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EDITORIAL

FOR THE THIRD year in succession we are able to begin our Journal with a recital of the honours bestowed on Forestry Commission men. Mr. A. H. Gosling, Director General, was honoured by the award of the C.B. This high honour recognises Mr. Gosling's contribution to British forestry and also the importance now attached to forestry in this country. Mr. A. L. Felton, Conservator of Forests, South East England, and Mr. F. W. Hamilton, Secretary to the Commissioners, were both awarded the O.B.E., and Mr. John Webster, Divisional Officer in charge of estate work in the West Conservancy of Scotland, received the M.B.E.

The Commissioners

Since our note on the Commissioners in the 1949 Journal there have been three changes. Major Sir Samuel Strang Steel, Bart., T.D., and Sir William Ling Taylor, C.B.E., both retired in November 1949 on the expiry of their terms of office. The Commissioners, in their Annual Report for 1950, have recorded their appreciation of the long and valuable service which both have given to the Commission and to British forestry. Professor John Walton, who is the Regius Professor of Botany in the University of Glasgow, was appointed a Commissioner in November 1949.

The Commission is now constituted as follows:

Lord Robinson, O.B.E. (*Chairman*).
Earl of Radnor, K.C.V.O.
J. M. Bannerman, Esq.
Major Sir Richard Cotterell, Bt.
Arthur Lloyd O. Owen, Esq.
John Edmund Hamilton, Esq., M.C.
Major John Stirling of Fairburn, M.B.E.
William Hubert Vaughan, Esq., O.B.E.
Professor John Walton.

The National Committees

The changes in Membership have been few. Sir William Taylor, who served on the National Committee for England and on the National Committee for Wales, retired from both on ceasing to be a Commissioner. Major John Stirling of Fairburn was appointed Chairman of the National Committee for Scotland on the retirement of Sir Samuel Strang Steel, and Professor John Walton was appointed to the vacancy in this Committee.

The Earl of Radnor remains chairman of the National Committee for England, and Mr. Lloyd O. Owen remains chairman of the National Committee for Wales.

First Thirty Years of the Commission's Work

The Forestry Commission was established on the 29th November, 1919, and thus in 1949 completed the first thirty years of its work. The *Thirtieth Annual Report*, published in 1950, contains a review of all the Commission's activities over this period, including the development of our present techniques in the forest and in the nursery. In this period State forests covering, in all, almost 960 square miles, have been built up, in spite of the vicissitudes of drastic national economies in the inter-war period, and the disruption due to the last war. To this great achievement everyone employed by the Commission has made some contribution and the credit like-wise belongs to all.

Staff Changes

We have to record the retirement of Mr. D. W. Young, Deputy Surveyor, New Forest, Mr. A. D. Hopkinson, Conservator, East Conservancy, England, Mr. A. L. Felton, Conservator, South East Conservancy, England, and Mr. F. W. Hamilton, Secretary to the Commissioners. We mark the occasion by giving short notes of the service of these officers. We reproduce photographs of Messrs. Young, Hopkinson and Hamilton, but we were unable to persuade Mr. Felton to face the photographer.

MR. A. L. FELTON, O.B.E., M.C.

Mr. Felton, who retired in June 1949, is one of the band of early students of British forestry. He started his studies at Oxford in 1906, went on to Germany in 1908 and 1909, and it was not till 1910 that he took his M.A. and Diploma in Forestry. After distinguished service with the army in France, he followed Mr. Hopkinson as Chief Instructor at the Dean School for Forest Apprentices, being at the same time Assistant to the Deputy Surveyor. In 1926 he was appointed Divisional Officer for Division No. 4, which covered the South East of England; he held this post till the outbreak of war in 1939, when he was seconded to the Home Timber Production Department, South East England. During the war years he had a very strenuous time in South East England, both with timber production and enemy raids. Mr. Felton's period of secondment did not terminate till 1947 when he returned, as Conservator, to his pre-war charge which, in the re-organisation, became the South East Conservancy. His services to forestry were recognised by the award of the O.B.E. in 1949, shortly before his retirement.

MR. F. W. HAMILTON, O.B.E.

Mr. Hamilton, who retired from the post of Secretary to the Commissioners in June 1950, can look back on almost fifty years of public service, of which forty-three were connected with forestry. He was with the Office of Woods in 1907, with the Interim Forest Authority, and with the Forestry Commission from its beginning in 1919. Mr. Hamilton is a mine of information on all matters connected with the Forestry Commission; he was Chief Clerk in the Office of the Assistant Commissioner for England and Wales from 1924 to 1945, except for a short break on timber supply work in 1939 and 1940. When the Commission was reorganised in 1946, he was appointed Chief Executive Officer in the office of the Director of Forestry for England, and in June 1947 was appointed Secretary to the Commissioners. Mr. Hamilton's meritorious service has been recognised by the award of the King's Jubilee Medal in 1935, the M.B.E. in 1938, and the O.B.E. in 1950.

A gift from the Commissioners and the staff was handed to Mr. Hamilton by Lord Robinson in the Board Room at 25 Savile Row, in the presence of

Commissioners and representatives of the staff, and all joined in wishing him many years of happy retirement. On another page we reproduce an informal portrait taken on a recent official visit with the Commissioners to the west of Scotland.

MR. A. D. HOPKINSON, O.B.E.

Mr. Hopkinson has retired from the Service after thirty years of strenuous service. He is a graduate of Aberdeen University and made his forestry studies at Tharandt Forest College, Saxony, in 1912. Up to the outbreak of the 1914-18 war he was Lecturer on Forestry in the Royal Agricultural College, Cirencester. During the first world war he served in France with the Gordon Highlanders and later with the Forestry Directorate in Normandy.

On demobilisation in 1919 he was selected to restart the Dean School for Forest Apprentices which had been closed during the war. In 1920 he took charge of the West Scotland Division, but was transferred in 1922, to Division 1, North England, where he remained for nineteen years. During this period the very extensive forests in the Border country and elsewhere, now producing considerable revenue, were made under his direction.

In 1941 he was transferred to Dean Forest as Deputy Surveyor, and, on the re-organisation of the Commission in 1946, was posted to East England as Conservator, where he served till his retirement in August 1949.

For many years Mr. Hopkinson was Chairman of the Technical Officers Association and in this, as in other fields, he displayed his characteristic energetic leadership.

Mr. Hopkinson's interests, outside forestry, are in natural history, particularly birds, and in sport, and we wish him many happy years of retirement.

MR. DAVID W. YOUNG, O.B.E.

Mr. Young retired from the post of Deputy Surveyor, New Forest, in August 1949, after having served with the Forestry Commission for thirty years. Mr. Young's interest in forestry started well before 1908 in which year he gained the Diploma of Forestry, Oxford, after taking his B.A.(Hons.), Natural Science, Oxford. He commenced his service in State Forestry in January 1914 as an Inspector of Forestry of the Ministry of Agriculture and Fisheries, and during the 1914-18 war served with the Home Grown Timber Committee and later with the Interim Forest Authority. He was one of the original Divisional Officers appointed by the Commissioners in November 1919, and served as Divisional Officer, No. 2 Division, with headquarters at Shrewsbury, till November 1925. He then went to the Dean Forest as Deputy Surveyor, where he stayed till October 1931, when he became Deputy Surveyor, New Forest, which post he held till his retirement in August, 1949.

Mr. Young's eighteen years as Deputy Surveyor, New Forest, has given him an unrivalled knowledge of this "miraculous survival of pre-Norman England" as the New Forest has been called. His knowledge was put to very good use in his capacity as Deputy Surveyor and also as Secretary to the New Forest Committee, 1947. The Report of this Committee is a wealth of information on the Forest and its peculiar problems; it led up to the New Forest Act, 1949, which has gone far to reconcile forestry and other activities in the New Forest.

Mr. Young is as enthusiastic a forester as ever, and while he has retired from the service he has by no means given up forestry. Our best wishes go with him.

December, 1950.

JOURNAL OF THE FORESTRY COMMISSION, No. 21, 1950

LESSONS FROM SWEDEN

BY MAJOR-GENERAL H. W. P. HUTSON
Chief Engineer

Sweden has fifty million acres of forest: Britain has only three million and much of this is in small dispersed pockets. The greater part of the Swedish timber is floated down to the mills and is hauled from the stump to the floatway by sledge over the snow. We have no driveable rivers and no snow roads. With logging conditions differing so widely in scale and in nature it might appear that Swedish methods and equipment could have little application in Britain. But we shall find when we look into the matter more closely that despite the obvious differences the logging problems of the two countries have much in common. Moreover there is no question of slavishly copying Swedish practice. We have rather to examine the reasons which have led the Swedes to adopt particular machines and techniques as well as the roles assigned to them. We shall then be in a position to apply, if need be, the results of Swedish experience to our own requirements.

Let us see first what the two countries have in common. Both have the same main objective—extraction at the lowest cost. Each should be guided in its approach to the problem by the same broad principles, since the task is fundamentally one of transportation and therefore solvable, whatever the circumstances, only by adherence to these principles. Sweden has adopted as her chief means of movement the waterways and snow provided by nature: we must use for the basis of our extraction the close network of roads with which our country is equipped. This is a difference only in degree, however, for roads are by no means excluded from the Swedish system. In the southern half of the country where watercourses and snow have never played the prominent parts they have in the north, and where railways have hitherto been the principal carriers, there is a growing tendency to build more roads into the forests and to rely increasingly upon road haulage. Even in the north it is likely, now that summer cutting is becoming a regular practice, that there will be a wider use of lorries for hauling the timber to the streams. If movement by road in Sweden does not play the all-important part that it does with us, its role is none the less a very considerable one.

Over the whole field of extraction we are both confronted by the two basic difficulties—an inadequate labour supply and rising wages. Equally we appreciate that mechanisation provides a means for overcoming them, but whilst Sweden has already gone far in this direction we are some way behind. This is only to be expected, for Sweden has been in the logging business in a big way for nearly a century, and has in consequence many engineering firms which have long been serving the industry and which are well fitted therefore to develop the new equipment needed and whose interest moreover it is to do so. Every phase of logging—the movement of the logs through the mill, their handling in the stock yards, the main haul with its loading and unloading operations, and the initial drag from stump to landing, has received attention, and all are now well mechanised except the drag from the stump. Means to mechanise this remaining phase are being actively sought.

It is clear from all this that there are similarities in aims and in methods of logging in Britain and Sweden. They are certainly sufficient to warrant an examination of the Swedish method of extraction by road. We will proceed with this now, but it has to be borne in mind that although we shall describe and discuss single processes these cannot really be treated in isolation. Always the equipment or technique for one stage is related to the needs of the operations which precede and follow it. There has to be constant appreciation of the fact that extraction will only be successful if it is treated as a continuous process with all the operating parts properly balanced and synchronised. The movement from the stump into and through the depot or mill must be built up into a steady flow and maintained as such. There was much evidence that this was being achieved in Sweden.

The key factor in any transportation problem is the pay load. Every effort must be made to keep this as high as practicable, and it was noticeable that the Swedes, in their road haulage, were working to an average pay load appreciably above our own. Nearly all the lorries seen working on timber haul from the forest were flat-bottomed six-ton vehicles with a two-wheeled trailer attached. This gives a pay load of about eight tons, and at the same time caters adequately for transport in pole lengths. It is achieved too with standard type lorries. No difficulty was observed in backing the lorry and trailer when coming alongside a landing or tip, and this was being done on forest roads not differing noticeably from our own either in width or in surface. The majority of the lorries we use are either three-ton or five-ton vehicles. They are not particularly suited to the carriage of poles, and their low capacity is a definite bar to economic working. Larger vehicles such as those used by the Swedes could operate on the forest roads we are now making and could effect savings in transport charges of the order of ½d., 1d. and 2½d. per cubic foot according as the distances moved were five, ten or twenty miles respectively.

Almost if not quite as important as pay load is the question of terminal charges, i.e. the costs of loading and unloading. The Swedes had mechanised these operations fully. Every timber-carrying lorry was fitted with a mechanical loading device. There were several types each with its particular merits, but common to all was the fact that loading was done by the lorry driver and his mate. No loading parties were needed. This gives the method great flexibility. There is no necessity to build up large landings of logs. The lorry can move down the forest road picking up its load from the piles stacked alongside. Since the day's output is determined almost entirely by the efforts of the two men the system is well suited to piecework.

The problem of loading might have been approached in another way—by the use of a tractor operating a shuttle service of detachable trailers. This method depends for its success on keeping the tractor moving. There must be no waiting to pick up the trailers. These are left in the forest for loading and in the depot for unloading. The tractor moves between, picking up a loaded trailer from the forest, taking it to the depot, dropping it there and at once collecting and going back with an empty trailer. And so on. In this way the number of trips made and the amount carried might be more than by the system of individually loading lorries. But it does not follow that the costs would be less. This would depend upon the labour required to load and unload the trailers. The Swedes have investigated the matter, and have come to the conclusion that unless the logs at the landings were in larger quantities than were customary the trailers could not be loaded economically. Moreover, to have these larger landings would raise the costs of the initial drag from the stump. As we are cropping at present considerably less volume per acre than the Swedes we should find these disadvantages even more marked.

Besides their loading devices, the Swedish timber lorries were usually fitted with quick-release stakes. No doubt the need for this equipment has arisen from the practice of offloading into rivers and lakes. Its time saving value is very high, and it would be well worth considering whether the idea could not be applied to our conditions. Certainly by their adoption of these mechanical loading and unloading devices the Swedes have obtained very material savings in time over manual methods. Indeed a comparison of the timings which were being achieved by some of their loggers and which were not, so it was said, in any way exceptional, suggested that the output by the mechanised methods might be 100 per cent. above our own present results.

Closely linked with loading and unloading methods and also with the question of lorry capacities, are such matters as the size of landings by the roadside and the manner of building the piles of logs, also the processing which the timber is to receive at its next destination and therefore the way it is handled there. Swedish practice in building up landings was clearly directed to assist the next operation of loading into the lorry. The landings were sited so that a lorry could draw up close alongside, the logs were laid parallel to the side of the vehicle and, to assist slinging, successive layers in a pile were separated by stringers. Where the offloading was to be done by crane the slings were either put in position before the loading was begun, or the loading was so arranged that space was left for the sling to be passed underneath and round the load. These are all matters of detail and vary a great deal according to the local conditions, but they must receive proper attention if the flow of movement is to be maintained and economical working achieved. In this connection, the many forests we have on steep slopes falling to a road, often a main public highway, present very awkward problems. If the timber is to be brought down by ropeway or chute, careful thought will have to be given to the manner of dealing with it at the bottom of the descent, or the handling charges here are likely to be unduly heavy.

The type of transport, its capacity and its mechanical equipment, cannot be considered apart from the load itself. The more uniform this is, the more standardised can be the transport equipment and techniques used to deal with it, and the more efficient should be the transportation. This calls for decisions as to whether the timber should all be brought.out of the forest in pole lengths or whether crosscutting and other processing should be done in the forest and assorted loads be taken out. The Swedes did very little crosscutting in the forest, but had to undertake a considerable proportion of their peeling there. They did the latter partly to assist flotation and also because the mechanical peeling capacity at their mills was insufficient to cope with the whole crop. None the less the practice was not regarded as satisfactory, due to the very much higher cost of peeling in the forest. This was all being done by hand, and was costing about twice as much as when done mechanically at the mill. Attempts are being made to develop a small drum peeler for forest use, but so far without success. The general opinion was that peeling and any other processing operations ought to be concentrated in the mills rather than done in small dispersed lots about the forest. The closer supervision, the more efficient equipment and the more continuous operation possible with large scale work in a permanent installation were found to give results which were better in quantity, quality and cost. In Britain, the dispersion of the forests and the small scale of the individual operations has tended to obscure the advantages of depot operation. The crops have not seemed large enough to bear heavy charges for mechanical equipment and the transport has been too scattered for economical operation. These difficulties might be overcome however by taking advantage of our excellent road network to group the forests for extraction purposes into units of sufficient size for the possibilities of mechanisa-

tion to be fully exploited. The extent to which such grouping would be practicable would depend largely upon the economic distance for road haul. It is probable that if we were working with eight-ton pay loads, mechanical loading, and transport organised specifically for the job, we should find that round trips up to some forty miles could be made economic. Within this limit many forest groupings of the order of 50,000 acres are already possible, and more will become so as the planting programme develops. It does seem therefore that the necessary scale for full mechanisation would not be impracticable.

Now let us turn to the question of operational technique. Provision of mechanical equipment—of the right type and in sufficient quantity—does not, in itself, ensure successful operation. There must also be the technique proper to the new equipment, and this will often be very different from that employed when the task is done by hand tools: it may well involve changes in organisation and sometimes in the class of workers employed. The Swedes, in their development of up-to-date logging techniques and equipment have for the past ten years or more been making considerable use of operational research methods. Special bodies, supported alike by the State and by the logging companies, have been set up to conduct investigations. The days when logging and hauling operations were organised by the loggers and hauliers themselves have passed. Now the logging companies plan and organise the work, construct the roads and other facilities and provide most of the equipment. There is consequently greater attention to ways and means of improving operating efficiency, and the inquiries of the job study departments, as the research bodies are called, are regarded as essential to this end. Moreover the practical application of the job study recommendations is made easier by the growing numbers of forest workers who are in permanent employment, due partly to the extension of logging operations beyond the winter season, and who can therefore be trained in new techniques, and made to use them.

One has to recognise that extraction is something very different from silviculture, and whilst the latter has definite similarities with agriculture, extraction and processing are largely industrial and engineering problems calling for factory rather than farm methods. In Sweden, where ready-made forests were to hand and awaiting exploitation, the outlook from the start of serious logging has been primarily industrial. We cannot expect the same view here where we still have to establish our forests, and the dominant concern must therefore be silviculture. None the less, efficient extraction is an essential of successful forestry, and more and more we must be prepared to adopt "factory" methods and to accept an increasing degree of specialisation.

Whilst there is little doubt that Sweden's general use of mechanical equipment and her well-engineered techniques are the principal explanation of her low logging costs, the effort of the individual worker is a factor which cannot be ignored. In Sweden as in Britain, the forest worker has belonged to the agricultural type. Logging in Sweden has been, and still is, a part of the normal occupation of the farmer. Most of the farms are small—less than twenty-five acres—and are located in clearings in the forest. Their yield is not enough to support a family. Work in the forest is therefore a welcome, usually a necessary way of making ends meet. It is complementary, too, to the farming, since it takes place in the winter when there is little which could be done on the farm. The typical farmer-logger is hardworking and skilful. He will fell, trim and peel 140 cubic feet in a day. With his horse and sledge he will haul twice this amount to a landing. But other labour is now being brought into the Swedish forests in increasing quantity. Not only are the logging companies building up bodies of permanently employed workers, they are also importing men of other nationalities—Finns, Latvians, Esthonians,

etc. And not all of this new labour is as experienced and as hard working as the true farmer-logger. When men from the cities were sent into the forest during the war years their output was sometimes less than twenty-five per cent. of what the farmer-logger achieved. In fact they could not earn enough to live on and the State had to subsidize them with special allowances. The outside labour now coming in is better than this. None the less it does mean some dilution of the farmer-logger type, and a lowering of the standard of individual performance.

This importation of labour from outside has been forced on the logging companies by the drift of the farmer folk to the towns. Many members of the younger generation of the farming families do not want to work in the woods. Sweden is much concerned over this problem of keeping the agricultural type of labour in forestry, and is spending a great deal of money in improving living conditions and amenities for the forest worker in the hopes of checking the move away from the woods. Whether this policy will by itself succeed is questionable. The cause of the movement is complex. It is not a matter purely of wages. In Sweden a good forest worker can now earn as much as he would receive in a town as a bottom grade industrial worker. Nor is the appeal of town life a full explanation. A view commonly held in Sweden was that the true reason lay in restlessness or uncertainty, in a disinclination to settle on a career without seeing more of what was offering. What is really wanted therefore, if the youngsters, and especially the brightest and most ambitious of them, are not to move away from the forests, is more choice of employment and wider opportunities.

A partial solution of this problem is provided in Sweden by their integration of wood-using industries. The Swedish logging companies with their large scale operations and far spreading range of activities—pulp mills, paper mills, board mills, saw mills and factories for all sorts of wood products can offer a wide choice of careers and every sort of prospect. In the course of time we may see somewhat similar developments in some parts of this country. As a step in that direction the grouping of forests which has been suggested would, by increasing the scale and the scope of our operations, create some fresh and better opportunities for advancement, and should help to attract and retain the workers we need.

The impression gained—and on a visit of less than a fortnight, it can be no more than an impression—was that the output of the Swedish logger was greater than that of our own forest worker. This seemed to be so even after making allowance for the greater effort involved in dealing with trees of small unit volume. Part of the explanation must lie in the fact that the Swedish logger is more of a specialist—he works at his trade and is not diverted to silvicultural tasks. In addition, all logging work in the forest is piecework. There is therefore not only opportunity to acquire skill, but that skill, in so far as it is reflected in output, earns money. These two factors—specialisation and piecework—are probably the principal causes of the Swedish workers' higher output.

NOTES ON AFFORESTATION AND NURSERY WORK IN THE NORTH-EASTERN UNITED STATES

By JAMES MACDONALD
Director, Research and Education

DURING THE COURSE of the United Nations Conference on the Conservation and Utilisation of Resources, held near New York in August and September, 1949, I was able to visit certain forests, and one large forest nursery, in the North-Eastern United States. The following brief notes bring out some of the more interesting points of the methods which are followed in that region. A more detailed account was circulated to technical officers in February, 1950, under the title: *Notes on Forestry in the North-Eastern United States.*

Broadly speaking, the problems which face foresters in New York and Pennsylvania are similar to those which confront us at home. Like us, they have a twofold task, to establish new plantations on land which is unproductive and to reconstruct and bring to full production the enormous areas of cut-over and badly-stocked forest which exist in these States.

They have some advantages as compared with ourselves but they also have some disadvantages. The advantages are:—

1. The absence of rabbits which makes fencing unnecessary and allows regeneration to develop freely.
2. The wide range of species at their disposal and the presence among them, of a number of useful shade species.
3. The absence of weed-growth of the kind represented by our thorns and brambles.

Their disadvantages are:—

1. The large areas of forest involved, which make intensive silviculture difficult at the present stage.
2. The long winter, followed quickly by growth in the spring, gives a very short time for the conduct of nursery and plantation work. In this we are favoured by our generally open winters which give a much longer working season.
3. The fires, which in spite of the protection measures taken, still occur at frequent intervals.

Much afforestation has been carried out in New York State, mainly on abandoned farm lands, and a general picture of the methods used is as follows:—

(*a*) **Species**

The species mainly in favour for planting are white pine, red pine (*Pinus resinosa*) (also called the Norway pine, not from any European association but because it was first used near the town of Norway, Maine), jack pine (*P. banksiana*), Scots pine, European and Japanese larches, Norway spruce, white spruce (*Picea glauca*) and Douglas fir.

