmers tend to regard woodlands as a nuisance, but, on the Continent, farmers plant their land with trees when they think they will bring a better return than crops, or when the land cannot be put to any other use.

That is not to say that farmers and foresters, on the Continent, may not disagree, on occasion, as to the use to which particular pieces of land are to be put; but there is recognition on both sides that such differences can be adjusted, and it is rarely that real antagonism arises. The fact that farmers find a place for trees on the farm makes for understanding of the foresters' position.

There are many reasons for the attitude of farmers to woodlands in this country. When the landlord and tenant system was general, the land was let for farming, but the landlords reserved the woodlands, and the game rights; and hence the conflict of interest. Nor was there any inducement to the tenant to plant since even in a long lease he could not hope to secure a return. There was a complete divorce between farming and forestry. The woodlands had no relation to farming; they were a nuisance, harbouring pests, which fed on the crops, and sometimes on the stock. The tenancy system no longer functions as it did, but, in farming circles, ingrained attitudes are maintained long after the conditions out of which they arose, have disappeared. And modern forestry operations have entered a new phase, which commends itself even less to the farming community although it affects a relatively small section.

The result of two wars and the extensive felling, rendered necessary because the usual importation of timber had to be suspended, left this country so denuded of forests, that a State forestry programme became necessary. That programme could only be implemented by withdrawing land from agriculture, and the intention was to increase the area of woodland on land marginal to agriculture. The task was assigned to the Forestry Commission, and any State agency in this country becomes a target which encourages shooting. However well the Commission may have functioned, and we may expect it to make mistakes, just as any of us are likely to do, it was bound to concentrate the opposition to forestry, and to make it appear more formidable than it is in reality. If a Commission has not a soul to be saved, it has always a body to be kicked.

A Prescriptive Claim?

The need to grow more timber in this country was agreed when the programme was made ten years ago, and the national trading position during the interval has made the need more urgent. If there is any land on which timber can be grown without disturbing any existing farming, that land has yet to be

discovered. The idea is widely held that farming, any kind of farming, has a prescriptive claim on the land, and that forestry should begin only where farming has left off. If that idea were accepted it would be quite impossible to plan woodlands efficiently, and it would be impossible to secure the area of woodlands which the national policy has declared necessary. It is not possible to avoid conflicting claims and so the best we can hope for is co-existence.

But should farming be allowed to claim a prescriptive right at all? A prescriptive claim can only be maintained when it can be shown that the best use is being made of the land. For arable land it is generally possible to make good the claim, although, even there, some parcels of land might be better in small woodlands, and it is interesting to observe the number of stock farmers on arable land willing to consider the value of woodlands for stock shelter. When we get to the hills it is much easier to challenge the claim that the prescriptive right lies with the sheep. It is on record as the considered conclusion of the Balfour Committee on Hill Sheep Farming in Scotland that "For generations hill sheep farming has been carried on as a form of extractive farming. Stored fertility has been slowly exhausted, herbage allowed to deteriorate, equipment allowed to waste away. Little has been put back into the land or the equipment of farms even in times when the industry could well afford it." In another part of the Report, it is stated, "There are some areas which can have no economic future for hill sheep farming even in the most favourable circumstances." That was in 1943, and since then we have had the Hill Farming Act under which the taxpayer finds half the cost of approved schemes of rehabilitation. Until we have a review of the working of the Act, and of the response of the sheep farmers to the assistance they have received, the most we can say is that they are still on probation.

But any claim of prescriptive rights is an entirely wrong approach. The hill sheep farms are on probation, and the upland farms are being kept going by what is no more than first-aid subsidies.