Pure plantations are not now regarded with favour, although at one time they were formed on a large scale, and the present tendency is to put out a mixture of conifers and then allow broadleaved species to seed themselves in if they are wanted.

The species most frequently used is the red pine which establishes itself rapidly. In appearance, it resembles Corsican pine and has much the same habit

and the same straightness of stem. In certain districts it is attacked by a sawfly and in those areas mixture with Scots pine is advised as this species appears to be immune.

White pine is not now used so often, mainly because of the damage done by the weevil, *Pissodes strobi*, which is considered to be a worse scourge than the blister-rust. The weevil is particularly severe in plantations in the open but is less of a menace to natural regeneration or to plantations with an overhead cover.

Jack pine is used on the more difficult sites, much as we would use *contorta*' and its hardiness and resistance to exposure make it a useful species.

It was surprising to see so much Scots pine being planted and to notice its excellent growth and appearance. Much of it is wavy or slightly crooked in the stem, due, it is believed, to the use of the wrong provenance. This may well be so, but in view of the low latitudes, it may not be easy to find a suitable race. The Pine Shoot Moth is present in the southern part of New York State and damages both Scots pine and red pine. In the central Adirondacks, Scots pine is not recommended for planting because it is a favourite food of the porcupine, which is common there. Scots pine is now much in demand as a Christmas tree.

Both European and Japanese larches are used more frequently than might have been expected and a few plants of Dunkeld hybrid larch were also seen. The value of the larches as producers of fencing timber is kept very much in mind and both these exotic species are apparently more likely to succeed in plantations than the "tamarack", the native larch, which is chiefly found in bogs and swamps. The susceptibility of larch to late spring frosts is well recognised in America, where such frosts are frequent, although not so severe as those in Great Britain.

Norway spruce is a popular tree and grows as well near New York, at least in the early stages, as it does in Great Britain. Its popularity, to some extent, depends on its ready sale as a Christmas tree but, for forest purposes, it is now less used, because it is attacked, sometimes severely, by *Pissodes strobi*. Where this insect is a serious pest, white spruce is now being used instead. It is a more accommodating species, being less exacting as to soils, but it has the disadvantage of being a slow starter.

The Douglas fir which is used is the "blue" mountain form, as the coastal "green" type has not proved to be hardy enough for the north-east. This Douglas is apparently giving variable results and it will not stand exposure, but on suitable sites, free from frost and preferably protected by a border of woodland, it is proving satisfactory. It is in wide demand as a Christmas tree.

(*b*) **Spacing**

For a considerable time, 6 ft. spacing was the standard, but the following spacings are now recommended by the New York State Forest Department.

For red pine, Scots pine, larches	8 feet × 8 feet;
for white pine....	5 feet × 5 feet or 6 feet × 6 feet (max.);
for spruces, Douglas fir	6 feet × 6 feet (max.).

In the Pack Demonstration Forest, comparative spacing plots have shown that the best results have been obtained with white pine when the spacing was either 4 feet × 4 feet or 6 feet × 3 feet. White

spruce responded well to the same spacings, but, here, half the trees are removed as Christmas trees in 8—15 years.

(*c*) **Preparation and Planting**

The authorities at the Pack Forest, in dealing with abandoned fields, prepare the ground for planting by using a double-mould board plough, which throws the turf both ways, to which is attached, a set of spring-type cultivator teeth, which perform a small amount of cultivation. The cultivated strip is about 12 inches wide and into it the plants are inserted. Planting is done by vertical notch made either with a mattock or with a planting iron.

(*d*) **Planting stock**

The use of seedlings is now almost universal, transplants having been given up mainly on the grounds of cost. Seedlings are normally root-pruned before being planted and it is said that there are rarely any heavy losses with the use of this type of stock. Pines and larch are put out as two-year seedlings; spruces and Douglas fir as three-year old.

Planting machines are in use in some parts of North America but the districts visited did not contain any land level enough for machine planting.

(*e*) **Treatment of Plantations**

Beating-up is not carried out if the survival is 80 per cent. or greater. Where necessary, it is usually delayed until the third year, which seems too late in view of the fairly rapid early growth of some of the species used. This is responsible for much of the irregularity which is common in the American plantations.

Only one plantation was seen at the thinning stage—a 24 year old crop of *Pinus resinosa* in Mr. Luther's forest near Saratoga, N.Y. Here the method of line-thinning was being employed, every fifth row being taken out, and the thinnings were extracted by jeep over the level ground.

I saw no pruning in any of the plantations visited and although a certain amount is done, there appears to be in America, as in most other countries, a conflict of opinion on the profitableness of the operation. Saws seem to be preferred to shears for the actual work and a recent publication of the Forest Service (Farmers Bulletin No. 1989) states that pruning shears are more expensive than saws and not so useful.

One interesting set of experimental plots was seen in the Pack Forest where various pines had been planted on worn-out arable land, or poor sandy soil, the bed of a former glacial lake. For a number of years the growth was very poor and the trees showed little sign of forming canopy. It was found first of all, by spreading brush (branches, etc.) over the floor in selected blocks, that the plots so treated began to grow rather better. Later, as a result of various trials of artificial manures, it was found that a striking response was obtained with potassium but little with phosphate, nitrogen or lime. As a result of this, such areas are now dressed with muriate of potash. In this case, the species was *Pinus resinosa* and the symptoms, poor shoot growth, short needles, and slight yellowing of the foliage, are similar to those formerly seen on Scots pine at Wangford, Thetford

Forest, on old blown-out sand areas. I think it probable that the condition would have corrected itself in time but the treatments applied have undoubtedly shortened the period.

(*f*) **Nursery Work**

The New York State nursery at Saratoga extends to over two hundred acres but, owing to the change from transplants to seedlings for planting the effective area has been reduced to 62 acres. This has had two effects. It has enormously cheapened the cost of raising planting stock and it has enabled the nursery to become fully mechanised. In addition to the nursery proper, there are packing sheds, cone stores, a seed extraction plant, a seed testing station and a seed store, the whole under the management of one man stationed at the nursery.

Most of the operations in this nursery are mechanised and this is naturally facilitated by the absence of transplanting and transplant lines. The seedbeds have a standard width of 4 feet and all the machines used are designed or modified with this in mind. Thus all the tractors and machines, which are used, straddle the beds exactly so that the tracks or wheels run in the alleys.

The following operations are mechanised.

(1) *Seedbed preparation*
The machine used appears to be a type of rotary cultivator to which is attached a device for forming the seedbed edges. It is drawn by a track-tractor.

(2) *Seed Covering*
Seed, after sowing, is covered with sand which is spread by a distributor drawn by a tractor.

(3) *Lifting*
The seedlings are now lifted mechanically by a two-row potato digger which not only uproots the trees but shakes the soil from the roots. At Saratoga they have to lift about a million seedlings per day in the height of the season.

Previously, another form of tree lifter was used, a knife which was drawn along by tractor under the seedbeds, loosening the soil. After this had passed along, the plants could be lifted with ease. This, set rather higher, could also be used for root-pruning.

(4) *Weeding alleys*
The alleys are kept free from weeds and the edges of the beds are periodically made up by another simple attachment to a wheeled tractor. Two steel blades, one behind each wheel, scrape the surface of the alleys as the tractor goes forward and remove any weeds. These blades are set at an angle, like the blade of a bulldozer, and the soil which they remove is thrown up against the edges of the bed.

(5) *Counting and bundling of seedlings*
The seedlings, after they have been lifted, are taken to a large shed where counting and bundling are carried out. This is done on a series of conveyor belts which make quite an impressive sight and are said to be capable of dealing with 700,000 to one million seedlings a day. The operators stand on each side of the belts, of which there is a parallel series, each with a box of plants alongside her (this work is done by women) and each

has a number. The numbers are painted at intervals on the belts, and operator No. 5, for example, places her seedlings on 5 when it passes before her on the belt. Culls are dropped on the floor. At the end of the belt, the plants are picked up by another worker, counted into bundles of 100, and each bundle is then placed on another belt and carried down to an electrically driven tying machine. The tied bundles are then passed to a storage and packing shed where they are packed for despatch. This is a large airy structure, the floor of which is covered with sand to about a foot in depth. The bundles as they come in are immediately placed in trenches, filled with water, which have been scooped in the sandy floor, and are kept there until they are crated or bundled for despatch. The methods of bundling and crating are similar to those in use in Great Britain, but the crates and bundles are run over a series of rollers into the trucks for transportation.

Sowing is broadcast and not mechanised. The density is calculated so as to give a stock of 50 two-year seedlings per square foot. The seedbeds are shaded at first with lath shelters, over which hessian is placed as it is found that this stimulates germination. Apparently this does not lead to damping-off as one might have expected. When the seedlings have germinated, the hessian is removed, but the lath shelters are kept in place and only removed for watering, which is necessary, and which is carried out by the overhead irrigation system. It is left to the man in charge to decide when water should be applied. The frames on which the lath shelter rests give the effect of the boxed-in beds which we have used experimentally. They are of standard size, made of wood, cross-braced and fitted with short, pointed legs which are pressed into the soil. They are removed at the end of the first winter. These sections are treated with copper naphthanate as a wood-preservative. Weeding is said to be eliminated by the use of weed-killing oil sprays. The oil is applied through an 18 foot tractor-drawn spray boom.

No manures are applied to the seedbeds but only to the green crops. Buckwheat and oats are the standard crops and they are manured with a 5-10-5 complete fertiliser at the rate of 500 lb. per acre, as well as with farmyard manure. I asked whether there had been any trouble with an increase in alkalinity in the soil. I was told there had been none but that, if it appeared, the condition would be rectified by the use of aluminium sulphate. In addition to the nursery proper, there are at Saratoga, a cone drying shed, a seed extraction plant, a seed store, and a seed-testing station.

The cone-drying shed, in which cones are given a preliminary air-drying before being sent to the kiln, is a timber framed building with walls of fine wire mesh, and a cement floor. The cones are dried in gauze-bottomed trays, arranged in stacks, one above the other, and each tray is designed to take about one bushel of cones.

The extraction plant, situated at a short distance from the drying shed, consists of a kiln and the usual ancillary machinery. The kiln is of an interesting type. It consists of six racks loaded with trays, which are taken from the drying shed, and each rack

is mounted on rails, so that it can easily be drawn out for examination of the cones, or for tipping the cones and seed into the shaker when the cones have opened sufficiently. When the racks are all in position they fit closely together. Heating is by electricity and the temperatures are controlled thermostatically.

The rest of the machinery, the rotating drum for shaking out seed, screens, dewinging and winnowing plant are similar to those used by us. They are all driven by an electric motor.

The seed store is an underground room, like an air raid shelter, kept at a constant temperature of 36°F. The seed is stored in carboys and each carboy is crated, which makes handling much easier.

No other nurseries were seen, but at the Pack Forest there was confirmation that the use of root-pruned seedlings is as satisfactory as that of transplants and, in many cases, more so. The cost of these plants is about one-third that of transplants.

In addition to root pruning, shoot pruning, especially of three-year seedlings, is sometimes practised in the United States, the seedbeds being gone over with something like an Autoscythe. The object is stated to be the improvement of the root shoot ratio.

(*g*) **Rate of growth**

The following particulars are of interest:—

TYPICAL RATES OF GROWTH OF PLANTED CONIFERS IN NEW YORK STATE

Species	Age	Mean Height Feet	Mean Quarter Girth breast height, inches	Our Quality Class
Pinus strobus....	36	48	$6\frac{1}{4}$	—
Pinus resinosa	24	37	$5\frac{3}{4}$	—
Pinus sylvestris	25	42	$4\frac{1}{2}$	More than I
Picea excelsa	31	40	$4\frac{1}{2}$	II—III
Larix europaea	25	45	$3\frac{1}{4}$	I—II

In the Luther forest, a privately owned property near Saratoga, a plantation of *Pinus resinosa*, 24 years old, carried 2,397 cubic feet per acre with a basal area of 91.64 sq. feet. The mean height was about 40 feet.

THE TREATMENT OF DEVASTATED WOODLAND

By B. R. G. HAMMOND

Forester, South-West England

ONE OF THE LEGACIES of two World wars is a large area of devastated woodlands. Many of these woods now carry some kind of a natural crop which requires special treatment.

As the forest under my charge was a typical example of such an area, it may be of interest to examine the way it has been reafforested, and the various problems that such an operation entails. Briefly Collingbourne Forest in Wiltshire covers some 1,300 acres of chalk downland, of which some 200 acres were planted, mainly with beech, between the acquisition of the Forest by the Commission in 1936 and the outbreak of the second World War. Of the remainder, approximately 800 acres have been planted during and after this war, and approximately 300 remain to be dealt with.

Most of the 800 acres of planting has been carried out on what can only be described as truly devastated woodland; the Forest originally carried an oak crop, which was felled, I imagine, on the selection system up to 1936, then cleared of the remaining trees by private firms and the Ministry of Supply during the last war; the latter Department not only removed the oak, but also the birch and other poles for pickets and other defence material. In addition, many oak tops were left on the area, and thus the whole presented a scene of complete chaos.

The problem at this particular forest was tackled as follows: to begin with a set of questions was compiled, which may be applied to similar areas elsewhere.

Briefly the main questions are:—

1. What, if any, useful species remain on the area?
2. What future have they, and are they likely to give a useful financial return?
3. Apart from these, what potential crops, if any, have we?
4. How shall these be treated?
5. What is to be done with the remainder of the area?

These are the main problems which confront the forester, and here they were answered thus:—

1. **What useful species, if any, remain?** In places birch regeneration has formed useful and promising clumps. There are odd mis-shapen birch, natural ash and sycamore scattered sporadically throughout—nowhere dense enough to form a crop. Throughout the area, dense patches of hazel from four to twenty years old exist.

2. **What future have they, and are they likely to give a useful financial return?** There is a useful local turnery market—obviously the birch can be allowed to grow on, thinned where necessary—the future financial return should be satisfactory. The odd mis-shapen birch may be useful as cover for the future beech plantations, which will probably form the main future planted crop.

The odd ash and sycamore can be left to grow on; in a beech mixture they will improve, and they are too small to warrant cutting now.

3. **Apart from the foregoing what potential crops have we?** The hazel of the right size is marketable now, but the older stools are going back and should be reduced to one or two stems to the stool; this should be useful cover for beech.

Natural regeneration is unlikely, as parent trees do not exist; possibly some birch will come in, but the quantity and density is doubtful and cannot be relied upon.

Planting is the only answer to form a timber crop.

4. **How shall we treat these?** Irregularly-aged hazel is a very different matter to deal with; crate rods, bean rods, brewers bungs, etc., all have possibilities depending on local markets. Taken generally, however, hazel is not a crop with any future, and the golden rule is to dispose of as much as possible in the "preparation of ground" stage; thereafter treat as a weed, except where required for shade for the beech, when it will be cut or killed at the right time. No other species exists in sufficient quantities to warrant attention.

5. **What is to be done with the remainder of the area?** It will have to be planted. On this particular chalk downland area beech is the obvious choice, and how to establish it on such a devastated site is the problem we have to face. We have 800 acres of such woodland, and obviously weed growth, etc., is continuing each year; therefore it is the most economic policy to treat as much as we can in each year.

Having decided therefore on the maximum area we can plant in the first year, we must next carefully examine the area. Generally it will be found that devastated areas are *not* uniform, patches of dense coppice intermingle with bracken and bramble areas. All the possible planting methods can be considered; for example, strips, groups, cleaning and burning for straight planting, etc., but the main point to grasp is that we wish to establish timber trees. We need not aim at a pleasing appearance, although it gives pleasure to the eye (and to the public), to see devastation transformed into neatness. Provided we can put in the trees with a reasonable chance of them growing, we must not clear unnecessarily, and we must always bear in mind that the more there are left on the ground, the more material there is for conversion to humus. Again, if beech is to be the crop, many useless weeds can form a valuable frost and sun protection; bracken can usually be planted through.

In the case of this area, and most others of the devastated type, the vegetation types can be roughly divided into three types:—

(*a*) *areas densely covered, which require heavy expenditure to make planting possible.*

These include coppice, old grown-in tops, sallow, privet, etc., and the minimum cost of cleaning such areas cannot be less than £11 per acre; it may cost anything up to £25.

(*b*) *Less densely covered areas, which are still impossible to plant without some removal of coppice and weeds.*

Such areas include hazel clumps, oak stools, etc., interspersed with bramble and bracken. Costs depend a great deal on the age and size of the stools, but generally £8 to £11 per acre should cover costs of this type.

(*c*) *Light coppice areas with bracken.*

Here the minimum amount of preparation is required, and costs should not exceed £5 per acre.

In conclusion, it is important to remember that frost-hollows exist in nearly all woodland areas. Where these occur, my advice is to spend money on complete clearance of coppice and scrub, and plant a frost-hardy species; it is false economy to leave cover, and plant beech, which as a general rule will never succeed in such frost hollows.

NOTES ON THE STATE FORESTS OF WEST GLAMORGAN

By J. H. CURRIE
District Officer, South Wales

THE FORESTS FORMING the subject of these notes are Rheola (including Crynant, Penllergaer and Pelena), Michaelston, and Margam; but for purposes of illustration, occasional reference is made to Cwmogwr, St. Gwynno, Llantrisant and Llanover Forests which are growing under similar conditions.

Situation

The forests under discussion lie close to Neath and Port Talbot in the county of Glamorgan; they are entirely within the South Wales coalfield and are two to twelve miles from the sea coast. They form a more or less continuous block some fifteen miles long and up to nine miles wide.

Area

The total area is 24,000 acres, of which 10,000 acres have been planted up to the end of F.Y.49.

Topography

The forests lie within the catchment area of the rivers Tawe, Neath and Avan, all of which flow in a south-westerly direction, roughly parallel and some four to five miles apart. These valleys were formed by faulting and ice action, and their sides are short but steep and run up on to a large, more or less flat, moorland top, called locally the "mountain". Few of these tops rise much above the 1,300 foot contour which, at present, is the normal planting limit, though we have gone as high as 1,500 feet in one instance. The highest point in Glamorgan lies on the boundary of the forest area and is 1,969 feet above sea level. In general, exposure to the south-west is considerable.

Geology and Soil

The forests stand entirely on the coal measures, and the underlying rock is Pennant sandstone or the related sandstone of the Lower Coal series. The Vale of Neath is the boundary between the east Wales bituminous coalfield and the west Wales anthracite coalfield.

Coal outcrops almost everywhere and much of the area has been extensively mined; it is, in fact, honeycombed with workings. The sandstone has a naturally high degree of cleavage and this has been greatly increased by subsidence due to the workings.

The soil is mainly deep, even on the mountain top, save only in those comparatively small areas where it has been removed by the ice. That there has been a lot of glacial deposition is proved by the frequent occurrence of stones from the millstone grit, limestone and old red sandstone formations which surround the coalfield on the northern side. The soil varies from sandy loam to heavy clay and changes are sudden and frequent. It is quite common to come across several changes in the course of one short furrow. Peat is common on the mountain top but, except for a few very boggy parts, it does not exceed two feet in depth and is often much shallower.

On the flatter parts of the mountain top, iron pan occurs frequently; it is never widespread but other forms of impeded drainage are, and a lot of

deep ploughing and draining is required. Elsewhere, on account of the steep slopes, the cleavage of the rock and the undermining, natural drainage is extremely rapid, and this affects both choice of species and growth.

Climate

Undoubtedly wind is the most important factor. Most of the forest area is fully exposed to the prevailing south-west wind which sweeps up the Bristol Channel with no mean force. Exposure to the north and east is also considerable, and the effect of valley draughts must also be taken into account. It may be, however, that in the past we have been too fearful of the effects of blast and we have recently been planting large areas which when acquired were regarded as "unplantable" on account of exposure. Nevertheless, wind is the principal factor affecting silviculture in this area.

Rainfall varies from about sixty-five inches in the valley bottoms to about eighty-five inches on the mountain. It is distributed fairly evenly over nine months of the year, the months of March, April and May usually being dry with strong north-east winds. Snow does occur, but does not usually lie for long, and frost is seldom important except in a few areas where the selection of species has been at fault.

History

Prior to the industrial revolution, which came rather late to these parts, the valleys were densely wooded. The most common species were oak and birch, but there was also a fair amount of beech and some plantations, mainly of European larch. Indeed, a survey made for the Board of Agriculture in 1815 says of the Rhondda Valley that there was growing there "oak and native larch unsurpassed in size and quality in any other part of the country". In the eighteenth and early nineteenth centuries, ironstone was mined on a small scale and the woodlands in the vicinity of the workings were gradually stripped, although some sporadic efforts at regeneration seem to have been made. About 1840, however, large scale felling began, to provide pitwood for the rapidly developing coalfield, and sheep were pastured on the felled areas, which soon degenerated into scrub and bracken. Quite a lot of oak coppice and larch did survive until the 1914-1918 war, and the last vestiges were not cut until the recent war.

Prior to 1875, when the bottom dropped out of farming in industrial South Wales, much of the mountain land was intensively farmed and grazed. There was an elaborate system of banks, hedges, ditches and dry stone walls; the traces of ploughing are still plainly to be seen in the most unlikely places; and recent deep ploughing on a bad bog at Pelena has disclosed an extensive system of mole drainage. After 1875, however, labour left the farms for the mines, the mountain became a sheep run, and arable and grass land degenerated to moorland.

Plantations Made by the Forestry Commission

The forests of Rheola, Llantrisant, Margam and Llanover, which included a considerable area of old woodland, were the first to be started, and planting commenced in 1921. The earliest plantations were not successful or, at best, were slow in developing. This state of affairs was for many years largely ascribed to "smoke damage" and it was not until sometime during the war that this theory was finally discredited; there is, in fact, very little smoke damage. Be that as it may, for this and other reasons, we seem to have hesitated to start any additional forests and, except for Dyffryn (now part of Crynant)

and Penllergaer, no new units were started in the industrial area until 1938. When the South Wales coalfield was scheduled as a distressed area, the Commission began to acquire land to help to provide employment. At this time, Cwmogwr, Crynant, St. Gwynno and Michaelston were acquired and planting was commenced in 1938-39. Experience had now given us a truer appreciation of the various locality factors, and the earlier mistakes were not repeated, although we have possibly been making others instead. The value of deep ploughing was realized and, by F.Y.41, a decrease in the programme and an increase in the number of tractors enabled us to plough almost everything that was ploughable. Unfortunately, either the drainage effect of ploughing was over-estimated, or we just did not have the labour to do any draining, and we are now confronted with a formidable drainage programme which we still cannot find the labour to complete. The advent of the R.L.R. and Cuthbertson ploughs in F.Y.46 has enabled us to improve our standards of cultivation and drainage.