A Social Problem

That cannot go on indefinitely, even if we were willing to continue the subsidies in the hope of something turning up. Something is already turning up which will demand more positive action than merely to keep things going as they are. The young people are going away, because they believe they can make a better living away from the uplands, and any intensification of production to provide incomes which would lessen the attractions which are drawing them now, would aggravate the problem. The uplands will also require rehabilitation and that will require the regrouping and amalgamating of holdings, to enable fuller use to be made of new methods, and so produce more per man to provide the higher incomes. More production, in what will continue to be stock-rearing country, means reducing the number of people employed on upland farms. That aggravates the social problem of maintaining a healthy community where the population is sparse, and as far as the young folk are concerned, the exodus is more a social problem than it is an economic one. The only occupation which can make use of the hills, and maintain enough population to provide a social life to which the young people in upland farming could belong, is forestry. Unless we can make a more realistic approach to the whole problem of maintaining upland farming, the generations which succeed us will find no conflict of interest between farming and forestry, because there will be little farming left to put forward a prescriptive claim. The choice may be between ranching and forestry.

A Better Understanding

What is needed is a better understanding on both sides. The foresters were given the job of planting the widest area they could find, in the shortest time. They, naturally, looked for large blocks of land, and were not interested in smaller woodlands which could be fitted into farming with the least disturbance. Farmers were willing to let land which was of no use go to the foresters, knowing nothing about whether it was suitable for forestry. Some of them became quite enthusiastic about shelter blocks, and asked why the Commission could not plant these to suit farming. Instead of getting together and trying to find some way of making their co-existence possible with the fewest points of friction they have conducted their discussions at the pitch of their voices, and at long range, just like a Four Power meeting. As long as we think in terms of large forests, with little contact with the great bulk of farms, the conflict is more likely to continue. If farmers would begin to think in terms of woodlands it would be mush easier to see how they could be integrated with farming, and if the Forestry Commission were able to extend the help they are willing to give to smaller woodlands, we should find the antagonism softening. I am not suggesting that the Forestry Commission or any other agency, should do the work of establishing woodlands primarily in the interests of farming. That should be a farming job, although the Commission may help in an advisory capacity. If farmers and foresters co-operate successfully in mopping up the remaining rabbits which myxomatosis has not accounted for, and maintain their co-operation to prevent any re-infestation by rabbits, then the costs of establishing small woodlands will be greatly reduced, and the planting and maintenance simplified. If we can keep the rabbits under, there are many small patches which could be profitably planted, but which are quite out of the question, if they have to be fenced against rabbits. With the increase in the number of owner-occupiers there is no reason why our new lairds should not copy the advice of the old laird in the eighteenth century to "Aye be stickin' in a tree." It was good advice agriculturally and economically in the eighteenth century and it added grace to a somewhat grim landscape. It is still applicable on all counts today.

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BOOK REVIEW:

IN THE WESTERN HIGHLANDS

By H. L. EDLIN
District Officer, Publications

I make no apology for selecting for review a book on a non-forestry topic, for all of us have an eye on land that we feel *should* be afforested, if the Commission's goal of five million acres of productive woodland is to be achieved. A glance at the map of Britain suggests that the Western Highlands of Scotland, extending for 250 miles from Cape Wrath south to the Mull of Kintyre, should provide a fair share of the territory we need. Interest in this region has recently been stimulated by two events, first the appointment of a Crofting Commission to deal with the particular problems of the small farmers of the region, who hold their land on a special system of tenure; and second, a declaration by the

Forestry Commissioners that they propose, over the next ten years, to carry out some 30,000 acres of new planting in crofting districts where there is need for some alternative employment to the traditional occupations of farming and fishing. So the appearance of Dr. F. Fraser Darling's *West Highland Survey—An Essay in Human Ecology*, is very timely. This volume of some 450 large quarto pages is published by the Oxford University Press at the comparatively modest price of 30s.; a copy is available on loan from the Alice Holt Library, and it is all good reading.