Scots Pine was quite extensively planted in the early days, but it later fell out of favour. In the 1930's it was severely attacked by Pine Shoot Moth (*Evetria*) and Pine Weevil (*Myelophilus*), and the pole crops were badly damaged by the glazed frost of 1940. The combined effect of all this was rather depressing, and when the writer, a born enthusiast for Scots pine, arrived in the coalfield in 1940, he was told that "there isn't a decent Scots plantation in South Wales". At that time there certainly seemed to be some truth in this statement, but now that most of the damaged stems have been removed in thinnings, an altogether different picture is presented and most of the Scots pine are seen to be in vigorous growth. Unfortunately, these early setbacks caused us to reduce greatly the area of Scots pine planted each year, and it now seems certain that we have planted a lot of Sitka spruce where we should have done much better with Scots pine. Apparently Scots pine can stand all the wind that it is ever likely to experience in Glamorgan, and the planting of larger areas on the drier portions of the mountain top seems indicated.

Corsican Pine was planted on a small scale in the early days, but by 1939 it was being quite extensively used as a substitute for Scots pine. This tendency was stopped by the increasing shortage of plants as the war progressed. It was also feared that if it were planted too high, attacks of *Brunchorstia* would occur, but although we have P.24 plantations at over 1,000 feet, none have, as yet, been attacked. At the higher elevations, however, some splitting of the stems of young shoots is noticeable, and Mr. W. R. Day of the Imperial Forestry Institute, Oxford, considers that this is due to a combination of early frosts and late ripening of the wood.

European Larch. This species has caused us a lot of trouble. Many tales are told of the magnificent larch plantations felled before and during the 1914 war, and a few survived until the last war. It was, therefore, natural that we should make much use of it, and planting continued, on apparently suitable sites, until 1929, when it became obvious that something had gone wrong. Hardly any of these plantations were making even reasonable growth, and most were going back fast. This is all very puzzling, especially in view of the known good growth of the former plantations, and various reasons have been advanced. Perhaps the origin of the seed was at fault, and perhaps the young plantations were not weeded hard enough in the early stages. It is probable too that all these earlier plantations had become well established before the collieries had been developed sufficiently to have any effect on the water table. It is very significant, however, that the natural seedlings from the previous crops, of which there is a fair profusion at Rheola, are growing vigorously. In addition, two plantations, also at Rheola, which were once

condemned, are now making reasonable growth, and it may be that we should again try this species on a small scale.

Japanese Larch is our standby species for all hillsides which are neither too dry nor too exposed. In this area of extreme fire risk, the speed with which it kills out the vegetation and gets into the brashing stage is highly valued. It has not been planted much above 800 feet except in shelter, but, during the war, it was used as a fire belt on all sorts of sites in full exposure, where, after about six years of check, it is now growing reasonably well. It seems that we can be rather bolder with Japanese larch than we have been in the past, and it has never yet been used on the very poor sites on which it is sometimes planted in other parts of the country.

Douglas Fir was, unfortunately, much too extensively planted in the 1920's. All sorts of hard *Aira* and *Vaccinium* sites were chosen and all too little bracken and old woodland. To crown all, a large proportion of the plants used were of the Colorado variety, and these have been severely attacked by chermes (*Adelges*). Again we quickly realized that something was wrong and adopted the simplest remedy; no more Douglas fir was planted. Some of the plantations were replanted with Scots pine, and these are now thriving mixtures which are being thinned to favour the Douglas fir; some were beaten up with Lawson cypress and hemlock, and these too are thriving mixtures and just entering the thinning stage. By far the largest area was left alone, at least until 1934-35, when most of it suffered a process, locally known as "delayed beating up". Unfortunately, the species chosen for beating up was Sitka spruce and no noticeable improvement resulted. If only Japanese larch had been used instead! These plantations have continued to struggle on, and they are now more or less in the thicket stage and growth is improving. The best Douglas fir in the coalfield is a P.23 plantation at Llantrisant, which received its first thinning in F.Y.48. Despite this rather discouraging tale, it is obvious that Douglas fir will grow in Glamorgan if we will only plant the green or Coastal variety on the right site, and the time has come to try again, probably in mixture with Scots pine.

Norway Spruce has never been planted on a very large scale, and in the past ten years the percentage of this species in the total planting programme has dropped considerably. This is largely because the planting areas have mostly been in exposed situations or on *Calluna* associations. It is slower to establish itself than is Sitka spruce, and for this reason the latter species has sometimes been preferred with the idea of saving on weeding. Be that as it may, the relegation of Norway spruce to a minor part in the planting programme is a great mistake, and we should now use it more freely. Let us try it at higher elevations and mix it with Scots pine on more difficult sites.

Sitka Spruce. In the twenties and early thirties, this species was largely planted in valley bottoms, frost holes and old woodland sites, and frost and honey fungus are still taking their toll. It is now confined to the more exposed situations, where it is planted both on deep peat and mineral soil, though on the latter it is now sometimes mixed with Scots pine. It grows well at first, but some of the ten-year-old plantations are disappointing, and during the last three summers, at least, it has been severely attacked by Spruce Aphis, *Neomyzaphis*. This encourages the belief that we would be well advised to make more use of Scots pine or Norway spruce. In recent years as much as 65% of the planting programme has been Sitka spruce, but this percentage is now dropping.

Lawson Cypress, Western Hemlock, and Abies grandis. These have all been planted on a limited scale and are all doing well. There is ample scope

for them in the industrial valleys, and it is unfortunate that they are in such short supply. Lawson cypress is particularly useful; it stands frost better than the spruces and is certainly valuable as a "pioneer", though it must be kept off dry sites. Even if it does form multiple leaders, this can be turned to some advantage in Glamorgan where there is a great demand for the foliage for wreaths.

Beech. Up to date, beech has only been planted on a small scale, but it does grow well and its use could be greatly extended; however, as the prime demand from local industries is for softwoods, it has so far seemed scarcely politic to do so. The value of beech, both as a fire belt in large blocks of pole-stage conifers and as a soil improver under open crops, should not be overlooked, and more use could be made of it for these purposes.

Oak. There are, undoubtedly, areas where the soil is suitable for oak; good timber has been produced in the past and some fine stems still stand. Unfortunately shake is now found almost everywhere and this too, may be due to the lowering of the water table caused by undermining.

Protection

This is one of the worst districts for fires in the Commission, and about a hundred fires are dealt with annually. Railways are a constant source of trouble and the lighting of mountain fires in the spring is unfortunately frequent. The locality is densely populated and on any fine weekend large numbers of people are to be found walking in or near the plantations.

Most fires start outside the plantations, but in hilly *Molinia* country, the task of getting to them in time and keeping them out is onerous enough. We have no mobile dam units, so the sack, shovel and ploughed fire line are our main defence and we all look forward to the day when more roads and equipment will make our task easier. At Margam, a 1,500 acre forest with a really bad fire history, some 1,450 acres have been burned since 1930, but fortunately none of the other forests has suffered to anything like the same extent. The last five years have seen a marked drop in the amount of damage done, despite a considerable increase in the area of young plantations, but we have been very lucky, and very great exertions will be required from all concerned to maintain this state of affairs. In F.Y.49 the cost of fire protection amounted to 7s. 4d. per acre, which is very low for such a dangerous district.

Protection "Other" is not a heavy item. Rabbits scarcely exist except at Dyffryn, where it is difficult to get them out of the dense rhododendron, and sheep are our biggest headache. Grey squirrels have been reported all around, but they have not yet penetrated into the coalfield; red squirrels are rare, and game, apart from the occasional hare, is non-existent. There are, however, a large number of roe and fallow deer on a new acquisition at Margam. These have probably escaped from the Margam deer park, and we shall certainly have to keep their numbers down. Voles are sometimes a nuisance; the last bad year was 1944, when some Lawson cypresses were girdled and some damage done to the roots of turf-planted spruce.

From time to time there have been outbreaks of other well-known forest insects, but each time nature seems to have restored the balance fairly quickly. Perhaps the most startling occurrence was the sudden appearance of a spruce bark beetle, *Ips sexdentatus*, in the hot summer of 1947, when many scattered groups of pine of various ages were killed. This insect was introduced, after the end of the war, in imported pitwood, and many breeding colonies became established. It is still to be found in the plantations, but the widespread damage of 1947 has not been repeated. The present plague of *Neomyzaphis* on Sitka

spruce is probably the most ubiquitous and destructive that we have had. It has been severe for three successive years now, and last summer several fifty feet high Sitka spruces were found to have been killed by it, and the growth of many hundreds of acres must have been severely retarded.

Utilisation

Thinning has been in progress since 1942 at Rheola and Margam; and in 1948 we started at Dyffryn, but it will be some time yet before it commences on any scale at the other forests. Naturally we have no trouble in selling all the pitwood we can produce, but generally the minimum top diameter is 3½ inches. There is a small demand for pitwood down to a three-inch top, and for laggings down to a two-inch top, but there is no market for pulpwood, and so we are left with a fair amount of minor produce to dispose of. While the thinning programme was still small this was quite easy, and there was a brisk demand for firewood and light stakes, but the programme has now greatly increased and the markets seem to have dwindled, and at present there is virtually no sale for stakes in West Glamorgan. In an effort to counteract this state of affairs, at Rheola, which adjoins a busy main road, the Forester has set up a sort of shop window at the roadside, and this is now attracting a lot of business. Our potential customers obviously do not realize that we have anything to sell, and a modest advertising policy seems indicated. In a locality where every other household receives a ton of coal per month for 7s. 6d., sales of firewood are not as easy as we would like. We do sell some, however, and, while we have never taken coals to Newcastle, we have sold a surprising amount of firewood in the Rhondda Valley!

The nature of the ground has made extraction a knotty problem, and we are still short of roads and equipment. Horses for tushing are quite unobtainable, and it looks as though we had better buy them for ourselves.

The demand for Christmas trees is quite phenomenal and we can easily obtain markets for all we have to sell. Unfortunately, Norway spruce has not been extensively planted in recent years and, therefore, our supplies may soon be greatly reduced, so we are encouraging locally the appreciation of Sitka spruce, Douglas fir and even pine. There is also a good demand for greenery for wreaths, and this becomes heavy in the weeks before Palm Sunday but, so far, we have failed in all attempts to encourage the use of species other than Lawson cypress.

Nurseries

All the locality factors are against the formation of permanent nurseries, and the forests under review, which have an annual planting programme of about 2,000 acres, have only some seven acres of temporary nursery of which about half is on firelines. The bulk of our plants have therefore to be imported from Tair Onen and elsewhere. "Heathland" conditions are absent, but Michaelston and Margam produce excellent two-year seedlings and "plus two" transplants at 1,000 feet in full exposure.

Staff and Labour

These six forests are at present run by seven Foresters and six Foremen, with the part-time assistance of one Forester at Rheola on produce.

The demand for labour is keen in Glamorgan and, as so many industries are offering a five-day week with a minimum wage of not less than £5, canteen facilities, etc., forestry has on occasion to make up numbers with any surplus from other industries. These men are unaccustomed to rural conditions of

work, and many more are more or less disabled by the common colliers' diseases, silicosis and pneumoconiosis. Most forests have a small hard core of labour which has been with us for a number of years, but the great majority come and go with bewildering rapidity. The introduction of "establishment" has not so far begun to check this, though it may eventually. We are short of labour at all forests, and this is most acute at Michaelston and Pelena where we have to rely on prisoners from Swansea jail. Our best hope of building up an adequate and skilled labour force is to get boys straight from school; by the time these have grown to manhood, they have become skilled and used to the conditions in the forest and so likely to stay.

Here, as everywhere else, the housing shortage is acute and, if we could get ahead with our building programme, we would undoubtedly attract and keep more and better labour. About 240 men and boys are employed at present, and about 60 more are required to keep up with the work.

General Remarks

What then, are the prospects for forestry in this highly industrialised locality? Despite many setbacks, the plantations are there to show what can be done. Possibly the volume per acre may never quite compare with that obtained in more favoured localities, but this need not worry us, as it is more than compensated for by the saving on delivery charges. Our markets are literally on our doorstep, and this, combined with intensive sales of minor produce, has enabled us to show profitable returns even from first thinnings of Japanese larch. (First thinnings in Norway spruce at Llantrisant must now be yielding substantial profits from Christmas trees alone.) There therefore seems little doubt that forestry can be a profitable business in Glamorgan. On the other hand, farming, as practised in many parts of this industrial area, is a declining industry. As there are few private owners in industrial South Wales with much interest in forestry, it seems reasonable to suppose that, before long, large areas of mountain and old woodland may pass into our hands, and it may well be that by the end of another twenty years the South Wales coalfield will be carrying one of the largest and most profitable forest areas in the country.

CRAIG PHADRIG FOREST

By E. G. RICHARDS
District Officer, North Scotland

CRAIG PHADRIG FOREST is situated in Inverness-shire some two miles west of the county town of Inverness. Of its total area of 212 acres, 48 acres are covered by acquired plantations planted in 1908, 1912, 1916 and 1922. Forestry Commission plantings made between 1926 and 1929 cover 155 acres. The remainder of the area, 9 acres, comprises stacking sites, agricultural tenancies and a prehistoric vitrified fort.

Locality Description

The forest occupies a ridge running north-east and south-west, at elevations of 30 to 550 feet above sea level. The characteristic rocks of the area, which lies on the edge of the great rift of Glen Mhor, are outcrops of conglomerate of the Old Red Sandstone series. The soils are partly drift; much of the ground is heavily leached; on the whole, natural drainage is good.

Though the rainfall is 26 inches per annum, drought is seldom serious. Frosts have not had any marked effect on tree growth.

The prevailing winds are south-westerly, but easterly and north-easterly gales can be severe; the danger of windfall is moderate.

State of the Area when Acquired

When the forest was acquired in 1925, the area scheduled for planting consisted of felled woodland, except for a few acres of poor agricultural land. Acquired plantations occupied about one quarter of the total.

Plantations made by the Commission

The main species used throughout are:—Scots pine, Corsican pine, Douglas fir and *Thuja plicata*. Scots pine has been planted on the drier and harder parts of the area. Corsican pine was planted on old arable land in F.Y.26, and this part of the area was first ploughed by a horse-drawn plough with good results. In general, the pines have done well, even if growth on the poorer soils and more rocky parts of "the Craig" has been slow.

On the better soils, which occur mostly at elevations below 400 feet, Douglas fir and *Thuja plicata* have been planted. Growth of both species has been good. The *Thuja* has made a very good crop of straight, clean timber, in spite of evidence of butt rot throughout the stand. Provided that the incidence of butt rot does not increase, all affected stems will be taken out in the next two (second and third) thinnings. The butt rot has so far affected only the first foot or so of all stems examined after felling.

A small stand of Japanese larch has done well on old arable land, and beech planted round the forest for amenity are coming away slowly but surely.

Protection

Owing to the proximity of the forest to Inverness, it has become a favourite week-end and early-closing-day haunt for the townsfolk. As a result, fire risk is always high during dry spells. The railway line running west from Inverness constitutes another source of fire danger along the northern boundary of the forest.

Losses from insects, mammals and birds have been negligible. Noteworthy damage by fungi has been confined to the butt rot in *Thuja* mentioned above.

Utilisation

The first and second thinnings are yielding good financial returns. The chief markets are for pitwood, sheep net stakes, rustic poles and, where sizes are large enough, for mill timber. Clippings of *Thuja* have been sold at a fair profit, for ornamental purposes, although the high carriage rates to the larger towns tend to limit this market to local demands. Some Douglas fir first thinnings have been sold standing to a timber merchant. Extraction is fairly easy, as the forest is well served with roads fit for vehicular traffic. Steep slopes in certain stands make dragging a difficult operation.

Staffing and Employment

The Forester lives in a Commission house situated in the forest, and the few permanent workers also live locally. There is no shortage of local casual labour, but few casual workers have proved to be suited to the type of work going on at present, viz., thinning and preparing produce.

Other Features of Interest

The vitrified fort on the top of Craig Phadrig is reputed to have been a stronghold of the Pictish King Brude. The description "vitrified" arises from the glass-like appearance of the stone work, which was originally fused together by burning timber beside the walls; today, however, the site is overgrown by grass, and the walls are hidden. Here, according to some authorities, Saint Columba won over Brude and his subjects to Christianity in the Sixth Century.

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The main species used throughout are:—Scots pine, Corsican pine, Douglas fir and *Thuja plicata*. Scots pine has been planted on the drier and harder parts of the area. Corsican pine was planted on old arable land in F.Y.26, and this part of the area was first ploughed by a horse-drawn plough with good results. In general, the pines have done well, even if growth on the poorer soils and more rocky parts of "the Craig" has been slow.

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GLEN URQUHART FOREST

By D. COTTER-CRAIG
District Officer, North Scotland

Situation and Area

GLEN URQUHART FOREST is situated in the parish of Urquhart and Glenmoriston in the county of Inverness. The town of Inverness has the nearest railway station, fourteen miles away by road. The total area of 3,778 acres is divided into three blocks. The smallest, Creagh Neagh, lies at the mouth of the glen, opposite the ruins of Urquhart Castle, on Loch Ness, and has an area of 260 acres. The second block is 2½ miles up the glen from Drumnadrochit, and has an area of 1,137 acres. The main block of 2,381 acres runs along the south side of the glen for about five miles.

Locality Description

The forest area lies between elevations of 200 and 1,000 feet. The slopes in places are steep and rocky, and the main block is intersected by two small burns with very steep banks in places.

The area lies on a conglomerate stratum of the Old Red Sandstone series, which itself gives rise to a reasonably fertile soil; but there is a considerable amount of glacial drift overlying the parent rock, giving rise to a variety of soils. Peat formation is common on the higher, badly drained areas.

The rainfall is in the region of forty inches per annum, of which some falls as snow. The prevailing wind is south-westerly, and from this direction the forest is well protected by the high ground behind it. It is, however, exposed to the west. Frosts are common and have had a considerable effect on the larch and Sitka spruce growth in places.

State of Area when Acquired

When the main block was acquired in 1923, the ground was covered with birch, mainly of poor quality, with isolated groups of Scots pine and a few larch. Creagh Neagh, acquired in 1949, was covered also with poor quality birch scrub on its lower slopes, with about ten acres of poor quality Scots pine of variable ages. The rest of the Creagh Neagh area is old woodland which carried a satisfactory crop of Scots pine felled by the Canadian Forestry Corps during the last war. The Balmacaan acquisition is mainly arable land and sheep outrun, covered with the same birch scrub.

The original area acquired was primarily a deer forest, but there were a few sheep kept there during the winter. On one of the new acquisitions, Drumclune, there are between 200-250 head of sheep.

Plantations made by the Commission

The main block was planted between 1924 and 1935, and there are now (1950) just under 2,000 acres of established plantations. The main species planted were Douglas fir, Norway spruce, larch, Lawson cypress, *Abies nobilis*, *Abies grandis* and thuya on the better sites, with Scots pine, mountain pine, *Pinus contorta* and Sitka spruce on the poorer sites. The areas planted on the higher elevations went through a long period of check, and required regular beating up; but some of these areas now show signs of becoming established. One or two areas have failed completely. On the lower slopes, most of the

planting has been successful, with the exception of thuya. The European larch have suffered from frost damage, and in some areas, canker is prevalent. Sitka spruce has also been heavily damaged in areas where the cold air drainage is bad, and have remained in check. Half the area of Creagh Neagh has been planted in the current year (P.50). Norway spruce and Sitka spruce have been planted on the better sites, and Scots pine at the higher elevations and on the rocky outcrops.

Protection

Fire risk in the forest is low from outside sources, for, although the glen is a popular resort for sightseers in the summer, they confine their activities to the main road. There are no rights of way running through the forest. Rabbit damage has been high in plantations where underplanting has been carried out, but on the whole, little damage has been caused by animal and insect pests.

Utilisation

Areas of Douglas fir and larch thinning have been sold standing to contractors. In view of the heavy thinning programme during the next few years, local contractors will have to be relied upon to carry out the thinnings, as the present labour force is inadequate to cope with both the present planting programme of 100 acres a year, and the proposed thinning programme. It should be possible to show a good profit, if the areas are sold standing.

Access and Extraction Routes

The lower part of the area is well supplied with fair weather roads, but more extraction routes will have to be laid out when the high level plantations become due for thinning. As some of the slopes are very steep and dragging by horse virtually impossible, chutes or wire ropeways will have to be employed.

Staffing and Employment

At the time of acquisition (1923), two keepers were employed by the estate, but the main block was only a small part of their total beat. The forest staff now consists of a Forester, a Foreman, two gangers and twelve men. Casual labour is at times obtained from Inverness. As in most areas, there is a general shortage of sufficiently trained men, and the high wages offered by other concerns working near the area make it difficult to recruit men.

The Forester lives in a Commission house in the area. There are also two Forest Workers Holdings. At the moment, eight new houses are being erected at Shenval, in the west end of the area. When these are completed, they will help, but will not solve, the labour problem.

Other Features of Interest

The name Urquhart is derived from a Celtic word meaning "woodside". The glen is well known for its scenery, and is a popular motor run for tourists during the summer months. The area originally belonged to the Seafield Estates. The road from Drumnadrochit follows the river Errick, and passes Loch Meiklie, a small but attractive loch, and at Corriemony turns and climbs over a shoulder of the hills to Cannich in Strath Glass.

GUISACHAN FOREST

By D. COTTER-CRAIG
District Officer, North Scotland

Situation and Area

GUISACHAN LIES AT the head of Strath Glass, thirty-five miles south-east of Inverness, in the parish of Kiltarlity and Convinth. A fair motor road connects the forest with the nearest railway station, Beauly, twenty-three miles away, and a local bus service connects the neighbouring village, Tomich, with the outside world.

The property was acquired by the Forestry Commissioners in 1934 and comprises some 2,370 acres, of which there were then 276 acres of mixed coniferous plantations and policy woodlands. The greater part of the area, some 600 acres, was covered with scrub birch, approaching maturity, and smaller areas of natural Scots pine. The balance comprised *Calluna* moorland, with relatively small areas of unplantable ground on the higher elevations. Most of the plantable ground has now been afforested.

Locality Description

The elevation ranges from 300 feet to just over 1,000 feet at the western end. Most of the slopes are relatively gentle, about twenty to twenty-five degrees, but there are one or two steep banked gullies about 100 feet deep at the western end.

The geological formations are gneisses and schists of the Highland series, breaking down readily and giving rise to a fairly deep, fertile, well-drained soil. Overlying the parent rocks is a considerable amount of glacial drift, mostly sand and gravel. As the forest is over five miles in length, there is a considerable variation in the soils.

The annual rainfall is about forty inches, of which a fair amount falls as snow. Both the frosts and snow are fairly severe. The prevailing wind is south-west. The general aspect of the area is northerly, but the valley seems to be well protected from all directions by the mountainous ground in the vicinity.

State of Area when Acquired

The existing woodlands at the time of acquisition were kept largely for their sporting value. Guisachan ranked fairly high as a deer forest, and the woodlands were used mainly as a deer harbour. The woods had suffered from under-thinning, and in some cases were in very bad shape indeed. Most of this area was felled during the War, and, at the time of writing, there are only about ninety acres of these original stands left. The forest has produced high quality Douglas fir. In 1944-45, when an area containing 83-year-old Douglas fir was thinned, the tallest tree removed was 145 feet high and the largest contained 372 Hoppus feet over-bark of timber.