This is a factual survey of 5½ million acres of territory, which has taken six years to complete and has required a staff of nine surveyors. Maps, graphs, tables, and statistics are all neatly marshalled in an objective fashion. Next to nothing is said about the scenery that attracts the summertime tourists, and if you are looking for romanticism about the lone shieling and the misty isle, you will not find it here. But every acre of this fascinating country has been surveyed and classified by scientists who appear to have set themselves one crucial question: How—if at all—can man continue to survive, in any self-supporting fashion, along the western fringe of Scotland?

The picture that emerges is little short of frightening. Taking the people themselves as a yardstick of prosperity, it is shown that, outside the few small towns, the population has been steadily declining for the past hundred years. Whereas, over this period, the population of Scotland as a whole has doubled, a drop of 50 per cent is the general rule throughout the West Highlands.

Some small islands now hold barely one fifth of their recorded maximum, and some still smaller ones have lost every soul, and are empty for the first time since the Stone Age. Further, the present population is an ageing one. If you had gone to Skye in 1861, you would have found children and young people far out-numbering their elders; today the numbers of children are insufficient for the replacement of the adults, so that still further shrinkage of population appears inevitable.

Dr. Darling outlines the changes in husbandry and social customs that have accompanied this decline, as well as the difficulties of transport that make any revival, whether of farming, fishing, or industry so difficult at the present day. He attributes the decline of agriculture to deep-seated ecological causes, such as the clearance of ancient forests, and the excessive substitution of sheep for cattle. The old subsistence farming has gradually given way to the provision of wool for a distant commercial market, or sport for landowners who only visit their estates for a brief annual season. Opportunities for alternative work are few and hard to organise, and the young and able men and women are apt to leave the ancestral croft for jobs in the cities, on the high seas, or anywhere in the wide world except the West Highlands. Little is said about modern forestry, but it is noteworthy that wherever a district is mentioned wherein the Forestry Commission's work is already under way, a more hopeful note is discernible. We are employing enough people to make a difference, perhaps a critical difference, between the virtual abandonment of a township and its continued life. That much, it may be added, is apparent even to a casual traveller through the Highlands; he sees new houses going up, instead of old ones falling down.

Foresters will realise, of course, that their work is only one of several projects that must proceed if new hope is to be brought to what Dr. Darling terms "a devastated human habitat."

They will also be the first to recognise that comparatively little of this rocky, mountainous, sea-indented zone is ideal country for afforestation. Problems of transport and labour supply are only too obvious. Yet it may be that forestry is the key project—the only one that can bring the benefits of stable

alternative employment to the crofter, and shelter to his land. The fact that reforestation may be the clue to restoration is suggested by the following passage in the author's Conclusion to his chapter on the Ecology of Land Use.

"The Highlands as a geologic and physiographic region are unable to withstand deforestation and maintain productiveness and fertility. Their history has been one of steadily accelerating deforestation until the great mass of the forests was gone, and thereafter of forms of land usage which prevented regeneration of tree growth and reduced the land to the crude values and expressions of its solid geological composition. In short, the Highlands are a devastated countryside, and that is the plain primary reason why there are now few people and why there is a constant economic problem. Devastation has not quite reached its uttermost lengths, but it is quite certain that present trends in land use will lead to it, and the country will then be rather less productive than Baffin Land."

The modern Scots poet Donald Macrae* once described his country as "a stone land, a hard land of bone . . . lean survivor of ice and frost . . ." and concluded: "We dwell on the stiffening corpse of Scotland." Such phrases were dismissed by most readers as a piece of whimsy. But here in Dr. Darling we have a scientist, with a world-wide reputation as an authority on the Highlands, arriving at just the same conclusion, and basing his views on a searching physical survey. Yes, the gaunt bones of primeval bedrock are beginning to show through the surface of fertile earth—not here and there but over broad expanses. Can we re-clothe them with the flesh and blood of living forests? The challenge is passed to us. We already have thriving pioneer forests such as Barcaldine, Glen Righ and Ratagan. If we could extend the share of the forests to one million acres, still occupying only one-fifth of the land surface, what a grand woodland that would be—and what a change it would bring to the economics of the West Highlands!

NORWEGIAN IDYLL

By C. P. WILDASH
Headquarters

The small lake which we used to visit was within twenty-five minutes run by motor car from the centre of Oslo, and was situated on an island jutting out into one of the backwaters of Oslo Fjord. It was the property of a man who was intensely anxious to preserve the seclusion of the place, which was thickly surrounded for the whole of its perimeter by bullrushes, water-lily pads and conifers, making fishing from the bank virtually impossible, or, at the best, only practicable at the expense of a great deal of valuable spinning equipment. To add to the natural hazards the owner had placed submerged tree-trunks and lengths of wire at all points where fishing from the bank appeared at all feasible. These measures not only discouraged poachers, but also furnished an ample supply of illicit fishing tackle for the fisherman who was there *with* permission.

The lake, like the fjord, was frozen hard all winter and the water at the seaward end may have been slightly brackish since our silvery spinners were soon tarnished when used in that part. The lake was approximately one mile

* In "The Pterodactyl and Powhatan's Daughter", published in the collection: *Modern Scottish Poetry* by Faber, London, 1946.

long and a half-a-mile wide, split longways in the centre by an island, thickly wooded, and by a dense bank of reeds which housed hundreds of mallard during the summer months. These reed-beds and the water-lilies made conditions ideal for pike, and, in spite of hard winters, to a lesser degree for perch. The pike grew to an immense size; their fins could be seen cutting the surface of the water in the deeper parts of the lake as they hunted the minnows in August; the perch formed a tinsel shower as they jumped from the water to avoid the onrush of the larger fish. At such times perch could be taken on the spinner with accurate casting just ahead of them. I landed one of 3 lb. 14 oz. in that summer: he showed no fight, and came to the boat like a dog on a lead. This fish was by no means a record, as the owner of the lake told me that he had caught perch as big as 5 lb. 4 oz. by netting over twenty years ago. Perch suffer more than pike in frozen conditions, and owing possibly to the heavy winters of recent years, the perch population had since decreased as the pike had increased. Possibly also as the water had not been adequately fished since before the war, the total numbers of fish were greater than previously, but feeding stuff was insufficient to allow them to grow to any reasonable size.

Whatever the perch situation, there was no shortage of pike; unlike the monster caught by trolling in Tyrifjord in 1951 which was said to weigh 50 lb., the largest that we managed to land did not exceed 5 lb. in weight, and none over 8 lb. had ever been recorded in the lake. Here as elsewhere they seemed to take a large silver spoon as well as anything, and although we fished on an average of once a week, from the time that the ice melted in April until early October, for two seasons, we had only one blank day. It was not, however the fishing alone that lent charm to this place, but also the idyllic surroundings. The island was sparsely inhabited, and the thick cover of reeds and conifers which surrounded the lake gave it a seclusion which must be unique for fishing within easy reach of a capital city. In one corner a colony of great spotted woodpeckers had made their home in a dead tree. A moorhen—comparatively rare in Norway—braved the pike-infested waters with her brood. Overhead the terns wheeled and plunged for the small fish, while in the woods the hooded crows winged in sinister flight. In the winter a pair of elk made their headquarters in the woods round the lake; evidence of their visit was to be seen by the trees on which they had browsed, and by their droppings on the shore and on the island in the lake which they visited as soon as the ice was thick enough to bear their immense weight. In the summer they disappeared, presumably further from the town into the vast areas of virgin forest, where the bear and wolf are still to be found.