There are scattered areas of natural Scots pine at the west end of the Forest, covering an area of approximately 100 acres. Most of this Scots pine varies in age between 80 and 130 years; the quality is poor, although there are some very good specimens of individual trees amongst them. One particularly good stand is growing on deep peat. Next to this stand is a small area comprising six acres of 25-year-old Scots pine which has been established by natural regeneration, the area having been fenced beforehand.

There were no sheep on the area.

Plantations made by the Commission

Planting was started in 1937, and, up to date, 730 acres have been planted; planting was continued on a limited scale during the war years. The main species planted are Scots pine on the drier, *Calluna*-covered sites, Norway spruce on the wetter and better ground, Sitka spruce on the peaty areas, and *Pinus contorta* on the higher and poorer sites. In addition there are about twenty-five acres of larch which shows promise; this larch is mainly European, but there is a small area of hybrid larch which is very promising indeed. In one or two places, a few old larch are standing, and around these are patches of natural regeneration. In F.Y.46, twelve acres were re-afforested, partially by planting and partially by natural regeneration of Scots pine and European larch.

Protection

Although the area is a popular tourist resort in the summer, and char-a-banc parties come from Inverness to view the Plodda Falls, so far there has been no record of forest fires. Burns traverse the area at fairly regular intervals and are utilised as fire breaks, and, in the event of fire, should provide a supply of water and a base for counter-firing. Rabbits and red and roe deer are present, but are kept well under control, and little damage is done. A certain amount of damage has been caused by mice and voles girdling the young trees. *Hylobius abietis* could be a menace, if the usual precautions were not taken. There is no recorded damage by other fungal and insect pests.

Utilisation

As there are no local markets, all of the produce has to be sold outside the area. During the war, a sawmill was operated at Balcladaich in the east end of the Forest. This sawmill has now been closed down.

Access Roads and Extraction Routes

The area is served by good estate roads. A new road, part of which follows an old drove track, has been built by the Hydro-Electric Board, and runs for about a mile through the area. The construction of this road has been carried out at the minimum of expense, bottoming being put down without surfacing; there are no drainage ditches, and at burn crossings concrete aprons serve instead of culverts. This road is only intended as a rough lorry road, but should serve as an extraction route. Also in the area there is an old disused carriage track, which could be converted at a reasonable cost to meet extraction demands.

Nursery

There is a small nursery of one acre at the forest. This supplies some of the plants required for the annual planting programme.

Staffing and Employment

In 1930 three gamekeepers and four forest workers were employed by the estate; this number had decreased to two keepers and one forest worker in 1934, when the Commission took over.

The permanent staff consists of a forester and seven men, who all live in the area or in Tomich. Owing to the housing shortage, casual labour is almost impossible to obtain.

Other Features of Interest

The literal translation of the Gaelic word *guisachan* is "fir forest", and this would tend to suggest that the old natural Scots pine and birch areas are relics of the old Caledonian Forest. The property was taken over from the crofters by Lord Tweedmouth in 1851, and, from that date until the turn of the century, it is apparent that a large amount of money was put into the property. The estate then passed into the hands of the Portsmouth Estates Improvement Company, from whom the property was acquired.

The valley has great natural beauty, with two fine water-falls. The main one, Plodda Falls, is nearly 100 feet high, and the course of a burn further up was diverted to supplement the flow of water. There is a considerable amount of varied wild life in the area, notably capercailzie, black game and red grouse on the higher ground. Roe deer are to be found, and herds of red deer can be seen grazing near the forest boundary during the winter months. A pair of golden eagles used to nest on one of the more inaccessible slopes of a burn, but they have not been seen in the last few years. The pine marten and the wild cat are also known in the forest.

WHENCE THE SEED?

By W. H. HAMILTON

Senior Executive Officer, Headquarters

ISSUED REGULARLY BY the Commission once a year is a little booklet bearing the title *Register of Identification Numbers*. It has no literary pretensions and to say the least is ugly in form and uninviting in text. Its production demands the greatest accuracy and its "circulation" is limited. Nevertheless it is an important publication and contains a wealth of valuable information.

The *Register*, which it should be noted covers plants as well as seed, was instituted under an instruction issued in the early days of the Commission by our present Chairman in the capacity of Technical Commissioner. The instruction reads as follows:—

"Identification Numbers will be allotted by the Commissioners to all seed and plants distributed within their operations; these Numbers will be included in Nursery, Compartment, and Plantation Records in order that full information as to stock used may be available in subsequent investigations.

Different Numbers will be given to supplies having different histories (date of crop, place of origin, etc.), and a permanent record of Numbers allotted, with necessary details, will be kept in London; copies of this list will be distributed as necessary and will be published from time to time in the Commission's Journal.

Seed or plants, on consignment, will be labelled with their Identification Numbers, which, with the Advice Note, will enable the complete history of the consignment to be traced.

Upon the receipt of the necessary information, Identification Numbers will be allotted by Headquarters to seed used in the Conservancy in which it is collected, and to plants received from outside sources. In all cases care must be exercised to avoid the mixing of consignments of different origin, to which separate Identification Numbers have been, or should be allotted."

The first issue was in respect of the Forest Year 1921. It contained only 56 entries covering a total intake of 4,132 lbs. of seed. The main species represented were beech, Scots pine, Douglas fir, and European larch. There was no Japanese larch and only 4½ lbs. of Norway spruce, and it is interesting to observe that the help of outside nurserymen was needed for the extraction of home collected seed. By 1948—the latest issue of the *Register*—the number of entries had increased to 542, and the quantity of seed listed had reached the enormous figure of 117,100 lbs. To avoid the doubts that may arise concerning the accuracy of these figures, it is prudent to disclose at once that one entry alone relates to 65,500 lbs. of acorns collected in the East England Conservancy. It must also be remembered that as the Commission now acts as sole importer into this country of Douglas fir, Sitka spruce, Corsican pine and Japanese larch seed, 3,600 lbs. of the seed was passed over direct to the trade and to owners of private woodlands. A comparison of the two sets of figures given above will indicate the development of this one small section of the Department's work. For those who find statistics interesting, I would add that the

Registers disclose that during the Forest Years 1921 to 1948 at least 5,420 different identifiable strains and species of seeds and plants were handled in the Commission's nurseries and plantations. There must, in fact, be many more, as up to and including F.Y.48 the numerous small lots of plants and seeds supplied direct to the Research Branch have not been recorded in the official *Register*.

Although the task of allocating the actual Identity Numbers and the preparation of the *Register* for printing is undertaken at Headquarters, the data for all home collected seed are prepared according to the origin of the seed, by the Director concerned. As collections vary from an ounce or two up to hundreds or even thousands of pounds, this must indeed be a cumbersome task. The identity of each collection must be preserved at every step as it passes from the parent trees through different hands on to the extraction and cleaning plant. In "store" it still must maintain its separate identity. Recently about 450 separate collections were reported by one Director alone; thus considerable work must have been involved, and as the policy of the Department is of course to encourage the collection of more and more native seed the task will increase.

Responsibility for preparing the data in respect of all imported seed rests at Headquarters. It is linked up of course with the actual purchase of the seed. Like unto Mrs. Beeton of cookery fame the Commission must "first catch its hare" (sorry I mean seed) and to find satisfactory seed is not always as easy as one might think. Of course there are no lack of offers, and surprisingly the following offer turned out in the end to be a "good egg":—

> "I promise you that I should be very glad to be you serviceable if the possibility should exist.
>
> By the examination of the price I beg to take notice that it is seed of first class quality. The seed has been carefully proved. It is seed of especial, first class and rare origins, in which the crop has succeeded under expensive, continual control, so that a changing and mixing is impossible.
>
> I know that the picea seed of other origins or such without garanty of origin is to deliver cheaper. Also I am able to spare you picea seed of the forests of the Northwestern low smooth for L—/11/lo pro lb. It is also seed of acknowledged origins. But I do not have picea seed without garanty of origin.
>
> I hope that you will resolve upon an order by these points of view. I may assure you that I shall put at your disposal first class qualities only".

It is true in this particular instance a dispute did arise over price and delivery costs, but apparently Headquarters was at fault as the matter finally resolved itself in the following manner:—

> "Whilst the sea-freight fob Hamburg, cif London respectively the air-freight fob Hamburg—cif London airport have to be paid as per the present regulations by you in foreign exchange the freight fob Hamburg including loading costs will be put to your account by this office. The freight fob Hamburg including loading cost will amount to estimately DM 35,—to DM 40,—for the whole shipment. The price is as mentioned estimated and not binding on our part.

The air-freight fob Hamburg cif London, which has to be paid by you in foreign exchange, will amount to 2/3 s per kg. On Shipments from 45 kg to 299 kg a freight deduction of 10% will be granted. On shipments above 300 kg to 999 kg the freight deduction will amount to 15%".

In such straightforward cases buying seed obviously becomes more of a hobby than a job of work, and if anyone is curious as to the sequel, the story is told in the F.Y.49 *Register* under Ident. Nos. 49/87 and 49/88.

ACORN COLLECTION AND STORAGE

By R. E. FRANCIS

Forester, South-East England

EACH YEAR IN early September, campaigning begins for good quality acorns in some twenty schools within a fifteen mile radius of Chiddingfold Forest. Before collection begins much is done to show the children the type of acorns required. This is particularly necessary as many Turkey oaks are to be found on the Surrey—Sussex borders; such seed is of course useless for our purpose. We require sessile or pedunculate oak seed, the latter being the commoner form in this district.

The seed is collected from old open-grown trees, as our own plantations give a very poor crop. The children receive 2d. per lb., but if collection was done by grown ups the cost would be more than twice as much.

Chiddingfold is the largest acorn collecting forest in the South-East England Conservancy, if not in the whole country. This year 62,700 lbs. were collected, but this quantity could have been doubled had it been required. Some seed (pedunculate oak) collected from Earl Winterton's Shillinglee Estate measured $1\frac{1}{2}$ inches long by $\frac{7}{8}$ inches wide and weighed half an ounce each.

The acorns are stored about 2 feet 6 inches deep in a rat-proof shed sunk two feet in the ground. When the acorns first come in they are turned every day for the first three weeks, after that three times for the next fortnight, and finally weekly until sufficiently dry for safe storage, some six to eight weeks from their first arrival.

During the summer months several parties of school children have visited our nurseries to see the fruits of their labour, and I think this has done much to encourage collection. Our aim to collect only the good sized acorns has helped to reduce the percentage of culling, and many of our one-year seedlings are over two feet high in a normal growing season.

BEECH SEED COLLECTION

By W. F. C. MIDDLETON
Forester, South-East England

DURING THE AUTUMN of 1948 large quantities of beech seed were collected in the South-East England Conservancy. At Arundel Forest alone between 7,000 and 8,000 lb. were collected from surrounding beech woods. When such large quantities are involved it is necessary to employ the quickest, and best methods of collecting.

The usual method is to sweep up everything under the seed trees, and to separate the seeds from the rubbish by means of ordinary hand sieves of a suitable mesh. When large quantities of seed are required this involves a large amount of manual labour. By this method the results obtained are often disappointing, and the net amount of clean seed in some cases is only between twenty and thirty per cent. Whilst it is recognised that it is beneficial to have a certain amount of foreign matter mixed with the seed for storage purposes, it must be remembered that where seed contains anything around fifty per cent. rubbish it more than doubles the floor space required, and also tends to make the seed "heat".

I found that the seed coming in over the first few days of collecting last year contained up to two thirds rubbish. As my target figure was 6,000 lb. this meant I should have required floor space for nearly 20,000 lb. As my floor space was very limited, I had to try to remedy this. I borrowed an old winnowing machine from a local farmer, and after an hour or so experimenting with different mesh "riddles" we found that it was possible to reduce the amount of rubbish to a much smaller proportion. It was also found to be considerably quicker than the old method of hand sieving.

At first we roughly cleaned the seed under the trees by passing through a coarse sieve to remove leaves, branches, etc., after which it was brought to the storage shed, and passed through the winnower. We soon found a better method was to take the winnower out by lorry to the seed trees, and put the seed, as swept, straight into the machine. This left practically all the rubbish in the woods and saved on transport. With a good beech mast as in 1948 it was possible, with the aid of the machine, for a gang of three men to obtain up to 200 lb. of seed per day.

Regarding the cost of winnowing machines, these can be obtained very cheaply as they are now obsolete on the farms. A good machine should be obtainable at under £5 and will repay its cost after being used for only a day or so.

COMPARISONS OF THREE METHODS OF STORING BEECH MAST

By R. J. JENNINGS
Forester, North Wales

THESE NOTES ARE written to comply with the request by the Deputy Director General in *Silvicultural Circular No. 25* that a report be provided on the results of two methods of storage of beech mast recommended in the above Circular.

The results of this very empirical experiment cannot of course be accepted as conclusive, as there may have been inherent differences in the various lots of seed, however it seems worth while to record the experience gained. It is our intention this year to carry out the treatments again, but with one lot of seed; the results obtained should then be of more value.

At St. Asaph Forest in North Wales Conservancy some 1,500 lb. of beech mast were sown in F.Y.49. This amount in three different consignments was made up of the following:—

A.	Beech 49/2	Ex Holland	700 lb.
B.	,,	Ex New Forest	400 lb.
C.	,,	Ex Swaffham, Norfolk	400 lb.

The first two lots were received together in good condition in January, 1949. Both had been well harvested and were fairly dry. No information was available as to the treatment that either batch had received prior to despatch to this unit.

Three methods of storage were adopted, the first two of which are recommended in *Silvicultural Circular No. 25*. Owing to the late arrival of the last lot of seed in an unsatisfactory condition it became necessary to use a third method of storage which appeared the best at that time. Details are given below.

1. The lot from Holland was mixed with its own bulk of sand and spread out on the floor to a depth of approximately fifteen inches, turned weekly and lightly watered when considered necessary.

2. The lot from New Forest was spread on the floor to a depth of ten inches, turned weekly and lightly watered when necessary.

The same building was used for storing both lots of seed, having a slated roof, tiled floor, and aeration vents in the brick walls.

The third consignment of seed, that from Swaffham in East England, had been stored for a considerable time at another forest before it was received at this unit in March. Having been a long time on rail in damp sacks it had heated considerably; some seed had germinated and the radicles had died off, and all of the mast was sweating; the consignment had a very doubtful appearance.

This lot was immediately stratified in damp sand for four weeks and sown in April, by which time the majority of the seed had pre-germinated.

No official germination figures were available, but a cutting test was made on the first two lots.

All seed was sown in April within the space of one week, and below are details of yields, etc. Owing to a shortage of seedbed space the sowing densities were heavier than is usual for beech.

SOWING RESULTS FOR BEECH SEED STORED BY THREE DIFFERENT METHODS

Treatment of seed	Identity No. or origin of seed	Amount sown	Density	% sound seed	Total yield	Usable seed-lings per lb. of seed	Av. Height inches	Max. Height inches
Mixed with sand	49/2 Holland	700 lb.	1lb.-4 sq. yd.	64	89,200	.128	7	16
No sand	New Forest	400 lb.	1lb.-4 sq. yd.	70	135,000	.337	6	16
Short Stratification	Swaffham	400 lb.	1lb.-3½sq. yd.	?	179,500	.448	6	9

Some surprise was caused by the heated seeds giving the highest yield, but it appears probable that the heating had not been so damaging as had at first appeared.

These seeds at any rate had been stored with ample moisture available, and the rise in temperature may only have been sufficient to cause pre-germination, whilst the short though immediate stratification assisted the continuation of this process and probably caused all sound seed to germinate. Although sown last, this lot of seed was the first to appear above ground.

These observations on one season's storage at this nursery suggest that of the two methods recommended in *Silvicultural Circular No. 25* that of storing without sand but with turning and occasional watering is the better of the two methods; the seed is easier to handle and to keep under observation, and provided that the necessary moisture is applied at the correct time no deterioration of seed should occur. The difficulty experienced in mixing with sand is to keep the seed mixed in the sand without having too much moisture available or too large a bulk of sand. When the sand dries out, as it soon does, particularly on the top layers, it tends to drop away from the seed and form a sand layer on the floor. In this bottom layer, which is usually damp and cold, no air can circulate and the seed is inclined to moulder or rot unless the maximum of attention is paid to it, although on an earth floor different and probably better conditions could be obtained.

As a point of interest the number of copper beech seedlings in each consignment were counted, details of which are given below:—

49/2	Holland	1,160	or 1 in 77
	New Forest	58	or 1 in 2,328
	Swaffham	110	or 1 in 1,632

The high percentage of copper beech in the Dutch seed will be noted.

VERMIN DESTRUCTION IN SEED STORES

By R. J. JENNINGS
Forester, North Wales

POSSIBLY THE CHIEF difficulty, in successfully storing hardwood seed over a period longer than a few days, is to keep rats and mice away from it. These vermin, principally the brown rat (*Rattus norvegicus*), the house mouse (*Mus musculus*), and the long-tailed field mouse (*Apodemus sylvaticus*) sometimes known as the wood mouse, if given an opportunity will establish themselves in or near a seed store and create certain havoc if left alone for a few days.

The storage of coniferous seed in glass containers or metal bins presents little trouble, but to store successfully several tons of beech and oak mast throughout the winter, which to be kept in prime condition must be open to air circulation, may well present a problem. Forewarned is forearmed, and it is advisable for everyone to make himself thoroughly familiar with every means for combating these pests.

These notes will be of little interest to the older generation of nurserymen; they have all learnt by practical experience what there is to know about this subject; they may, however, be of some use to our newly trained men who may at short notice have to take charge of a considerable amount of hardwood seed in a good mast year.

The brown rat is well known by everyone, but a brief account of its appearance and some of its habits may be of interest. A full grown male rat averages about eighteen inches in length including the tail; the female is not as large. The colour of the fur on the upper parts of the body is grey-brown, whilst underneath it is a dirty white; the very prominent ears are flesh coloured, as are the feet and tail. Fortunately the males usually outnumber the females, and were it not for this strange circumstance we should be pestered with them much more than we now are.

Rats breed during eight or nine months of the year, having as many as six litters; the brood varies in number from four to seventeen, though nests of twenty and more are not unknown. The animal is mature at three to four months of age, when it can and will commence to breed. Breeding will continue for up to four years.

The food of the rat consists mainly of grain, but there is little that the animal will not eat if the opportunity of a tasty meal presents itself. Fish, flesh or fowl—dead or alive—green vegetables, potatoes, etc.,—it will devour every conceivable matter from leather to soap.

Some rats make their nests in the fields and ditches, building their homes of dry moss, grass and leaves or dead bracken in a suitably situated hole, while others that live mainly in sheds or granaries will construct their nests of odd pieces of sacking, paper, string and the like. Wherever they dwell they live in colonies, generally sleeping in the day and emerging from their quarters at dusk, or when all is quiet, to satisfy their appetite or to obtain fresh material for their nests.

The two species of mice mentioned above are well known ; their habits are similar to those of the rat. Breeding at less than two months of age, they may produce five litters a year of six or more in number. Silent and shy by nature, the mice will almost certainly be found in the vicinity of seed stores; grain and other seeds are their favourite food. Mice will establish themselves at the first opportunity, to eat and carry off all they can; they will climb and

run up or down a bare wall ten feet in height, and can make their way through unbelievably small chinks and crevices. Constant attention is needed to exclude them from a store; once inside they will construct their nests in the wall or roof thatch, and their presence soon becomes apparent by the husks of the seed they have eaten.

If a specially constructed seed store enclosed with mouse proof netting is available, things are much easier for the forester, but to exclude rats from barns and buildings where seed has to be stored is almost an impossibility. The rat has a peculiar construction of its hind feet, which it can reverse when necessary from the usual position, enabling it to ascend or descend perpendicular walls that to the inexperienced eye appear unclimbable.

The first signs that rats and mice are visiting acorn or beech mast stores are small heaps of seed, usually in a corner, some nibbled, some split open, and some carried there and left. These heaps if untouched will increase in size, the rodents usually making use of the same corner at each visit. New colonies of rats have ringleaders, usually the oldest and wisest of the family, and if these old stagers discover a new source of food they will lose no time in bringing along their friends; so if short work can be made of these ringleaders when they pay their first attention to the seed, it will be much easier to deal with the remainder as they are then left without advisers. The odd rat on his first visit can frequently be dealt with by the break-back trap, if baited with a cube of hard bacon fat. The domestic cat can often account for the first visitor or two, be he rat or mouse, so give him a night or two in the acorn store.

If, however, rats have established themselves in the vicinity of a seed store, no time should be lost in taking the necessary steps to eliminate them, whether it be by ferreting, traps, or poison.

Unless it is very thoroughly carried out, ferreting is not a very satisfactory way of ridding the place of rats. The usual effect of this business is to frighten more than are killed; the vermin will probably leave the vicinity for a day or two, but will return and settle down when all is quiet once more. If, however, it is decided to use ferrets, make quite certain that they are large and heavy enough to overpower their quarry, as in the course of a day's rat destruction they will be engaged in many fights; the rat is a savage creature when cornered, and will give a good account of itself. Make quite certain too, that plenty of ferrets are on hand; don't expect one ferret to tackle four or five rats at a go and emerge looking the picture of health and strength.

If traps are to be used, have two dozen or so at least on hand, and to ensure that they are free from any human scent, scald them for a minute or so in a bucket of boiling water; they will quickly dry. It must be continually borne in mind by anyone contemplating ridding their building of rats that these vermin possess an extraordinary sense of smell, and any careless handling of traps will at once arouse their suspicion and make their extermination very much more difficult, as, like all wild creatures, they fear the scent of a human being above all else. Once quite clean, the traps can be laid, unset, casually about the seed, and in particular in the regular runs that the animals always use. When the rats have become accustomed to the sight of these unset traps lying about, so that they ignore them and travel over them, they should then be carefully set in the same position. Two or three settings will account for the majority of the depredators. Another deadly way of using traps is to lay a bait in the form of a half cooked rabbit or pigeon in the middle of the shed, and surround it with traps carefully set and laid one on top of the other so that wherever a rat creeps or treads in its effort to reach the bait it must spring a trap. Rats caught in this way usually die instantly, as they are frequently caught by the body; others will come to the bait and suffer the same fate.

Probably the most certain way of complete destruction is effected by the use of poison and virus. Having used a considerable amount, we have found the most deadly to be Rodine, a phosphorous compound which when spread on bread cubes is quickly taken and eaten by the vermin. One method is to provide water near the baits, which the rats will immediately drink after eating the bread. This will result in their corpses being picked up inside the building. If, however, no water is at hand, they will go off to drink at the nearest stream, where they will quickly die. Poison baits should always be laid under cover in the holes, or in small drain pipes where domestic animals and poultry may not come upon them.

A most successful destruction of rats and mice can be accomplished with the use of Liverpool Virus, which contains a culture of a disease fatal to rodents. If this is to be employed, it is a good plan to feed the vermin for a day or two with wheat, oats, or bread to encourage them to the site where it is intended to lay the virus. When they have been attracted to the desired spot, feed them regularly for the next ten days with baits treated with the virus. Once they have been infected, the disease will be conveyed throughout the whole colony and none will remain.

A useful preparation to have on hand is "Reynardine", manufactured by Messrs. Gilbertson and Page of Hertford. If pieces of sacking are soaked with this liquid and laid about the seed, little trouble will be experienced with rats or mice; they loathe the smell and avoid any contact with it whatsoever. This is useful with small lots of seed.

There are, of course, many other ways of taking rats and mice, dead or alive, with cage traps, box traps, snares, adhesive lime, etc., but they are of little use in the type of seed stores or buildings with which we are concerned. Whichever method is adopted, the most successful results will be attained by the man who can surprise the animals, by careful handling of traps and the successful camouflage of human scent.

PROBLEMS AFFECTING HEATHLAND NURSERIES AND THEIR PRODUCE

By H. V. S. DIER
Divisional Officer, West Scotland

IT IS NOT proposed in the following notes to attempt to cover the whole field conjured up by the words "Heathland Nurseries", but merely to treat with certain aspects of the subject and some of the problems to which they have given rise. The discovery in recent years of what phenomenal results—both with regard to rate of growth and to yield per pound seed sown—may be obtained on suitably prepared heathland sites, has completely set by the board many preconceived notions held by experienced foresters. For those who wish to keep abreast of the times, it has occasioned considerable re-orientation of outlook, and for those whose job it is to set the standards, it has necessitated considerable research into the techniques most likely to assure success. Each year an increasing proportion of the total output of seedlings is raised in heathland nurseries. It is therefore of importance that the most suitable techniques for use in heathland nurseries should be determined as soon as possible. Final decisions cannot be based entirely upon research using square-yard units, no matter how many times replicated, but only upon large scale field trials both in the nursery and upon the hill. In these experiments, which should be made from the economic as well as the silvicultural approach, and on a variety of sites, nothing within reason should be left untried. Certain of the experiments already made in the West Conservancy, and others which are proposed, are described in the following notes.

Capital Expenditure on Formation of Heathland Nurseries

It is sometimes argued that since the life of a heathland nursery is directly determined by how long it remains relatively free from weeds, it is a waste of money to sink capital into such a short term project. This school of thought favours a system of rapidly shifting cultivation, blithely moving on to "pastures new" as soon as the first weed raises its ugly head. Is this attitude a valid one? Let us see.

At Devilla Forest the heathland nursery was sited in a woodland area previously carrying fifteen-year-old Scots pine, which had been burnt and cut down two years previously. Destumping proved costly, and it was also considered expedient to enclose the area with mouse netting at approximately 3s. per yard. One third of the capital outlay, together with such annual expenditure as the cost of preparation of the beds, of seed and manures, of sowing and weeding, etc., was charged against the current production of usable seedlings, on the assumption that the nursery would be abandoned after three years. On that basis, the cost of production worked out at 2s. 9d. per thousand seedlings (unlifted) and it is certain that even this estimate is too high, since there is every indication that this nursery will remain relatively weed-free for six or more years. Assuming that the cost of raising comparable seedlings in an established nursery (two-year seedlings) is at least five times this figure, it is evident that considerably more capital expenditure might have reasonably been incurred in creating this heathland nursery. With a yield per acre of 3,500,000 usable one-year Sitka spruce seedlings, increasing the capital outlay by £1,500 per acre (of which £500 would be charged against current production) would only increase the production costs by a further 2s. 10d. per thousand.

The case may be argued in another way. Assuming that, with Sitka spruce, the yield of usable one-year seedlings per acre of heathland nursery is three

times that of usable two-year seedlings in established nurseries, it follows that one acre of heathland nursery has six times the productive capacity of one acre of established nursery. Making allowance for greencropping, on a four-year rotation, further increases the ratio to 1 : 7½. Put in the form of an equation, 1 heathland nursery year = 7½ established nursery years. Thus, if a heathland nursery has to be abandoned after only three years it is nevertheless equivalent to an established nursery twenty-two years old. It has been considered justifiable to incur heavy capital expenditure on work such as intensive drainage in established nurseries which have become worked-out long before twenty-two years; similar work in a heathland nursery would be even more justified.

The foregoing remarks are not intended to recommend unbridled expenditure in the formation of heathland nurseries—each case must be judged on its merits and the standard for comparison must be other heathland nurseries, not established ones—but merely to show that if what is in all other respects the most suitable site for a heathland nursery requires considerable capital expenditure to render it workable, such expenditure may be justified. The tendency is to select sites which require the minimum of preparation, and rightly so, but if such sites become rapidly infested with weeds and have to be abandoned after one or two years, it would probably have proved cheaper in the long run to have sited the nurseries in the middle of a pole-stage plantation, even though considerable extra expense in preparation were thereby involved.

Economy in Manures and Composts

The desirable rate of application of manures and composts needs thorough investigation for each individual heathland nursery. At Devilla the manurial prescriptions of the Macaulay Institute for Soil Research are accepted without reservation. At this nursery there is no question of composts of hopwaste diluted with other materials proving cheaper than pure hopwaste, since it lies within six miles of several breweries; nor is there any question of any other composts giving better results. Any economising in hopwaste that may be done in future should be purely on silvicultural grounds, or to make a product in short supply go further. The saving in cost per thousand seedlings which would result from reducing the approved rate of application of hopwaste, or dispensing with it altogether, would be negligible, but the effects upon the seedlings would be great. At Devilla, thirty tons of hopwaste were applied per acre in the first year, and there is now proof that, at this rate, manuring will only be necessary every second year, and indications that once every third year will be sufficient. To cite an extreme case, supposing the normal rate of application were thirty tons per acre annually, what would be the net saving per thousand seedlings if no hopwaste were to be applied? The overall cost of hop manure, including purchase price, haulage and possible composting, is 25s. per ton at this nursery. Assuming that the yields of seedlings per lb. of seed sown were not reduced through the absence of hop manure—and this would be the inevitable result—the saving per thousand one-year Sitka spruce seedlings would be 2d., and no greater than 6d. to 8d. in respect of any other species!

A better case for reducing the rate of application can be made from the point of view of silviculture and management. At Devilla, at least 10% of the one-year Sitka spruce seedlings and 40 to 50% of the one-year pine, larch and Douglas fir seedlings are fit for planting. Many of the remainder are on the large side for lining-out by existing methods and all, in a wet season, tend to be "drawn". If, after exhaustive comparative trials in the field, it be found that one-plus-one plants prove more satisfactory for planting than one-year seedlings, it should be possible to raise seedlings more suitable in every way for lining out than at present, by reducing the intensity of manuring.

Problems of Management

The fact that in a heathland nursery millions of seedlings have to be lifted, graded, boxed and despatched, and that the whole area has to be prepared for sowing with all the multifarious work that preparation implies, and then sown with seed, all within the space of a few weeks, has given rise to grave difficulties in management and control. Not the least of these is the unbalance of labour requirements caused by this seasonal rush. The problem will naturally be less serious at nurseries situated in forests employing large squads of men on other work; this is not the case at Devilla. Here it has been partly solved by engaging big numbers of European voluntary workers, but this can only be a temporary expedient. Another factor which must be taken into account is the weather. If this is adverse at the time of lifting and resowing, these vital operations will be delayed, even if large numbers of men are held in reserve. Two ways by which these difficulties may be circumvented or overcome are considered below. The first is to provide each heathland nursery with a "twin" so that one may be prepared for sowing whilst the other still carries its crop of seedlings, and to raise tree crops in these in alternate years; alternatively, a large nursery could be split into two sections. The second is to extend the season of intensive effort by commencing lifting well in advance of demands from outside sources. Both of these propositions are worthy of fuller consideration.

Replication of Heathland Nurseries

As already mentioned, the essence of this system is to have two heathland nurseries as nearly identical in all essential points as possible, one of which may be prepared for sowing and sown, as expedient, irrespective of the progress of work in the other. After being cleared of seedlings, the second nursery would be greencropped or allowed to lie fallow until the autumn when it, in its turn, would be prepared for sowing the following spring. This alternation of utilisation would be repeated until either one nursery or both had to be abandoned. On the face of it, there appears to be much in favour of such a system, but actually it has only one small advantage over the second method to be discussed below, and many disadvantages. The advantage lies in the fact that preparation for the next year's sowing could take place in an early spell of frost; not too hard to make the ground unworkable, but sufficiently severe to prohibit any lifting of seedlings. The most serious disadvantage is that the effects of greencropping upon the mysterious chemistry and ecology of heathland nursery soils is not yet clearly understood. In addition, there is the very real danger that greencropping may introduce troublesome weeds. Fallowing is less likely to prove deleterious, but the vacant ground may require to be weeded. In both cases, utilisation of the ground will only be partial and, although the ground rent may be low, this is a material objection.

Lifting in Advance of Demands

It follows that, if lifting is begun in the autumn, preparation of the ground for sowing can proceed in an orderly fashion all through the winter until the only ground that remains unprepared is that holding the lifted plants, where sheughing is employed as the method of storage. There are two alternative methods which may be adopted for the storage of the lifted plants. They may either be sheughed or they may be stored in boxes. Sheughing may be done either in the nursery of origin or at the receiving nursery or forest. If the seedlings are to be stored in boxes, it is preferable that this should be done at their destination.

From the point of view of management there is much to be said in favour of such a system. Silviculturally there are many objections and these will be dealt with in detail under the following heading.

The Effect of Disease and Silviculturally Questionable Handling upon the Vigour and Survival Rate of Heathland Seedlings

It is often stated that seedlings require much more careful handling than transplants, and experience tends to confirm this. The assumption has also been made that heathland nursery seedlings require more sympathetic treatment than seedlings from established nurseries, and that they have smaller powers of recovery since their growth has, in effect, been forced. Observations made at Devilla suggest that neither assumption is true. The summer of 1948 was abnormally wet, and in the early autumn the dense beds of Sitka spruce seedlings, which had made very good growth, were attacked by what was diagnosed by experts as *Botrytis*. It is probable that an early severe frost was the predisposing factor, and that the *Botrytis* was purely secondary; whatever the cause, many of the seedlings died back for two or three inches from the tip. Now there is one point about a well-grown heathland nursery seedling as distinct from a "normal" two-year seedling, which should be mentioned here. This is that the former is a complete, well-balanced plant in miniature, well-furnished with at least one whorl of side branches and with the entire stem thickly studded with fat healthy buds, any one of which is capable of forming a new leader should the need arise. Thus, any seedling which had died back for even half its height still carried at least three or more such buds. Nevertheless, the seedlings which had suffered from die-back presented a sorry sight.

Over one million Sitka spruce seedlings had been allocated to another Directorate from Devilla. It was, therefore, considered expedient to cull these heavily before despatching, by removing all those which appeared to be dead or had fewer than four living and healthy buds. As an experiment, in anticipation of criticism from the receiving nurseries, all of these "rejects" which had at least one living bud, and even some of those apparently dead, were lined out in an extension to Devilla Nursery. The results were amazing. Nearly all of the obviously living seedlings, and even some of those which appeared to be dead, survived and grew as much as eighteen inches that season. Where the living bud had been buried in lining-out, a strong new shoot grew up from the soil beside the dead first-year shoot. The colour and vigour of these one-plus-one transplants were extremely good, and the survival rate was at least 60 per cent. This salvage operation was definitely worth while and indicates that, so long as it is still living, there is no such thing as a heathland nursery one-year Sitka spruce cull. It is worth recording here that over two million of these seedlings were lined out in established nurseries in the West Conservancy and that, although the degree of culling was far less severe than that accorded to consignments to other Conservancies or to the nursery trade, the survival rate compared, almost without exception, very favourably with that of "normal" seedlings, and that the colour and general vigour of the resulting one-plus-one transplants were in every case far superior. It is also significant that only one complaint was received from the nursery trade about these seedlings.

If the principles of silviculture alone, unadulterated by considerations of economy or management, were followed to the letter in nursery and planting practice, no sheughing would be permitted; seedlings would be lined out direct from the seedbeds, and plants would go straight from the nursery to their final destination on the hill. Such perfection is unattainable for obvious reasons, and the storage of plants in sheughs is accepted practice, but always with the proviso that the plants must be thinly spaced with their roots completely protected from drying winds and frosts, and that they should not remain in the sheughs one day longer than absolutely necessary. The operative word here is "necessary". If it has been considered advisable, for reasons of economy and management, to countenance a practice which is contrary to all the precepts of

good silviculture, might it not be equally justifiable, for the same but stronger reasons, to aggravate the "crime" in respect of heathland seedlings and store them, after lifting, for several months *if necessary, provided that the increase in death rate was not out of proportion to the advantages thereby accruing*? It was in an attempt to find the answer to this question, that the following experiment was carried out at Devilla in F.Y.49.

Batches of Sitka spruce seedlings were lifted and correctly sheughed in the months of November, December, January and February. In March, these seedlings which had been sheughed from 1 to 4 months, were lined out alongside seedlings lifted the same day. At the time of the August count, not even the seedlings lifted in November had a death rate 10 per cent. higher than the control and, in almost every case, the sheughed seedlings appeared more vigorous and healthy. It is admitted that the winter of 1948/49 was mild and open and that, had this winter been severe, far greater losses in the sheughed seedlings might have been experienced. Such conjecture can only be answered by repeating the experiment over the course of several seasons. However, it is not too early to suggest that even if the losses resulting from prolonged storage after lifting are as much as 25 per cent. greater than "normal" losses, this silviculturally inferior technique may be justified on managerial and economical grounds. It is for a statistician to decide at what point the advantages accruing from early lifting are cancelled out by the increased losses due to prolonged storage.

An alternative method of storage is also being investigated in the West Conservancy. Briefly, this is to commence lifting at Devilla from November or December onwards, and to pack the seedlings upright in boxes with the roots lying on an inch or so of moss litter. Various methods of packing, such as dividing the boxes into several compartments by thin walls of straw, are being tried out as a prevention against heating and fungal attack. The boxes are then despatched to the lining-out nurseries and stored either in airy sheds or in the open. If in the open, they are covered with a light layer of bracken or straw whenever frost threatens. In both cases, the moss litter will be kept in a moist but not soaking condition. In the spring, a careful count of both the dead and living seedlings will be made, and the latter will be lined out alongside a known number of freshly despatched seedlings. Full records of both the stored seedlings and of the controls will be made, giving measurements of height growth, a description of colour and general vigour, etc., in addition to the survival rate. Should the seedlings stored in boxes compare favourably with those stored in sheughs, the former method will probably be preferred in future, since it does away with the necessity of setting aside a considerable area of the heathland nursery for the sheughs.

The Use of One-year Heathland Seedlings for Planting

As has been said already, at least 10 per cent. of the Sitka spruce one-year seedlings, and from 40-50 per cent. of the other species sown at Devilla, are classed as suitable for planting. Over 200,000 of the Sitka spruce seedlings were planted in extensive trials in the West Conservancy during F.Y.49, on a variety of sites and at many forests. Remarkable results were achieved. Almost without exception, the percentage loss did not exceed 10 per cent., and at many forests there were fewer deaths with these seedlings than with two-plus-one and two-plus-two transplants planted alongside as controls. The comparative absence of late spring frosts may have been largely responsible for these results, but it should be emphasised that the period from early May to late September, was phenomenally dry, and probably occasioned as severe a test to newly planted seedlings as a late frost would have done.

Generally speaking, the planting of the seedlings was more costly than that of transplants, since more care was taken both with the preparation of the ground and with the actual planting. Thick mounds were sliced, and on ground ploughed with the Cuthbertson plough, steps often had to be cut in the spoil if the seedlings were not to be buried. This is a disadvantage but, nevertheless, the results have proved so promising that the experiment will be extended in F.Y.50, not only with Sitka spruce one-year heathland seedlings, but also with other species such as Japanese larch and lodgepole pine which were not available in the previous year. A cross section of all the common sites to be encountered in this Conservancy, covering all the variations in soil, aspect and exposure, will be planted experimentally with the appropriate species.

The Suitability for Planting of One-Year Heathland Seedlings as Opposed to One-plus-one Transplants of Heathland Origin

It has already been stated that the death rate of one-year Sitka spruce heathland seedlings planted in F.Y.49 has been no greater than that of two-plus-one or two-plus-two transplants; but there is, as yet, no proof that this will always be so. It has also been stated that the seedlings have proved more costly to plant. Hence, although in terms of production costs the seedlings may be twelve to fifteen times as cheap as transplants, if the cost of planting the seedlings be considerably greater than that of the transplants, there may be no monetary savings by using the former. Moreover, if it be eventually found that areas planted with seedlings require considerably more beating up, this may even swing the balance definitely in favour of transplants. To date, experience in West Conservancy indicates that it will always be cheaper to form plantations with heathland seedlings than with two-plus-one or two-plus-two transplants. It may be assumed that one-year seedlings cost 55s. less per thousand when received at the planting site. If the average planting costs per thousand transplants are 25s. (a reasonable figure), heathland seedlings will not cost more than half as much again to plant, *i.e.*, 37s. 6d. per thousand. The net saving will therefore be 55s. less 12s. 6d., or 42s. 6d. per thousand *immediately after planting*. Even if considerably more beating up of the seedlings than of the transplants should later prove necessary, it is doubtful whether the increased cost would exceed 20s. per thousand plants originally planted.

If a similar comparison is made between one-year heathland seedlings and one-plus-one transplants of heathland origin, the issue is not so certain. The difference in costs of production is considerably less, probably no more than 30s. Such transplants require no abnormal care in planting, yet they appear to retain the superior vigour and powers of recovery of heathland as compared with other stocks. Hence there may be considerably greater saving in beating up by using one-plus-one transplants of heathland origin. Only large scale comparative planting trials can supply the answer, and these are planned for F.Y.50 and succeeding years. Should the one-plus-one transplants prove superior as a result of these trials, the economy in hopwaste suggested in the previous paragraph on "Economy in Manures" can be put into effect.

Thus, it will be seen that whilst heathland nurseries have opened up exciting possibilities, how to use these to the best advantage is still largely a matter of conjecture and surmise. The solution of these problems should constitute an exciting challenger to the "forward lookers and right thinkers".

HEATHLAND NURSERIES AT DEVILLA

By W. FAIRBAIRN
Forester, West Scotland

THE GROWING OF coniferous seedlings on heathland sites has been carried out at Devilla Forest since 1945. A great variety of manurial treatments, both organic and inorganic, has been tried, and results have shown that spent hops in any form have a remarkable effect on the size and out-turn of the seedlings, even without the additional application of artificial fertilisers.

Spent hops fresh from the breweries, supplemented by a complete NPK fertiliser and a dusting of lime, was the standard manurial treatment for F.Y.48. The hops were applied to the beds at weekly intervals from November to March, while the inorganic fertiliser was applied three weeks before sowing.

100 lb. of Sitka spruce were sown in April : this was the main species used. The result was 7¼ million usable one-year seedlings to be lifted and despatched to other nurseries and forests for lining-out and direct planting. For trial purposes, small lots of other coniferous species were also sown.

Shortage of time between the lifting and the preparation for the new sowing necessitated a slight alteration in the F.Y.49 manurial treatment. An adequate supply of fresh spent hops could not be collected in the few weeks available, and composted material was used. Bone meal replaced the hoof-and-horn meal previously used. The extensions of new ground were given the 1948 treatments.

European larch, Japanese larch, Sitka spruce, Douglas fir, and lodgepole pine were the chief species sown in F.Y.49. A few control units were left untreated, with the following results:—

SEEDBED RESULTS FOR VARIOUS SPECIES ON TREATED AND UNTREATED GROUND AT DEVILLA HEATHLAND NURSERY

Species	Treated with Hops+NPK			Untreated		
	Plants over 2ins.	Average ht. ins.	Maximum ht. ins.	Plants over 2ins.	Average ht. ins.	Maximum ht. ins.
Scots pine	80%	3	5	Nil	¾	1½
European larch	100%	8	14	10%	1¼	3
Japanese larch	100%	7	17	5%	1	2½
Hybrid larch	100%	6	12	Nil	¾	1¼
Sitka spruce	90%	5½	12	5%	¾	2¼
Douglas fir	100%	7	12	No control units		
Lodgepole pine	100%	5	9			
Maritime pine	100%	5	7	20%	1½	4

Cultivation problems in the raising of one-year heathland seedlings are varied and complex, and trials will have to be done over a number of years before definite conclusions can be reached. The success or otherwise depends on the following factors:—

(*a*) Suitability of site
(*b*) Quality and origin of seed
(*c*) Climate.

Provided these features are satisfactory, there is no reason why usable one-year seedlings should not be grown on the same site for years. On one of

the heathland sites at Devilla, the 1949 crop of one-year Sitka spruce was as good as the 1945 crop. Actual figures were 80,000 usable plants per pound of seed sown, with an average height of 4 inches and a maximum of 8 inches.

Briefly summed up, the advantages of the heathland nursery over the established nursery are:—

(1) Out-turn higher per unit area.

(2) Plants fit for lining-out at one year instead of two.

(3) Weeding costs cut to 1/6th per acre, or 1/20th per thousand plants.

(4) Better root system.

(5) Saving of ground by continuous cropping.

(6) Saving in capital expenditure as heathland sites bought at moorland valuation, whereas established nurseries are at agricultural valuation.

(7) More relative sowing surface by having a wider seedbed, e.g., Devilla has a five foot bed with one foot alleys.

The technique of heathland nursery cultivation cannot be standardised, as even sections in the same nursery may demand different treatment, but the following general points should be kept in mind when breaking in new ground.

(A) The top layer of peaty humus left after the removal of the surface vegetation should be retained as much as possible. Even one inch of this may tip the balance between success and failure.

(B) The subsoil should not be disturbed. Cultivation to a depth of only three inches has produced eight-inch Sitka spruce seedlings.

(C) Degree of consolidation of seedbeds can only be learned by experience, but generally more consolidation will be required by humous soils, i.e., those with a high percentage of peat or other organic matter.

Half-starved plants should never be produced, and a high degree of fertility should be the aim in every nursery: this high level can be achieved in a heathland nursery without the usual influx of weeds.

To illustrate this point, the following observations were made at Devilla:—

Sorrel (*Rumex*) shoots elongated ten inches in seven days.

Rose-bay (*Epilobium*) grew eight inches in height in seven days.

Heather (*Calluna*) germinated in July and by September was a bushy plant nine inches high and in full bloom.

Japanese larch grew fifteen inches in nine weeks from a two-inch seedling on the 1st August to seventeen inches by the 3rd October.

Birch germinated in June and by October had cast its leaves; by this time it was twenty-six inches high with fourteen inch side branches, a beautifully symmetrical five-month-old tree.

This shows that a high degree of fertility can be reached in a heathland nursery, which, in the absence of weeds, can be solely utilised for the production of remarkable crops of coniferous seedlings.

PREPARATION OF A HEATHLAND NURSERY

Springwood Nursery (Broxa) Allerston District

BY J. D. CHISHOLM
Forester, North-East England

IT WAS DECIDED in the early summer of 1949 to open up a new heathland nursery at Broxa; I was accordingly instructed to begin work near Springwood with a view to preparing a five-acre nursery, mainly for seed beds. The acreage was subsequently increased to twelve, and it was later found necessary to line out on seven acres out of the total.