Red squirrels abound both in the town and in the surrounding countryside in such quantities that the Norwegian forestry authorities have put a price on their tails. These squirrels are prone to great variations in colour during the autumn and winter months, when they shed their red summer coat and put on coats of colour varying from pale grey to a reddish-black which looks black in contrast to the snow. I have never noticed such colour variations in Great Britain, and consequently when I arrived in Norway for the first time in late summer, thought that there must be a great number of grey squirrels and black mutations of the red squirrel similar to those seen in the Austrian mountains. This led to some confusion, and eventually caused me to write a letter of apology to no less an authority than Miss Frances Pitt. There are, I think, no grey squirrels in Norway, and although both black and white mutations of the red squirrel were to be found, they did not seem to be at all common. These mutations did not, moreover, seem to have their incidence governed by latitude or altitude, or by any other geographical feature.

Among the most common land-birds round Oslo, the magpie and the hooded-crow are so numerous that it is a wonder that any other birds at all can survive their depredations. In spite of them, however, the variety of small birds, bullfinches, robins, titmice, flycatchers, nuthatches and woodpeckers is very great. I noticed a pair of long-tailed titmice during the winter of 1950-51, although how they survive the hard weather of Norway is a mystery. The Norwegian springtime is made gay—almost rowdy—by the arrival of hordes of redwings and fieldfares, which sing their rather repetitive song practically all night round about midsummer, and make sleep in a country which enjoys only two or three hours darkness at that time of the year exceedingly difficult. They pay for their "frowardness" however in the trappers' nets, and are served up as a delicacy with cranberry sauce, labelled "Kramsvogl" on the menu. All parts including bones and head are eaten, and although rather fatty, make a pleasant change of diet for those who have no conscience about eating these attractive little birds. Incidentally, the Scandinavians consider the pike and perch as table delicacies, although to my way of thinking they are about as tasty, and of the same texture, as a dusty pincushion!

SEVENTEENTH-CENTURY FORESTRY ON A HERTFORDSHIRE ESTATE

By W. O. WITTERING
Executive Officer, Scottish Directorate

Towards the end of the seventeenth century, the then large estate of Broadfield, stretching across North Hertfordshire between Buntingford and Hitchin, fell into the hands of one James Forester who, unlike his father-in-law from whom he inherited the property, took an active interest in the efficient management of his estate and the timber production of his woods.

Hertfordshire was never a forestry county and in modern times can only boast one state forest. James Forester, unaided by any form of planting grant or tax relief, was a keen silviculturist and kept detailed records of income and expenditure concerning all his forestry operations. It is interesting to look at these nearly 300 years later and compare them with the present day position.

In 1604, the Broadfield woodlands had supplied James I with 663 timber trees for shipbuilding purposes and out of the saplings planted in their stead, in his first year on the estate Forester was able to market 39 oaks and 3 ashes from Foxholes Wood near Hitchin. He records that on 7th March, 1690, he sold a parcel of ash timber to a firm of wheelwrights for 11d. per foot "allowing 2 foot in 20 for the barke upon the measure, and throwing in 10 foot in the whole bargain, whereof I have received as Earnest 2s. and one moiety of the remainder to be paid at the measuring and the other at Michaelmas next ensuing." His felling was carried out on piece-work rates—he writes: "Paid Beadle Senior for felling 5 Ash, 2s. 6d." Disposing of the stumps evidently presented no problem —"Pd. for gunpowder to rend ye ashen-roots, 3s." No part of the trees was wasted, bark peelers received 4d. the yard and the bark was sold to a tannery. "Received of Thomas Law of Hitchin, Tanner, the sum of £15 3s. for 297 yds. of Barke." The branch wood was made up into faggots at a cost of 10 a penny: "Pd. Will Beadle for making 90 faggots, 9d.; Pd. Finch for making 16 score of kiln faggots, 4s."

One of Forester's first problems in re-organising the estate woodlands was that of conversion; he found a saw-pit indispensable and soon had one constructed and put into operation: "Pd. for sawing 622 feet of Running Worke at 16d. ye 100, 8s. 3d.; Pd. for 70 feet of Breaking Worke at 2s. 6d. ye 100, 1s. 9d.; Pd. Tim Humberston for ending 39 bunch of lath at 4d. per bunch, 12s." The woods however were unable to provide all the timber required on the estate as he records: "Pd. the Bargeman for bringing 300 of deales to Ware, £3." (These presumably came up the River Lea from London Docks.)