The site consisted of a flat area of moorland lying between two deep ravines some 200 yards apart; the general aspect is south, the centre being somewhat raised to give a slight fall to east and west. Ground vegetation consisted of a thick covering of heather (sometimes eighteen inches high), with some scattered birch and Scots pine scrub not more than six feet high. The area is exposed and windswept in winter, with a rainfall of about twenty-five inches per annum. The soil consists of a podsolised calcareous grit, with an iron pan in most places, lying at a depth varying greatly from ten to eighteen inches or more below the surface; the following profile illustrates the detail.

Soil Profile

	inches	
A_0	0— 3	Peat
A_1	3— 6	Leached grey sandy soil with small rock fragments; stained in many places from A_0.
A_2	6—10	As A_1 but less staining; more rock fragments and more compact.
A_3	10—10.5	Thin layer of black peat formed by dead roots; not always present.
B_1	10.5—11	Dark layer of humus and sand.
B_2	11 —11.3	Dark brown pan, hard, often with compacted rock fragments. Not present everywhere.
B_3	11.3—30	Red-orange-brown sandy soil with rock fragments—often large, but not excessively hard; some clay content.
C	30	Yellow buff sandy soil, rock fragments increasing in size, and less clay.

Three machines only were employed from start to finish.

1. Red Spot Fordson Major with Rotary Hoe attached.
2. Ferguson Tractor with Spring-toothed cultivator. (The teeth were all set in a line to provide a rake, or sweep.)
3. D4 Caterpillar Tractor drawing a Killifer sub-soiler.

The first operation was to cut the heather and small scrub, for which purpose the Fordson Rotary Hoe was set to cut (at the most) one inch below the surface. This completed, the Rotary Hoe blades were set at zero, and the area covered again; the object being to beat out any humus and peat left adhering to the heather roots. This operation took forty hours at a total cost of £22 0s. 0d., i.e., 11s. per hour.

The second operation aimed at clearing the heather from the area. The Ferguson and spring-toothed harrow were employed for the purpose, in much the same way as a farmer uses a hay rake, sweeping the heather to the perimeter, and working gradually back towards the centre of the Nursery. This was completed in 131½ hours at a cost of £33 19s. 5d., i.e., 5s. 2d. per hour.

Thirdly the area was subsoiled at 4½-foot spacing, using a Caterpillar Tractor and Killifer drawn at fifteen inches depth. This took 32 hours at a cost of £25 12s. 9d., i.e., 16s. per hour.

Lastly the cultivation of the ground was undertaken by working the soil three times with the Fordson with Rotary Hoe attachment; first at one-inch depth to break up the humus layer and any remaining heather roots; secondly at three inches depth to mix the humus layer and mineral soil; and lastly at six inches depth to obtain the correct texture of soil to a depth suitable for seed sowing or even lining out. These three cultivations were quite essential in view of the very hard and rocky nature of the ground, which could not have been broken up without the use of a sub-soiler and a Rotary Hoe. These cultivations took 53¼ hours at a cost of £29 5s. 9d., i.e., 11s. per hour.

A rabbit-proof fence was considered necessary, and sixty chains, including two swing gates, were erected by unskilled labour. Costs were kept low by using the Caterpillar Tractor and sub-soiler along the entire fence line to facilitate the driving of fence stakes, and the Ferguson Tractor and plough to open up a trench for turning out the foot of the netting. Details of fencing costs (in 1949) are:—

	£	s.	d.
Labour	31	15	6
Netting	56	15	0
Wire	3	15	0
Staples		15	0
Stakes	24	15	0
Strainers and Struts	2	0	0
Gate Posts	1	5	0
Gates	7	0	0

Summary of Costs

1.	Initial cutting of heather (Rotary Hoe)	£22
2.	Clearing heather from Area....	£34
3.	Sub-soiling	£25
4.	Cultivation	£29
5.	Fencing (including materials)	£128
		£238

The work was completed in August, 1949, the total cost of £238 working out at just under £20 per acre, including fencing costs, or £10 per acre if fencing is excluded. It is thought that this will compare favourably with costs of nursery formation anywhere, especially as previous experience on nearby sites using quite different techniques has indicated heavy costs of £60 per acre or more. For future guidance, however, it is thought that costs can be cut even more, mainly by an initial burning of heather.

FURTHER NOTES ON COMPOST AND ITS APPLICATION

By W. G. GRAY
Forester, Research Branch

IN *Journal* NO. 19 (1948) pp. 10-13, details were given of the preparation of organic composts. The general principles of making compost as given in that paper, apart from size of heaps, remain unchanged. Since publication, however, opportunity has been afforded to visit Conservancy composting sites and to discuss problems that arise in practice with foresters.

It is clear that in most Conservancy nurseries composts will continue to be prepared in the open, due to the high cost of preparing compost under cover on a large scale. Unfortunately, where heaps are prepared in the open, drying out, coupled frequently with a limited water supply, often presents a serious obstacle in the way of preparing good compost using the technique outlined in the 1948 *Journal*. The present note covers a number of observations, and suggests changes in the construction of heaps in the open, which are already in practice in some localities.

Preparing the heaps. To reduce the danger of drying out of heaps in the open, some form of side protection is necessary, together with an increase of the width of the heaps. It is suggested that the heaps should be ten feet wide with the sides and ends protected by a wall, four to four-and-a-half feet high, constructed of straw bales. The actual compost material will completely fill the inside of this straw "bay". The length of heaps constructed by this method can be as long as practicable. With certain materials there may be some difficulty in securing adequate aeration in an enclosed heap of the size suggested. Improved aeration can be ensured by leaving spaces between occasional bales, or by inserting drain pipes between the bales. The baled straw forming the wall of the heap will become well weathered, and could be incorporated in the new heap after a season and replaced by bales of fresh straw.

Leaching. During the composting process leaching takes place to a greater or less extent, depending on the amount of water applied. In composts prepared in the open where heaps are not protected, and especially in high rainfall areas, leaching can be extensive. Covering the heaps with straw, heaped so that water tends to run off, especially when composting is complete, will be of assistance. The use of curved corrugated sheeting (weighted down), resting on the baled straw walls, would provide protection during the whole composting process. For a permanent composting site a concrete base with drain and pit, so that all leachings could be returned to the heaps, would be very advantageous.

Season of composting. Composts can be laid down at any time, but while the atmosphere is warm results are the most satisfactory. It is probably not advisable to compost in the open during the winter.

Selection of compost sites. As water is required, especially during the initial stages of composting, heaps should be sited near a water supply. It is probably economical to transport the base materials to a central point where water is available. A power-driven pump for supplying the water should be provided.

pH and decomposition. Green crops and composts decompose more rapidly in certain alkaline soils. In agriculture, sheet composting with straw

is possible, where the soil is naturally more alkaline. This method could not be used in acid forest nursery soils; consequently the organic material is composted artificially, and a large part of the decomposing process is completed before the material is applied to the soil. The degree of decomposition required to be beneficial to plant growth, may well vary between the types of material to be composted, and it therefore becomes essential to ensure that all composts are well broken down before being applied; otherwise the process has to be completed in the soil with a consequent loss of soil nitrogen. This in turn may cause nitrogen deficiency in the seedling stock. It has been found on an acid heathland nursery soil that seedling growth is poor in the first season following a green crop, probably due to this cause.

Hopwaste compost. This is known to give good results. It is partially broken down in processing at the brewery, and can be applied without composting to the more alkaline soils, and to many acid soils provided the pH is not too low. It forms a satisfactory activator, and is probably best used in mixture with base materials, where it should form not less than 25 per cent. of the volume of the compost as made up. It is most useful in mixture with straw and bracken, and where plentiful it might be used to advantage in a 50/50 mixture.

Straw compost. This is deficient in phosphate, and generally does not give good results when used alone in acid heathland soils, which are also low in phosphate. In such soils the phosphate requirements must be adjusted by the use of fertilisers, before straw compost can be really effective. It therefore follows that straw must be well composted before being applied, particularly to soils of a low pH.

Bracken compost. This material would be expected to produce a higher nutrient content than straw, as it includes the assimilating parts of the plant. This is certainly the case when cut and composted in July before the nutrients are returned to the rhizomes. The phosphate in bracken tends to be washed out by rain after cutting; therefore composting in the green state is probably the best approach, unless it can be "hayed" and stored under cover.

Green crops. Generally this method of replacing organic matter is restricted to the more alkaline types of nursery soil, the breakdown taking place in the soil with a consequent drain on the soil nitrogen. At present it is somewhat debatable whether any significant stimulus, at least to seedling growth, is obtained in this way. In high rainfall areas the use of ley crops permits transplanting to be carried out under moist conditions. At Oxford no benefit has been observed from the use of either lupin, mustard or buckwheat on an agricultural soil type nursery with a pH around neutrality.

Farmyard manure. On a point of interest, it is known that certain fungi found in dung attack plants of the ectotrophic mycorrhizal group, but do not appear to attack those of the endotrophic groups.

Application of composts. It has been customary to apply composts for raising seedlings shortly before sowing in the spring. Where the base materials have been chaffed prior to composting, the mass is in sufficiently short lengths to be effectively incorporated in the surface layers of the soil by machines. Where composts have been prepared without chaffing, incorporation can be more difficult; such material might well be applied in late summer to bare fallows. Further mechanical cultivation to prevent weed growth would also reduce the compost still further.

Application of fertilisers. It is suggested that fertilisers should be applied separately to the soil, and not incorporated with a heap during composting, owing to the danger of loss by leaching. This of course refers to those fertilisers which are being used *in addition* to those actually required for the composting process.

Consolidation of seedbeds. It is considered that the total seedling yields may be influenced by the degree of consolidation of the soil applied in the preparation of seedbeds. With mechanical cultivation, together with the incorporation of bulky compost in the spring, there is a danger of the surface layers remaining too loosely packed and fluffy, with the result that the soil dries out and germination and survival may be seriously affected. The requisite degree of firmness might be tested when the beds are finally prepared, by pressing the soil with the hand clenched, when only slight indentation should be possible. Hard packing of the surface layers on the other hand should be avoided. This can occur on the somewhat heavier soils, when suitable weathering has not taken place prior to forming the beds. The importance of the correct degree of consolidation applies mainly to coniferous and small-seeded broadleaved species.

Compost, soil and plant growth. It is accepted that composts used so far have their optimum effect in stimulating plant growth when applied to heathland or woodland nursery soil types, and are less effective when applied to old nurseries of the agricultural type with a relatively high pH. It is not considered essential that a mycorrhizal association should exist for satisfactory growth, although it is possible that at least on woodland and heathland sites such an association would ultimately occur. It is known, however, that certain species have a greater growth response, more especially in the seedling stage, when raised in soils of a known pH range. There also appears in a general way a correlation between the pH range in which growth is best, and the mycorrhizal group to which the plant is associated. The selection of species for the two soil types might be as follows:—

On heathland and woodland acid soil types pH 4.5 *to* 5.0 *Ectotrophic mycorrhizal group.*

Pines and spruces
Larch
Tsuga
Oak
Beech
Birch

On old agricultural neutral to alkaline. pH over 5.0, *usually* 6.3 *to* 7.0 *Endotrophic mycorrhizal group.*

Lawson cypress
Thuya
Ash
Sycamore
Sequoia sempervirens
S. wellingtonia
Poplar
Willow
Walnut

NURSERY MECHANISATION

By M. E. McNULTY
Forester, South Wales

NURSERY FORESTERS ARE continually worried about costs, and endeavour to try out new ideas to keep them at a low level, whilst at the same time ensuring that the full annual programme is completed. This controlling of costs is not at all easy when one remembers that present day wages and overheads are approximately three times the pre-war figure, while at the same time it cannot be said that the output by the nursery staff has kept pace with the increased expenditure. To keep costs, therefore, within the limits of proper nursery economics, it is essential that manual effort be supplemented by as much mechanisation as possible.

Nursery foresters may be interested in our efforts at Tair Onen, towards that end, for the past few years. Tair Onen Nursery was started in 1936 and may now be considered in the established category with all its attendant ills—unavoidable over-production in its early years with consequent lowering of natural fertility and high incidence of weeds.

Our main worry was the high cost of weeding broadcast seedbeds, which reached its peak in 1946. As well as the cost of weeding, at least 10 per cent. of the first year's seedlings were lost, mainly through faulty weeding by inexperienced labour. When one considers that our weeding areas in an average year amount to about sixty acres of lines and seedbeds, one may appreciate our problem.

To meet the situation, the "Macslat" Multiple Seedsowing Drill was evolved. It is worked on the endless belt system with a density control, and sows eight drills longitudinally, the drills being four inches apart. The machine opens the drills, sows the seed and covers it with grit in one operation, though the grit covering part requires further development.

The 1946 model had a wooden hopper mounted on tyre-less cycle wheels, the endless belts being provided from an old inner tube of a lorry. The principle of its working was satisfactory.

The 1948 model is an improvement on our first effort. It is a compact, all-steel unit mounted on pneumatic tyred wheels, having its endless belt specially made. The machine at present is manually operated. It is visualized that a later model may be power-driven with other refinements. The present machine costs approximately £55. Theoretically, drills take up three times the area of broadcasting, but in this instance it was decided to drill at broadcasting density. Plants coming out as first-year seedlings would not hurt. Those remaining in for two years could have a proportion pricked out at the end of the first year, leaving in for the second year a number corresponding to that of normal drilling density. The plants pricked out would of course be bedded out elsewhere.

In practice the following comparisons stood out this year (1949). 4 lb. of Sitka spruce were sown in each case, of the same identity number.

	Drills	*Broadcast*
Density of sowing	55 sq. yds. per lb.	55 sq. yds. per lb.
No. of seedlings per lb. at stocktaking	13,500	3,540
Cost of sowing per lb. { Prepare bed ...	45/- per 100 sq. yds.	45/- per 100 sq. yds.
Cost of sowing per lb. { Sow seed	2d. per lb.	5d. per lb.
Quantity of grit per 100 sq. yds.	4 cwt.	16 cwt.
Cost of grit per 100 sq. yds.	4/8	18/5
Cost of covering 100 sq. yds.....	2/9	2/9
Weeding		
Number of times during season	{ Hoe twice Weed twice	Weed twice
Cost of weeding per 100 sq. yds.	89/5	170/10
Cost per 1,000 seedlings	5/8	40/3

The following general results were found this year (1949), taking in all species, some of very poor germination.

Drills		*Broadcast*	
Area drilled	27,868 sq. yds.	Area broadcast	6,350 sq. yds.
lb. sown	416	lb. sown	94.8
Yield	5,320 thousands	Yield	889.25 thousands
Yield per lb.	12,788	Yield per lb.	9,380
Yield per sq. yd.	191	Yield per sq. yd.	140

General Observations

Manual weeding of drilled beds need only cover one-fifth of the area, whereas in broadcast beds the whole area must be covered. Hoeing can be carried out on the other four-fifths of the drilled beds. A seven-pronged two-inch-spud multiple hoe was evolved, complementary to the seed sowing machine. Two men hoe eight drills simultaneously and cover 2,400 sq. yds. in one day.

It was noticed that seedlings in drills grew to a greater height the first year than those in broadcast beds. The constant hoeing gives better moisture retention. It is not suggested that drilling is necessary for all nurseries. Obviously in newly started nurseries where there is no weed growth for the first few seasons, broadcasting is easier.

Readers of the *Quarterly Journal* of the Royal Forestry Society of England and Wales will have noticed, in the October 1949 issue, an article by Mr. W. E. Hiley on his observations on Nursery Machinery and Methods, from a recent visit to Western American Nurseries. He describes machines similar to those developed at Tair Onen for drill sowing of seed, except that the American product is tractor-pulled. It shows that other up-to-date countries are fully alive to the potentialities of nursery mechanisation as a contribution to lower costs.

LINING-OUT SEEDLINGS

By W. GARNER
Forester, North-West England

IN THE PAST various methods for lining-out seedlings have been tried in an attempt to speed up and improve this operation.

At Clipstone the most satisfactory method yet tried, and one which gives the best all round results, involves the use of a flat board in place of the old nursery line.

The board acts not only as a line for cutting the straight-back trench, but also as a stamping and levelling board. It has become very popular with the workmen as each man is given a plot or section on his own. He is an independent unit and his day's output is not affected by the speed of the other members of the gang, as is usually the case in most methods of lining-out.

By the use of this board the increase per man in the number of plants lined out is on an average 1,000 per day, i.e., an increase of thirty per cent. Apart from the saving in time and money thus effected there are many advantages in the method. For example, the plants are inserted at the correct height by bringing the collar of the seedling in a line with the base of the board, the surface of the ground is kept at one level, hollows in the ground causing water-logged patches are eliminated, and stock-taking is facilitated by the fact that there is a uniform number of plants in each line. Alley-ways approximately eighteen inches wide left between the sections enable weeding and hoeing to be done from either side; trampling in and between the lines is thus eliminated.

One other important advantage of this method is that it stimulates competition among the workers not only in lining-out but in weeding

When lining-out one-year-old first grade seedlings a board twelve feet long, nine inches wide, and half an inch thick is used. This will take 100 plants at a time. For bedding out a smaller board nine feet long, six inches wide and half an inch thick gives very satisfactory results.

LUPIN AS A GREEN CROP

By D. F. MARSHALL
Forester, East England

LUPIN HAS GIVEN good results at Willingham Nursery in Lincolnshire, although the soil is very sandy and a hard pan underlies much of the ground. In the early summer of 1949, three nursery sections from which plants had been lifted, having a total area of about 14,000 square yards, were fallowed, cleaned, and sub-soiled. On June 21st, blue lupin seed was sown with an ordinary corn drill drawn by a Ferguson tractor. The drill was set at No. 4 on the density scale, which was equivalent to 1½ hundredweight of seed per acre. On the following day a dressing of National Compound Fertiliser was broadcast at the rate of five hundredweight per acre, and harrowed in.

Having had little rain just previous to sowing, and as it turned out, little after, I had grave doubts about the seed germinating at all. Nevertheless, on June 27th, just six days after sowing, the lupin was through, the density and germination being better than expected. As everyone knows, the summer of 1949 was very dry even for the east of England, which never has a very great rainfall. Not having been able to manure the land with farmyard manure or compost, I was not expecting much of a crop, but the results were better than I had even hoped for. By mid July the crop was well established, and on August 25th the lupin, just showing a tint of blue, was ploughed under.

The average length of stalk was about twenty-seven inches, and I thought that at this height it would perhaps require to be cut first to enable it to be fully covered. My fears were unfounded, for the Ferguson tractor, drawing a single-furrow sixteen-inch plough, covered (with few exceptions) the whole of the crop, ploughing to a depth of six to seven inches.

Blue lupin grown on three sections in P.48, also a very dry summer, gave every satisfaction and carried (P.49) some of the best Corsican pine, two-plus-one, grown at Willingham.

The seed, as far as I am aware, was untreated, no organic manures were used, and having had a very dry season the results were very satisfactory. The sowing of lupin before mid-June is not advocated, as it would mean the crop having to be ploughed in before mid-August, leaving a further five to six weeks or more of growing season, in which time a crop of unwanted nursery weeds would cover the ground. In any case, a late sowing gives a longer period to clean-fallow the area.

KINVER NURSERY

By G. H. STOCKLEY
Forester, North-West England

THE HEATHLAND NURSERY at Kinver is quite a new addition to the North-West England Conservancy; its description and how it was established are briefly set out below.

The site is part of old common land, chiefly grass and bracken; there are no records of cultivation of this area for at least fifty years, and possibly much longer. The nursery is situated on a gentle slope facing south-west, but very exposed. The soil is of a very light character, the parent rock being soft sandstone.

Cultivations commenced in December, 1948, on eighteen acres, with several "applications" of the power-driven Rotary Hoe—an excellent machine for breaking up old turf and bracken areas. The top four inches of turf, bracken and soil were pulverised to a very fine tilth. This was followed by ploughing-in the resultant "humus" to a depth of about eight inches. The bracken roots brought to the surface by this first ploughing were then harrowed off. The land was ploughed a second time to a depth of ten inches, so as to bring up the remaining bracken roots and also the buried "humus" back into the top four inches of soil. The site was thoroughly worked, but it was inevitable that some bracken roots should excape attention, and these did persist in odd patches throughout the ensuing summer months. However, a further ploughing and harrowing of the affected sections, as they become available, will eradicate these last few stray roots. The nursery was fenced and cultivated during December, 1948, and January-February, 1949.

Almost two million seedlings were lined out during March and April, and, in May, eight acres of seed beds were sown. Unfortunately, almost the whole of this operation had to be carried out during a very dry spell, followed by an unusually hot and dry summer. The effects of this drought were fatal on the light sandy soil at Kinver, and severe losses occurred. An extension has now been cultivated and laid out, adjoining the original area, bringing the total to twenty-eight acres. On to this ten acres extension has gone 120 tons of fresh chaffed bracken and 13,000 gallons of sewage waste, and the area is now being utilized for lining-out.

Given a normal growing season during F.Y.50, the outturn from this nursery may well prove to be remarkable, as results from some of the surviving stock of F.Y.49 have indicated.

PLOUGHING THE YORKSHIRE MOORS FOR TREE PLANTING, 1869*

BY JOSEPH BRADLEY
Ebberston, Yorkshire

THERE ARE LARGE quantities of waste land in the North Riding of the county of York, and in other district of England and Scotland, which have hitherto proved comparatively valueless, either for cultivation or for the growth of timber, on account of the existence, at a small depth from the surface, of what is generally known by the name of Moorband Pan.

This pan (vide *The Book of the Farm*, by Henry Stephens, vol. ii, p. 665; "On the Formation of Moorband Pan") is a thin waterproof seam or film, from one to six inches thick, lying beneath the surface at a depth varying from four to fifteen inches, holding water like a bason, and being so tough that the roots of trees or plants cannot penetrate it.

Trees planted by the ordinary method of holing or notching on similar soil in this district have never yet succeeded thoroughly, although many different ways of breaking the pan have been tried.

The system of open gripping, though expensive, has perhaps hitherto been attended with the best results, but it is only a partial cure, for though the trees contiguous to the grips grow well, those which are more than two yards distant from the grips are in the same unhealthy state as if the grips never existed.

Even when holing has been done with the greatest care, and the pan at the bottom of each hole thoroughly pierced and broken by the tool, it is observed that, before the trees planted in them have had time to get their roots through the fractured pan, a healing up of the pan has taken place, and the trees gradually pine away.

Nor is it to be wondered at that trees do not grow under these circumstances, when it is considered that in spring and autumn they stand in a bason of water; in summer they are starved by the continual evaporation of the stagnant water from about them, while in the frost of winter they are liable to have their roots frozen up in a solid mould of ice.