He carried out a lot of planting in the seven years before his untimely death in 1696 at the early age of 36, and when the estate changed hands 160 years later a timber merchant obtained £2,000 for "the finest of the trees". He grew osiers on some undrainable ground south of Hitchin and found a ready sale for them. A magnificent double avenue of lime trees which led up to the house was planted at a cost of 15d. per tree.

Forest amelioration was high on his expenses sheet and he paid at the rate of 4d. per foot for hedging and ditching. Pest control was rated at 1d. per rat and 2d. per mole killed.

He makes little mention of his staff though he kept a special hand "to look to ye woods" who was assisted in extraction operations by his coachman who was paid £4 per annum "to brew, goe to carte, and what I direct him."

Forester received quite an income from the game on his lands and sold venison at 5/- a haunch; hares fetched 1/-, pheasants 1s. 4d. each and rabbits 6d.

Now there is little to be seen of the glories of Broadfield; the mansion house has been replaced twice, most recently in the early 30's, and the village of the same name has disappeared. Most of the land is now agricultural and lost to forestry.

This article is based on the late R. L. Hines book Relics of an Uncommon Attorney, *and is reproduced by kind permission of the publishers, Messrs. J. M. Dent.*

ORNAMENTALS

By R. G. MURRAY
Forester, West Scotland

Dictionaries define the word ornament as—that which adorns, anything that adds beauty—this definition is particularly apt when applied to ornamental trees and shrubs, the addition of a few decorative trees and shrubs can alter the general view from a dismal and depressing scene to a veritable picture,—very easy on the eye.

Nowadays, there is such a plentiful selection of ornamental species to choose from, that it is surprising to find that very few of our forests can boast of any kind of collection, in some cases even very few differing species of trees; there may be perhaps, areas of uninterrupted Sitka and Norway spruce only—a study in monochrome.

However, the remedy lies in our own hands, even if we were confined to spruce we could add a few from the forty or so available, you can even have golden varieties! Aside from spruce there is such a great number of colourful species with varying shades of foliage, from near white—through golden yellow to reds and blue, with many flowering types which can provide sufficient shades to make up any colour scheme.

It is not intended that we should ban the timber trees, but if we plant one-hundred-thousand of those, surely we can afford to plant one-hundred ornamentals to brighten the landscape, and come to think of it, they have other uses—educational and experimental, an odd new tree may sometimes develop into rather more than mere ornamental. In 1831 a new species of spruce heralded in as *Picea menziesii* was planted in gardens, and fifty years later in plantations—and now—as *Picea sitchensis*, or Sitka spruce, it provides the home market with an ever increasing amount of very valuable timber. Probably some of our present day "new trees" may well hold the majority in future plantations.

I would presume that in the majority of forests and especially in the case where old private estates were incorporated into Commission areas, there would be a small existing collection of rare species, and in some instances very rare plants indeed; unfortunately quite a number would be overlooked, some accidentally cut down, overplanted or otherwise lost.

Some time ago whilst going through an old garden, I drew the attention of the gardener to a solitary bramble stem which was trailing out from under an overgrown rhododendron. His comment was, that he would have to clear up the undergrowth sometime! This bramble was *Rubus biflorus*, an Indian species, I suppose that if the gardener had carried out his intention, he would have finished the life of that particular plant.

In my opinion it is wise to catalogue all the select species that may be found in the forest area, including those discovered in out-of-the-way corners or in farm fields. A list can be made up with the names and location of each; this can be very helpful at times of seed collection. Further species can be added from time to time whether planted for amenity, silviculture, or just local interest. Many nurseries have a collection of flowering shrubs available for amenity planting. To gain a number of different species is preferable to an over-accumulation of only one or two,—even the loveliest of plants will lose interest if met with at every turn.