The writer of the following report contemplates setting forth as briefly as possible (though not exactly in accordance with the rules laid down in the Society's journal) for the use of landed proprietors and other persons desirous of utilizing such barren land, a new practical system of thoroughly breaking up the pan, and planting the ground at a cost that will bear a favourable comparison with the cost of planting ordinary soils that are not naturally subject to the disadvantages of a pan.

The piece of land that forms the basis of this report was prepared and planted in the autumn of 1869, and in the winter of 1870. It is situated on a high ridge between two valleys which run north and south, in the parish of Allerston, in the North Riding of the county of York, and is about ten miles from the sea-coast. Its altitude, according to the Ordnance Survey, is 610 feet.

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* The above article originally appeared in the *Transactions of the Highland and Agricultural Society of Scotland*, Fourth Series, Volume 4, 1872, page 92, under the title:—"On Planting Exposed and Barren Moorland resting on Moorband Pan"; it earned the premium of a "medium gold medal". We are indebted to the late Mr. W. Forsyth, Divisional Officer, North East England, for bringing it to our attention, and to the Secretary of the Highland and Agricultural Society for permission to reproduce it here.

It contains an area of about 70 acres, and is thoroughly exposed to every quarter with the exception of a small part of it at the north-east corner, where it is protected by the end of a narrow plantation of about 50 years' growth, composed of larch, Scotch and spruce firs. This old plantation is only a belt of about 20 yards in width, and is planted on soil where there is no pan. The larches are still healthy, and are sound and well hearted, while the Scotch and spruce firs are comparatively worthless, owing, no doubt, to the exposure to wind and to the narrowness of the belt.

The surface-soil of the 70 acres is black and peaty, about three inches in depth, and was covered with stunted heather. Below this is a hard gravelly soil, varying from two inches to one foot in depth, and resting on the pan. Below the pan is found a yellow sandy sub-soil, resting on the oolite limestone of which these hills are formed.

Preparing the Land

In the month of March those parts of the ground upon which the heather had attained a considerable growth were burned; some portions of it, however, having been burned some few years ago, and now covered with plenty of young heather three or four inches high, was not reburned; and, from the healthy and luxuriant condition of the trees, it would seem that it would be the best plan to burn the heather three or four years previous to planting, for the young heather affords great protection to the plants.

The land being thus cleared, it was then ploughed. The plough used was one of Messrs. Ransom's Y.R.C., made of wrought-iron. It was found, however, that each furrow-slice on trial fell back into the furrow when the plough passed on; in order to obviate this difficulty, an additional coulter was fixed on the opposite side of the beam, the point of which descended to the wing side of the share in a parallel direction to, and nine inches apart from, the other coulter. By this contrivance the furrow-slice, which is nine inches wide and two inches deep, is completely cut out, and falls on the unploughed land. The furrows are four feet distant from each other. Two men (one to manage the horses and the other the plough) and two horses are required to work the plough effectually. The quantity of land ploughed in one day of $7\frac{1}{2}$ hours, with one plough, was four acres. The ground, rendered hard by the dry season, filled with the heather roots, which are bad to cut, and in many parts abounding in fast stones, thus necessitating a very slow rate of speed and steadiness, is very difficult to plough, and is very hard work.

Sub-soiling

The nine-inch furrows being made, the sub-soil plough was then used for breaking the moorband pan and loosening the soil under it. The handles and beam of the plough, which has been made specially for the purpose, and which it is thought necessary to give a short description of, consists of oak with a body of wrought-iron and steel. The coulter is partly of wrought-iron and partly of steel made perfectly hard; the sock is of cast-iron chilled on the under side and soft on the top side; one of these socks, if sound, will last one day. To the beam of this plough, which is $5\frac{1}{2}$ by 8 inches at its junction with the handles, and gradually tapers off towards the end of the plough to 4 by $4\frac{1}{2}$ inches, is made of sufficient length to admit of additional appliances for cultivation. At each end of the beam there is a strong wrought-iron lever attached to it and two metal wheels on the framework of each lever about two feet six inches apart, which run on the surface of the ground. They are so regulated as to allow the plough to go into the ground from ten to eighteen inches, and greatly assist the men in directing the plough when at work, or when setting in the plough at the ends of the furrow, or when raising it out of the ground.

By means of these levers also, when the progress of the plough is arrested by fast stones, the plough is drawn backwards, and is thus more readily freed from the obstruction, for the plough is not only drawn backward but is also lifted to the surface, thus it glides over the stone, and, the levers being let go, again descends into the ground of its own accord. There is also a rack and pinion at the extremity of the plough, which carry a strong cast-iron wheel, and assist the front lever when required. The beam and handles are strapped together with strong wrought-iron plates and bolts. The wood and iron work is made remarkably strong. By means of this powerful plough the pan is broken up, not only along the whole length of each furrow, but actually over the whole area between the furrows; this was found to be the case both by examining the pan after the plough had passed, and by the fact of the intermediate ground being tilted up and cracked under the feet of the workmen who walked at the side of the plough. Four men and six powerful horses worked this plough, which in a day of 7½ hours ploughed on an average three acres and two roods.

When this operation was completed its good effect was at once apparent. A heavy fall of rain took place and the land so treated remained perfectly dry, while the adjoining land of an exactly similar nature, and separated from it only by a wall, was half pond, half swamp, and remained in that state the whole winter.

Cultivating after Sub-soil Ploughing

In autumn, when the sub-soil had been exposed to the action of the atmosphere and become somewhat consolidated, a kind of drag, with three tines and a wheel six inches wide on the sole in front, was used for pressing down the soil and breaking the clods. The tines of the drag, descending to a distance of twelve inches, work more effectually when the surface is compressed with this wheel. It pulverises the soil and presses it firmly down, and thus, not only is the soil in a better state for the reception of the young trees, but also there is less fear of the plants being lifted by the frost. It is a very valuable implement, and indispensable to the barren land planter. One man with two horses will do six acres per day.

Planting the Prepared Soil

To plant the quantity of land, which was about 70 acres, twelve men and seven boys were employed. Each man was furnished with a half-worn garden spade, the blade of which was about eight inches long and seven inches wide, with a shaft 20 inches long, making the full length of the spade two feet four inches. The average weight was three pounds. The spade is inserted in the ground in a slanting direction, and then lifted up with one hand sufficiently to admit of his placing the roots of the plants in the cavity with the other. The spade is then withdrawn and the soil falls upon the roots, which are planted deeper by two or three inches than they have been in the nursery garden. He then places his foot on the soil and presses it down firmly upon the roots, taking care to draw the plant upwards to within half an inch of its original depth in the nursery garden. Thus, if the plant has been placed three inches deeper than in the nursery, it is in order to straighten the roots, pulled upwards 2½ inches. The sod which had been removed by the plough was then cut, and a portion of it pressed down upon the soil close to the plants to hold the stem of the young tree upright against the side of the furrow. The first man goes on and plants the trees at the edge of the furrows four feet apart; the second follows and plants his trees in the adjoining furrow, and plants them so that the trees in two furrows form a triangle. One boy serves two men with plants; six boys, therefore, supplied twelve men, while one boy carried the

trees from the place where they were couched up to the boys. Each man planted throughout the season 750 per day. In the month of February, when the weather was open, each man planted 1,000 per day.

The number of trees planted on 70 acres of land was 157,200 of larch, 25,350 of Scotch firs, and 2,000 Corsican pines.—Total, 184,550. For a space of 50 yards to the north-east and west sides of the ground the trees were planted three feet six inches apart, and the remainder four feet apart. On the north side one Scotch fir was planted to three of larch. On the other portion one Scotch fir to twenty-four of larch. About 2,000 Corsican pines were distributed all over the ground in place of Scotch firs. The greater part of the trees, supplied by Messrs. John Grigor & Co., Forres, and Messrs. Drummond & Son of Stirling, N.B., were one-year seedlings, one year transplanted, and replanted into our own nursery ground for one year. They had fine fibrous roots, and were only taken up about a day before replanting. The trees have grown remarkably well; most of them have pushed out many fine lateral branches from three to four inches long, and leading shoots from three to six inches long. The number of dead trees in the whole piece of ground is about 3,000 out of 184,550. The fact of this small number of deaths, viz., 3,000, and, considering the dryness of the season of 1870, shows that the result of this new system is decidedly encouraging. And on this account 120 acres are being prepared for planting during the forthcoming season.

The writer now wishes to show, by giving an accurate statement of the cost of breaking up the ground for the above-named plantation, that the system of planting advocated in this report is not more expensive than those generally in use.

Cost of Previous Ploughing

Two men, at 2s. 6d. each per day....	£	0	5	0	
Two horses, at 3s. 6d. per day		0	7	0	
Wear and tear		0	1	0	
Four acres ploughed		0	13	0	
Cost of ploughing		0	3	3	per acre

Cost of Sub-soiling

Four men, at 2s. 6d. each per day	£	0	10	0	
Six horses, at 3s. 6d. each per day		1	1	0	
Wear and tear		0	4	0	
Three and a half acres per day	£	1	15	0	
Equal	£	0	10	0	per acre

Cultivating the Furrows

One man, at 2s. 6d. per day	£	0	2	6	
Two horses, at 3s. 6d. each per day		0	7	0	
Wear and tear		0	2	0	
Six acres cultivated a day		0	11	6	
Equal	£	0	1	11	per acre

Planting the whole of the Trees

Labour only—men and boys	£ 35	17 6
Taking up trees and couching them on land	2	10 10
Carriage from nursery to plantation	3	0 0
Seventy acres planted	£ 41	8 4
Equal	£ 0	11 10 per acre

Cost of Trees

		s.	d.			
123,700	Larch, at	13	6	per 1,000	=	£ 88 10 0
33,500	Larch, at	11	0	do.	=	18 8 6
17,450	Scotch Firs, at	9	0	do.	=	7 17 0
7,900	Scotch Firs, at	7	0	do.	=	2 15 4
2,000	Pines, at	15	0	do.	=	1 10 0
Total 184,550	Seventy acres planted					£119 0 10
	Equal per acre					£ 1 14 0

Cost per Acre

First Ploughing	£0 3 3	
Sub-soiling	0 10 0	Labour only equals
Cultivating	0 1 11	£1 7 0 per acre
Labour in planting, &c.	0 11 10	
Cost of Trees	1 14 0	
Total cost	£3 1 0	

The advantages derived from the use of this system are:—

First.—That the pan is thereby thoroughly destroyed over the whole surface to be planted.

Second.—That the trees are then planted with less labour than by any of the systems hitherto in use, as the detailed cost given above will confirm.

By reference to the foregoing table, it will be seen that the cost per acre is £1 7s. 0d., whereas, from information obtained from proprietors in the neighbourhood, who have followed the system of draining the ground by open grips made about 15 yards apart, the cost was £2 per acre, and for holing and planting at four feet apart, the cost varied from £1 5s. 0d. to £2 per acre for labour.

Fencing

The north-west and south sides of the piece of ground in question, are enclosed by a drystone wall about four feet high.

On the east side, a wire fence has been made with end straining posts of oak, nine feet long and ten inches on the side of the square. Other oak straining posts are set about 70 yards apart, of eight feet long, and eight inches on the side of the square. These straining posts have strong pieces of oak-wood nailed on the bottoms of each for abutments, also strong diagonal pieces braced from the bottom of the intermediate posts to the top of the straining posts,

and all fastened together. The intermediate posts are made of larch, about seven feet long, and of an average diameter of five inches at the ends, and fixed at a distance from one another of seven feet. Alternate posts are the root ends of trees, and set in the ground in the usual manner; the others are the second cut of larch, average four inches in diameter, and sharpened at the thicker ends, and driven into the ground with a large wooden mallet. All the posts stand four feet above the surface of the ground, and at the top of these there is nailed a strong larch rail of an average diameter of three inches, in lengths of 16 feet, spliced together at each end.

There are five lines of galvanized drawn wire. The top strand is of No. 3; the two next are of No. 4; and the two bottom ones are of No. 6, wire gauge. These are fixed to the posts with galvanized staples in the usual manner. At each end, where the strong oak straining posts are fixed, the wire is put through eyes of $\frac{3}{4}$ wrought iron straining bolts with strong nuts, and the wire twisted together at the ends.

When the above-named fence was completed, there was fixed on the whole line of fence, galvanized two-inch game netting, two feet deep, No. 18 wire gauge; one edge of this wire netting is fixed close to the level of the ground, and through the meshes on both edges of it is threaded No. 8 galvanized wire, for the purpose of straining it, and securely fixed to the posts by staples. On each side of the wire netting on the ground line of fence is put a thick sod for preventing ground game entering the enclosure.

And also on the top of the wall, before referred to in this paper, there is fixed galvanized wire of the same description, but 18 inches wide. This is fixed to larch stakes seven feet six inches long, of an average diameter of $2\frac{1}{2}$ inches, driven into the ground on the outside of the wall about nine feet apart. Thus, the stakes reach two feet above the wall, and the wire netting is fixed exactly in the same manner but on the top of the wall, and for the same purpose as that on the ground before mentioned.

Estimated Cost of Stone Wall

Quarrying stones	£0	2	6	
Leading stones	0	4	0	
Preparing foundations	0	0	3	
Building wall	0	3	0	
	£0	9	9	=per rood of seven lineal yards.

Total quantity of walling, 271 roods 3 yards, at 9s. 9d. per rood equals £132 6s. 5d., or about £1 17s. $9\frac{3}{4}$d. per acre.

Actual Cost of Wire Fencing

		s.	d.			£	s.	d.
No. 10	Straining posts	4	6	each	=	2	5	0
296	Intermediate do.		5	each	=	6	3	4
750	Yards of wire fencing and staples		$6\frac{1}{2}$	pr. yd.	=	20	6	3
6	Oak gate posts	5	0	each	=	1	10	0
3	Wood gates and ironwork	15	0	each	=	2	5	0
Felling poles, cutting into posts, setting do., and fixing wire—labour only					=	12	0	5
(or about 12s. $8\frac{1}{2}$d. per acre)						£44	10	0

Actual Cost of Wire Netting, &c.

No. 211 Larch stakes, 3d. each	£ 2	12	9
1,900 Yards wire netting, 18 inches wide 750 Yards wire netting, 24 inches wide 3,400 Yards No. 8 wire and staples	40	2	9
Preparing wall, and fixing netting—labour only	15	19	6
(or about 16s. 9½d. per acre)			£58 15 0

Mr. Forsyth supplied the following further information:—

The ground ploughed by Joseph Bradley can still be identified at Allerston. It consists of the Black House Plantation and the eastern portion of the Warren Plantation. The crops planted by Bradley were sold in 1916, when forty-five years old, for about £70 per acre, a figure which may be compared with the cost of planting, £3 1s. 0d. per acre, given above. Bradley himself, who was agent to Sir George Allanson Cayley, of the Brompton, Allerston, and Ebberston Estates, for many years, died about 1916 at the age of 82, so that he lived to see his plantations grow to something like their full stature.

THE FORMATION IN ONE YEAR OF A SINGLE PLANTATION OF ONE THOUSAND ACRES

By I. R. B. MARSHALL
District Officer, North-East England

THIS ARTICLE IS written in regard to the peat fells of northern England and southern Scotland which are in the forty to sixty inches rainfall belt. Peat is normally a tractable planting medium, and being on the fringe of the wet area, we avoid excessive lost time. The large scale programmes involved also mean that costs are low.

The soil is peat overlying boulder clay, with occasional rock outcrops of limestone, basalt (whinstone) and sandstone (freestone). "White" ground or *Molinia* is the principal peat forming vegetation but "black" ground or heather covers much land as well. Peat is usually seven to fourteen inches in depth. Basin peat or bog which occurs in hollows or terraces has up to thirty feet of anaerobic peat formed from an *Eriophorum/Scirpus/Erica tetralix* plant cover.

Often hard heather riggs or knolls are evident, and bracken banksides occur in the sykes or streams. The various vegetational types receive different treatments.

Selection of Species

On deep peat, and on peat at higher elevations up to the usual planting limit of 1,250 feet, Sitka spruce is used. Norway spruce is planted in "white" ground lower down, where mineral soil is at nine inches depth. Where there is an admixture of *Molinia* and heather, Sitka spruce is planted, together with Scots pine at lower and lodgepole pine at higher elevations. Pines are also planted pure on heathery knolls and on mineral soils. Japanese larch and Douglas fir are planted on sheltered bracken sites. About 80-90 per cent. of the trees used are spruces.

Sitka spruce planted on bogs is treated with basic slag at the time of planting. Later the heather is cut and mulchings from drain bottomings are applied. Slag is also applied to Japanese larch.

Although a moisture-loving tree, spruce seems to have a surprisingly virile root system; even in the exceptionally dry summer of 1949 losses of F.Y.49 planting were not unduly high, but this may also be attributed to the wet nature of the peat. A spruce plant dropped accidentally into a drain may survive for a long period.

Preparation of the Ground

Turf planting is adopted primarily for reasons of drainage, but also to improve aeration and reduce weed competition. About 80 per cent. of the ground can be prepared by machinery, or by machinery and hand with the remainder by hand alone on rocky and steep ground.

(*a*) *By hand.* This is done by the "Belgian" turf method whereby turf drains are cut at twenty-feet intervals. The resulting spoil or castings are sliced into twelve-inch cubes. All this work is done with the rutting spade. Hacks or drags are used to place the turves at five-foot intervals and the drain bottom is shaped by bottoming spade.

One man can prepare two acres in a week.

Tools

Rutters: .... Left and Right foot. Blade roughly triangular. Blade eighteen to twenty-one inches long, fifteen inches wide at top. Stout T-shaped handle of ash.

Hacks: .... Two or three prongs, with handles thirty to forty-two inches long.

Bottoming Spades: Tapering blade, fifteen inches long and five inches wide at top.

(*b*) *By machinery alone.* Medium crawler tractors such as International T.D.9, Fowler F.D.3 with Cuthbertson plough, or light crawlers T.D.6 or D.2 with Begg plough carry out ploughing at five-foot spacing. It is necessary to have broad tracks on all tracked tractors. Plough furrows are not quite so deep as hand produced turves, but the trees seem to grow just as well. One tractor and plough can do from fifteen to twenty acres per week.

(*c*) *By machinery and hand combined.* F.D.3 or T.D.9 and Cuthbertson plough, are used to plough at ten or fifteen-foot spacing, with the cutting and spreading of turves done afterwards by hand from the plough furrows. At ten-foot spacing one outfit should plough thirty to thirty-five acres per week. Hand spreading is done at the rate of four acres per week per man.

At fifteen-foot spacing of furrows, fifty to sixty acres should be ploughed in a week, and three acres spread by hand per man.

A modified Cuthbertson device for ploughs, which slices out turves from furrows like "cutting a piece of cake", can now be seen at Kershope Forest. This comprises a roller with large knife-like slats, the turves produced being put into position by hand.

Drainage

General Principles. Old "sheep" drains, where of suitable alignment, are made use of. Further drains are made just off the contour to prevent erosion. Plough furrows are aligned with regard to drainage, although main drains will not be put in until ploughing of turves has been done. The main drainage pattern is superimposed on the plough furrows, these being spaced sixty to one hundred yards apart, totalling about ten chains per acre.

Bogs are "pre-drained" two to three years in advance of planting, and drains are placed at one-chain intervals.

Draining may be carried out by machinery or hand.

(*a*) *By machinery.* Cuthbertson ploughs can drain the same proportion of the planting area as can be ploughed for turves. Some hand work is necessary afterwards to connect watercourses, cut drain ends, deepen and clear drains of debris that will have fallen in. Draining by Cuthbertson is carried out when main drains are to be set at an angle to plough furrows, resulting in a herring-bone pattern. The rate of large scale output is not yet known.

(*b*) *By hand.* This is done on the unploughable portion of the area, say 20 per cent., and also in certain cases where main drains are to run in the same direction as turf furrows and selected turf furrows are deepened by hand, thus forming "turf" drains. Tools are similar to those used for preparing ground, but no turves are laid within five feet of the drain edge.

Fencing

Sheep are common but very few rabbits occur on the fells, and only sheep netting forty-two inch by four inch mesh is used. A lot of the fencing, due to the progressive nature of afforestation, is temporary, and dismantling and re-erection

are constantly taking place. Generally sheep are grazed up to a few months before planting is done. Two men can erect fifty chains of fencing in one week.

Planting

To ensure the necessary high standard of work, supervision should be concentrated, especially where piece-work planting is done.

Plants are hauled to the planting site by crawler tractor and sledge. The wetness of peat precludes lorry haulage. Plants are heeled-in in dumps of 2,000 around the edges of the compartments. Very large consignments are handled—any number up to 205,000 at one time, this quantity being hauled in one week by one tractor over one mile.

Where large blocks are to be planted, roads, if not already existent, should be planned and constructed beforehand, in order to minimise time for transportation of men and haulages.

Tools

In the Kielder District, the semi-circular spade is in vogue and shows good results silviculturally. Its blade consists of a half-cylinder of metal, ten inches long, being roughly scoop-shaped. In use, a plug of soil is lifted out by turning action. The plant is placed in the hole, plug is replaced, and the ground is firmed.

Elsewhere garden spades are used for spruce planting, roots being dispersed between turf and ground, and not bunched as with semi-circular spade. Mattocks are used for planting on rocky outcrops.

Specifications of Tools

Semi-circular spade: ten-inch base, cast-iron; handle twenty-two inches long.

Garden spade: blade twelve by ten inches.

Mattocks (Long cutter): 5 or 5½ lbs.

Costs

Practically all operations are on a piece-work basis.

Preparation of Turves

(*a*) *By hand.* This costs 2s. 2d. per chain. At thirty-three chains per acre of twenty-foot turf furrows, the cost is 71s. 6d. per acre.

(*b*) *By machinery alone.* (Not sufficient data yet.)

(*c*) *By machinery and hand—*

(i) The cost of fifteen-foot ploughing, including labour, fuel, depreciation, etc., in ideal weather conditions is 14s. per acre.

(ii) Spreading by hand is 1s. per chain. At forty-four chains of fifteen-foot furrows this works out at 44s. per acre. Hence total cost is 58s. per acre.

This gives an indication of the saving obtainable by machinery if used economically on straightforward ground during the summer period. Winter ploughing should be avoided, as costs rise sharply and may exceed those for purely hand work.

Draining

(*a*) *By hand.* This is about 4s. per chain; with ten chains per acre the cost is 40s.

(*b*) *By machinery.* Cost by Cuthbertson Draining plough is not yet known.

Fencing

Sheep netting, erection cost only, 5s. per chain.

Planting

The rate is 1s. 8d. per 100 plants, or about 30s. per acre, representing 1,750 plants

The two tables given below show for a planting programme of 1,000 acres on a single forest unit:—

(1) Table of operations.

(2) Summary of costs.

These are given on the basis that 80 per cent. of the ground is ploughed at fifteen-foot spacing, completed by hand, and the remaining 20 per cent. all done by hand; hand draining is done throughout.

Two tractors are occupied between April and June on ploughing and haulage of fencing material; one only between November and February on plant haulage.

(1) *Table of Operations*:—(see page 68). This shows that 18 men and two tractor drivers are needed.

(2) *Summary of Costs*:—(mainly Accounts Head E.13).