If plants are not obtainable from our own nurseries there is always that small vacant corner in the garden where a few seeds can be raised—to see how they get on, or tested to find out if they can withstand our climate. Interested friends and neighbours may supply cuttings or seed. Of course there are various methods of acquiring new trees. I am told that the gentleman who introduced the Monkey Puzzle filched the seed (nuts) from his plate whilst having dessert down in South America—it was an official luncheon too!

Where there is an existing collection of the lesser-known trees and shrubs without name-tags—and very few have—the identification is sometimes tough going. Old names persist and catalogues are a bit mixed, listing the old name and the new as two entirely different plants. This can be sorted out with a little care and study and checked up with a botanical authority. In some cases plants may have a label quoting numbers, and letters; those as a rule are register numbers made at the time of collection. This number is a means to identification and should be preserved.

Books dealing with trees and shrubs are readily obtainable; authoritative and descriptive works of this type usually give characteristic and distinctive features which help with the identification of the various species and varieties. With a good book which gives a fairly up-to-date and comprehensive list, it is comparatively easy to work out and identify your actual specimen by elimination.

When plants are definitely identified they should be labelled. Types of labels range from elaborate embossed but expensive affairs down to the strip of old lead, with the name scratched on with a nail—crude but none the less effective, and practically indestructible. Labels should be attached to the plant by means of a *loose* loop of wire. Incidentally, the embossed aluminium labels that anyone can make with a penny-in-the-slot machine on a railway station are very cheap, and very durable.

Methods of arrangement are varied. At one time each estate would have a Pinetum; this was usually a piece of land set aside to contain examples or specimen trees of pine, spruce or cypress, etc.—a type of conifer garden or proving ground. Another term was Arboretum; this could contain a large collection of tree species, each tree set well apart in order that it would show true form and habit, at the same time improving the possibility of seed collection. This type of tree garden was, for educational purposes, a mine of information and everlasting interest. Sometimes as a safeguard, trees were planted in groups of three, that is—three of each species, so when they became established the poorer trees could be removed, leaving the healthiest and best tree.

Groups and individual trees or shrubs planted at intervals at roadsides or odd corners of plantations can be very effective for amenity purposes, rather scattered perhaps, but in this way species can be suited for soil condition and light or shade requirement.

Numbered amongst the trees and shrubs are many dwarf, stunted or creeping types which have their uses in that they may serve to ornament some unsightly ruin or broken wall. We all know the value of *Cotoneaster horizontalis* which can give good evergreen cover, with the added attraction of bright red berries in winter. The only danger in this direction is that some of the creeping or climbing types can go just too far—if they get out of control.

I have seen *Polygonum baldschuanicum*, credited with a growth of twenty feet per year, covering old dead trees with a profusion of white blossom—quite a show, and very picturesque. This plant can well be anything but ornamental if allowed to romp; though not truly a shrub it serves to illustrate that the more rampant types should be avoided.

There is a general misconception that exotic (foreign) plants must be unhardy, and therefore require to be protected from frost and exposure, when in fact, many plants imported from China, India, and Japan are very hardy and well suited to exposure as their original habitat may have been a very high and snow-covered elevation. Quite a number of varieties remain untried because they are considered weak, tropical, or not of importance as a timber tree.

There may be varied opinions as to the type of plants that should be planted for ornamentation, but if we plant a few *Leycesteria formosana*, some of the *Sorbus* group of the *Pyrus* genus, and some *Stranvesia davidiana*, we can at least earn the thanks of the birds by providing something to sustain them over the winter months, and the thanks of the wayfarer by providing a gleam of colour to brighten grey skies.

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At 1st October, 1955

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6 Queen's Gate,
Aberdeen

Telephone: Aberdeen 33361

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SCOTLAND, SOUTH CONSERVANCY

Greystone Park,
Moffat Road,
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