		£
Turf ploughing	800 acres at 14s.	560
Hand spreading	800 acres at 44s.	1,760
Hand cutting and spreading	200 acres at 72s.	720
Hand drainage	1,000 acres at 40s.	2,000
Planting	1,000 acres at 30s.	1,500
Fencing 300 chains	at 5s.	75
Tractor 2 weeks		48
Plant haulage—Tractor 12 weeks (plus assistant) say		360
		£7,023

The costs of plants and materials are not included in the above figures, and certain items of machinery expenditure are likewise omitted. No allowance has been made for lost time.

TABLE OF OPERATIONS

Months	Work	Quantity	Period in man or tractor weeks		Percentage added for times when planting operations not possible	Total in man or tractor weeks		Average No. of men or tractors employed
			Man-weeks	Tractor-weeks		Man-weeks	Tractor-weeks	
April/May	Turf ploughing at 15 foot spacing	800 acres	—	16	5%	—	17	2 tractors
June	Fencing	300 chains	12	2	5%	12	2	1 tractor
June/November	Hand spreading	800 acres	266	—	5%	280	—	10 men
April/November	Hand cutting and spreading	200 acres	100	—	5%	105	—	3 men
May/February	Hand drainage	1,000 acres	250	—	10%	275	—	6 men
November/February	Plant haulage. 1,500,000 plants for 1½ miles.	—	14	14	25%	17	17	1 tractor
November/March	Planting	1,000 acres	200	—	20%	240	—	12 men
						929	36	

PLANTING DOUGLAS FIR IN RHODODENDRONS AT CREAG LIATH, GLEN GARRY FOREST

By R. MURRAY
Forester, North Scotland

CREAG LIATH, a section of Glen Garry Forest, lying in the Great Glen about midway between Spean Bridge and Fort Augustus, was acquired by the Commission after a mature crop of exceptionally fine timber had been utilised.

At the time the Commission commenced preparatory work in P.30, the earliest P. year in this section, rhododendrons had established a firm hold on the ground. On the greater part of the area, those rhododendrons were very dense and many of them reached a height of ten feet or more; on other parts, there remained openings of various sizes between the rhododendrons. Also scattered over parts of the area were old scrub trees of oak, beech, elm and birch.

The total area of P.30 is 100 acres, 38 acres of which were planted with Douglas fir in groups, or blocks. The remaining 62 acres were straight planted in the larger openings, and in those parts where the rhododendrons were less dense, *among* the rhododendrons.

It is, unfortunately, impossible now to give separate costing figures for the different methods which were adopted, and the costings given are for the 100 acres as a whole, covering the various operations (excluding fencing costs) before establishment had been obtained.

Costings (1930)	£	s.	d.
Removing scrub and rhododendrons, 100 acres at 72s. 5d.	362	3	9
New drains—600 chains, over 100 acres at 3s. 11d. per chain....	117	10	0
Repairing drains, 81 chains at 5s. 1d. per chain	20	8	4
Planting—100 acres at 48s. 6d. per acre	242	10	0
Beating-up—100 acres at 9s. 1d. per acre	45	8	4
Weeding—June 1930, to August 1944, which operation also includes cutting back rhododendrons, at 43s. 6d. per acre	217	10	0
Setting up Douglas fir and removing blown scrub, December 1932, to May 1933	21	4	4
Total cost of operations mentioned	1,026	14	9
Total cost per acre	10	5	4

In the treatment of the 38 acres which, as already mentioned, were planted with Douglas fir in groups or blocks, two distinct methods were adopted, which I shall describe as methods 1 and 2.

Method 1

Groups were made by cutting holes in the rhododendrons, between the edges of which were left ten to twelve feet of uncut rhododendrons. In these groups, which are about twelve feet in diameter, sometimes 13 and sometimes 16 Douglas fir plants were planted, the Method being, of course, the "Anderson" Group System.

Method 2

This method comprises groups of various sizes, the larger of which may be termed blocks, planted at 4½ to 5 feet spacing. It appears that some of the plants were planted in these groups, or blocks, after openings had been cut in the rhododendrons for the individual plants. Between the edges of these groups, or blocks, are margins which vary considerably in width and shape, in which the rhododendrons received no treatment.

Method 3

In P.36 the strip method was carried out, which, for reasons of comparison, let us call Method 3. Here strips, 30 feet wide, were cut in the rhododendrons, the distance between these strips, in which the rhododendrons were not cut, being 20 feet. The 30-foot strips were then planted with Douglas fir at 5½-feet spacing.

Comparisons

Method 1 was carried out on a part of the area where old scrub trees were absent, or were few in number, which, naturally, assisted greatly in the uniformity of the groups, which uniformity is maintained over the whole area under this group method. It is evident also that the absence, or scarcity, of these old trees contributed greatly to the even development of the groups. This method has utilised the ground very effectively, and as failures have been almost negligible, there are very few unproductive blanks, which are so often found among rhododendrons. The groups have also succeeded in killing out almost all the rhododendrons in or around them.

As regards choice of species, Douglas fir has proved a very successful tree for this group system in rhododendrons. Admittedly, the trees in the centre of the groups tend to become suppressed and, in most cases, the trees which will form the final crop will not be those in the centre of the groups, but, nevertheless, there are available in each group sufficient choice stems to form a satisfactory final crop.

The height of the average tree in those groups is 40 to 45 feet, and a combined cleaning and light thinning is at present (1949) being carried out. Care is being taken not to reduce needlessly the valuable shade which is now present, and only those trees whose presence is definitely harmful to the select stems, and those that are badly suppressed, are being removed.

On the whole, this group system has proved very successful in overcoming the rhododendron problem, and it would appear that the method would be equally useful in scrub, where large trees would not make impossible a fairly regular spacing of the groups.

Method 2 was carried out on a part of the area where old scrub trees are fairly numerous. The shade of these old trees (the crowns of which must have spread considerably since the area was planted, and too few of which were girdled, or removed, at the initial stage), though not sufficient to retard the rhododendrons, was, combined with the shade of the rhododendrons, too great for the young Douglas and, under these conditions, some fairly large blanks have occurred. In these blanks, the dead Douglas plants may still be found among the rhododendrons. These Douglas plants seem to have come away quite well for the first few years, and they were not killed until six or seven years after planting. In some cases, the old scrub trees themselves have been blown down, after having caused all the damage it was possible for them to do. A poor reward for our clemency towards them in the first place.

Owing to the irregularity of the distances between the groups or blocks, in some of which the rhododendrons are still quite vigorous, access to the groups is very difficult and, in some cases, quite impossible until tracks have first been cut in the rhododendrons. The absence of fairly regular spacing between the groups, or blocks, at the initial stage, for which the old scrub trees are not blameless, weighed heavily against the success of this method from the beginning, so far as killing out the rhododendrons was concerned; and though the results in this report equal those in Method 1, the irregular patches of rhododendrons which have not been killed out are evidence that this method cannot be presented as the solution to the rhododendron problem.

Method 3 was carried out in P.36, under conditions similar to those found in Method 1. It has been very successful, and the strips of Douglas, which are closing up rapidly, are already killing out all the rhododendrons within their reach. It is not quite certain if the strips of rhododendrons, will be completely killed out, but this seems probable. It might have been advisable to have made sure of this by reducing, slightly, the width of the unplanted strips.

In the planted strips, many of the Douglas have already reached a height of 25 feet; there are no blanks within the strips, and this method seems to be a very successful one in overcoming the rhododendron problem.

Conclusion

In the foregoing notes, it will be seen that a combination of high scrub and rhododendrons is a very difficult problem, not so much as regards the initial work as in subsequent treatment, and it seems that a well-defined plan, as is found in Methods 1 or 3, is necessary.

In Method 1, where the groups were regularly spaced and of regular size, with close planting in the groups and with no overhead cover, the Douglas fir had little difficulty in getting up and later forming a close enough canopy to kill the untouched rhododendrons between the groups. This even spacing of the groups would not have been attained had the method been tried in areas where old scrub trees were numerous.

In Method 2, the margins of untouched rhododendrons between the groups were often too wide for them ever to be successfully suppressed. Many of the failures of the planted Douglas are due to the combination of suppression by rhododendrons and the overhead shade of the old scrub trees. If the method is to be tried again, it would seem essential to remove the old scrub before planting, and to see that the margins of untouched rhododendrons were never left wider than some ten to twelve feet.

In Method 3, the planted strips were able to get away easily, and tending is made easy by the concentration of the work in strips. The only defect is that the width of twenty feet of uncut rhododendron strips may be excessive and that complete killing out of rhododendrons may require a reduction in this width. The method as employed, however, seems to be successful.

In general terms, therefore, it may be said that Methods 1 and 3 are preferable to Method 2. It is probable that there is little difference in the costs of these two former methods, that both can be successfully employed in dealing with rhododendrons, but that the ease of access and subsequent management inherent in the strip method (No. 3) would favour the adoption of this method in the future.

A NEW PLANTING BAG

By R. J. JENNINGS
Forester, North Wales

AT ST. ASAPH FOREST this year we are trying out a new type of planting bag designed and made locally in an attempt to eliminate the obvious weaknesses of the old type. Constructed of stiff canvas with sides ten inches high attached to a light tin base measuring twenty inches by twelve inches with a gusset at the ends, the planting bag resembles a "hold all".

Two large handles of wire on the top enable the planter to carry the bag easily as he moves forward every two yards to plant a tree, and while he is actually planting the bag is always resting on the ground.

With stronger material in canvas instead of sacking, it should be possible to avoid drying of the roots by wind and frosty air; the flat tin base ought to simplify puddling in dry weather, and by having the bag of trees where they can be handled and singled properly, all dropping and wastage of plants will be avoided.

New tools or appliances are not always popular with the British workman; but we have reason to believe that by removing the load from their backs and thereby increasing their freedom of movement in planting and thus making it possible to plant more trees and earn more wages, our new article may prove to be worthy of further use.

TURF PLANTING OF BIRCH

By D. J. HUGHES
Foreman, North-West England

AT GISBURN FOREST in the West Riding of Yorkshire, an amenity belt of birch planted along a roadside has provided interesting evidence that this species may benefit from planting in turves. As a matter of urgency, some of these birch were planted in turves, and others notched into the ground. The growth and the rich green foliage of the turf-planted trees was striking.

THINNING PLANS

BY F. C. HUMMEL

Mensuration Officer, Research Branch

A PLAN SHOULD be a rational guide to efficient action. In a laudable desire to achieve silvicultural perfection some foresters prepare thinning plans that fail in this object through being too complicated. An acre is selected here, perhaps five acres there; so it goes on throughout the forest every year, and to complicate matters even more, some stands are put down to be thinned again after two years, others after three, four, five or even more years.

What is the alternative? Here is a suggestion. First, divide the forest into as many "blocks" as is necessary to ensure the efficient use of labour and extraction routes. In some forests no such sub-division is necessary. If a forest lies between two villages, each housing part of the workers, and each with a constant demand for local produce, two "blocks" could be formed. Sometimes the position may be more complicated, but the principle remains the same.

Secondly, divide each "block" into three "sections". In any one year all thinnings, and for that matter also other work such as drainage, road repairs, etc., should as far as possible be confined to one of these sections. In that section each stand is inspected and is either thinned or left over for another three years. There is no question of "just leaving it over for another year".

A system such as this has several advantages. Once started it runs on more or less automatically; by concentrating the work in any one year to one third of the area it facilitates supervision, reduces the risk of overlooking odd patches, and it also enables the forester to devote more time to silviculture; and if a wind blow or other calamity forces a temporary departure from the plan, its framework remains intact and it is comparatively easy to revert to it when the emergency has been dealt with.

"Why three sections?"—and "Does the idea work in practice?" are perhaps the two most important doubts that leap to the mind. Let us deal with the second one first.

All permanent sample plot work is now organised on this basis. There are two "blocks" in the sense that I have used the term here; one Scotland and North England, and the other South England and Wales, and a sample plot party operates in each. One or more conservancies form a "section" and in any one year all plots in the appropriate "section" are inspected and if necessary thinned and remeasured.

Many practical difficulties had to be overcome in the three years that it took to get the system working, but now we are more than rewarded for this trouble by the time and petrol we save.

The reason for choosing a three-year cycle is perhaps best explained by considering other possibilities. A two-year cycle is unnecessary even in the fastest growing stands unless previous thinnings have been too light or delayed,

in which case stands should be treated out of turn to avoid wind blows and other calamities. A four-year cycle on the other hand is definitely too long for some stands of fast growth. Thus, three years appears a happy medium, and later in life, as the rate of growth slows down, the three-year intervals can readily be changed to six-year intervals within the framework of the general plan. In some forests of consistently slow growth, and notably where Scots pine predominates, four-year or even five-year cycles may be preferable.

However, these are points of detail. The main point is that a thinning plan, like any other plan, must be simple to be workable, and if it is not workable it does not fulfil its object of being a rational guide to efficient action—And this is where we started!

THINNING BY PIECE WORK
ESTIMATION OF AVERAGE VOLUME PER POLE

Technical Instruction No. 1/49

The investigations of the Costing Research Team have shown that in some of the Commission's forests insufficient care is given to the problem of determining the average volume of a thinning pole for purposes of fixing piece-work rates for felling, trimming out, etc. In certain cases absurdly high piece-work rates have been fixed as a result of over-estimating the average cubic contents of the poles. Faulty estimates also lead to serious discrepancies in the stock-taking returns.

It is not a simple problem; unless the sampling is carried out systematically and the data methodically recorded, it is easy to go far astray.

The following procedure should be adopted in future:—

1. The District Officer or Forester must satisfy himself that the stand to be thinned is sufficiently uniform to enable a satisfactory piece-work rate per score of poles to be paid over the whole stand. If not sufficiently uniform the stand must be subdivided as necessary.

Note.—For the purpose of this Memorandum the term "stand" applies to the whole area to which a given piece-work rate is to be applied. In some cases a stand may extend over more than one Compartment, in others several separate blocks of plantations, provided they are similar as regards species and size, may be aggregated together to form a single stand to which one piece-work rate would apply.

2. The average volume per pole is to be based on the measurement of a total of at least 50 felled trees, selected in groups in different parts of the stand. The number of groups will vary as follows with the size of the stand:—

Under 5 acres	2 groups of 25 trees each
5—10 ,,	5 ,, ,, 10 ,, ,,
11—20 ,,	7 ,, ,, 10 ,, ,,
21—30 ,,	9 ,, ,, 10 ,, ,,
Over 30 ,,	11 ,, ,, 10 ,, ,,

3. A week or more before a gang is due to start thinning, the Forester (or Foreman, if authorised) will traverse the stand after it has been marked for thinning and select the sites for the sample groups. These should be distributed more or less evenly over the stand. At the site of each group, one marked tree of about average size should be selected at random, and it and the nearest nine thinnings to it should be felled and measured (except in stands of under five acres).

If there are one or more Silvicultural Circular No. 22 Thinning Yield plots in the stand concerned, each of such plots can count as one of the sample groups. A circular plot may yield a good many more than ten thinnings, but it only samples one part of the stand. It is still necessary to select groups in other parts of the stand in order to provide a reliable sample. More complete information about the stand as a whole would obviously be provided if all the groups were laid out in the form of circular sample plots, but it is assumed that this would seldom be practicable owing to the work involved.

4. If the thinnings yield poles of two size classes, e.g., Class I and Class II poles, and if it is considered **essential** to fix separate piece-work rates for each size, ten trees of each class (20 trees in all) must be selected and measured in each group.

5. The felled sample thinnings should be numbered with red paint and carefully measured according to the method laid down in Silvicultural Circular No. 22, except that it is unnecessary to record quarter girth at breast height or total length to the tip of the tree. There is also no need to keep crooked poles (firewood) separate. Trees should be left in the length, i.e., not cross-cut. It is the responsibility of the Head Forester or District Officer to check the positioning of the groups and the measurement of the sample poles.

Note.—The instructions in this paragraph refer only to groups which are not laid out as Thinning Yield plots in accordance with Silvicultural Circular No. 22.

6. Provisionally, i.e., until separate forms are printed, Form T.Y.3 should be used for recording, with indelible pencil, the measurements of each of the sample poles. Volumes should be given in Hoppus decimal feet.

7. If the stand contains one or more circular thinning yield plots, it is not necessary to copy the thinning measurement data on to the form used for recording the sample groups. If a thinning yield plot contained measurements of, say, 24 thinnings totalling a volume of 48.45 cubic feet, it will be sufficient to enter these figures at the end of the list and add them in to arrive at the total.

8. The volume of all the poles measured and recorded on form T.Y.3 will be totalled, and the average volume obtained by dividing the total volume by the number of trees. This average volume should be entered at the foot of the form. The forms are to be carefully filed for record.

9. The piece-work rate, which should be fixed at so much per **score** of poles, must be approved by the District Officer (or Head Forester) and not varied without his consent.

FORESTRY COMMISSION
25 Savile Row,
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June, 1949

PRUNING OF OAK

By J. G. WASS

Forester, Research Branch

SAMPLE PLOT NO. E.91 in the Forest of Dean, Gloucestershire, was visited in January 1949, and observations were made on the pruning which was carried out in 1928 when the oak was 70 years old. The pruning was done whilst the plot was being thinned—this plot is thinned to a heavy (D) grade—and the wounds dressed with tar. Reports on the pruning given in 1933 and 1938 both mention that the rate of occlusion was slow.

Observations in 1949 were mainly confined to thinnings since these afforded more easy access, although several standing trees were inspected. A table has been prepared giving information on the occlusion of the trees inspected, from which it will be seen that in all cases of small branches pruned, healing of the branch wounds was complete. Occlusion occurred more slowly in the case of the larger branches. Usually where it was found that serious rot had set in following pruning, the branch scar was observed to be at such an angle as to allow easy penetration and collection of water. This was also seen to be the case on several of the standing trees.

There was no evidence that aspect influenced the speed of occlusion, although it must be pointed out that this plot is well sheltered on all sides, but it was observed that dominant trees appeared to occlude more quickly than sub-dominants. This is thought to be due to the more vigorous radial growth of the dominant class tree.

On smaller scars there was no indication of swelling where occlusion had taken place. The larger scars (over 3″ diameter), were raised $\frac{3}{8}$″ to $\frac{1}{2}$″ conical fashion at the centre of the occlusion, giving a ridge-like appearance. In all cases the swelling appeared to be confined to the area of occlusion only.

The presence of the ridge-like swellings running along the centre of newly occluded wounds, and the lengthwise slits on wounds partially occluded, which were observed in Plot E.91, show that on oak, the speed at which the callus grows over the wound surface varies with position, growing fastest at the sides, not so fast at the top edge, and slowest at the bottom edge. This is thought to be caused by the movement of sap running alongside the wound setting up irritation, and greater cell activity. Secondly, the sides of the cells of the stem cambium are cut lengthwise and, since the division of the cambium cells naturally occurs parallel to the longitudinal direction, the healing over must occur most rapidly where the edges of the wound run parallel to the direction of the fibre, and slower where the fibres are cut at right angles.

When any branch is removed from a tree, there occurs at the edges of the wound the rapid growth of the youngest bark parenchyma cells. Under the influence of wound irritation, the cambium adjacent to the edges quickly forms swellings which gradually grow wider until they cover the wound surface. The wood covering the wound, however, does not grow together with the wood of the wound surface, but adheres to it.

It is sometimes said that when green-pruning oak, if the cut is made through the base of the branch swelling, the wound will heal more quickly than if the cut is made above the swelling, even although the area of the cut surface may be increased. The reason for this is that when the cut is made flush with the stem and through the branch swelling, it runs with the direction of the fibres; whilst if the cut passes above the swelling, the fibres are cut at right angles (the fibres

at this point running in the direction of the branch) and fibres cut lengthwise heal more quickly than those cut across. Had accurate records as to the condition of the branches pruned in 1928 been made, it would have been interesting to see if the oak in Plot E.91 support or contradict this view.

The speed of healing depends on several factors:—

(i) The season in which pruning is carried out largely influences occlusion. Zederbauer (quoted from Mayer-Wegelin), observed that healing was slow when trees were pruned in October, and it is thought that this might be explained by the fact that, at this season, the wound surface would be exposed to frost, possibly resulting in the cambium at the edges of the wound dying back and so increasing the wound surface, whilst at the same time the activity of the tree would be at a low ebb. Of pruning experiments on oak carried out in January, March, April and August, Zederbauer states that the healing process was most rapid in the March/April pruning. The explanation here would appear to lie in the fact that sap flow was greatest at that time thus rendering occlusion more rapid. It is thought possible that in the case of summer pruning the cambium at the wound edges might be exposed to sun-scorch, resulting in the dying back of the cambium and so retarding occlusion.

(ii) The natural vigour of the tree, having regard to age, is thought to have considerable effect on occlusion. It has been observed that dominant trees occlude more rapidly than sub-dominants. Also if a tree is pruned at an age when its growth is at its maximum, then it is thought that the vigorous nature of the tree at this stage will make for more speedy healing of wounds.

(iii) Wegelin (1) claims that the speed of occlusion is affected by the position of the wound on the stem, i.e., wounds in the crown and slightly below it are said to heal over rapidly, while with an increase of distance from the crown the healing is slower. Presumably this implies that the tree is more active in the crown, and that the lower the wound is from the crown the less active that particular area of the tree, and therefore the slower the occlusion. The observations of the oak at Bradley Hill did not support this statement with the exception of tree No. 15.

Considerable importance is attached to the question of duration of healing for it is during this period that the tree is open to attack by fungi or bacteria, and therefore the shorter the period of the healing process the less chance of infection by fungi, etc. Furthermore, it has been observed on trees where occlusion has taken place at a very slow rate that the callus ring has piled up in a ridge-like manner forming a cup round the wound. This enables water to collect, which of course encourages rot and has a nullifying effect on the healing process.

Wounds should be dressed with coal tar, lead paint or some other preparation. It appears that coal tar has been the most used preparation for this purpose and although it may not necessarily accelerate the healing process, it does not impede or delay it; to a large extent it prevents the enlargement of the wound by protection from frost and sun (the effects of which would be to rupture the internal cells of the cambium) and thus it ensures the undisturbed course of the healing process. Wegelin states that the application of coal tar sets up an irritation which brings about an increase in cell activity thus rendering occlusion more speedy. Zederbauer observed that the dying of tissue around the wound after autumn pruning was stopped to a considerable extent after the

wounds had been well tarred. Personal observations on fruit trees, however, prove creosote to be too toxic for use as a wound dressing.

Special mention should be made of the removal of forks or other branches set at an acute angle to the stem, which results in leaving a wound surface at an angle to the stem and not flush with it. (See table, Tree Nos. 5, 17 and 24.) As has already been pointed out, the process of occlusion will be retarded owing to the cutting of the fibres at right angles. Furthermore, as the callus ring forms, the wound takes on a cup-like appearance which enables water to collect in the lower part. Not only does this water aid rot but it also has the effect of causing the callus to grow up from the edges of the wound vertically, so increasing the depth of the wound and providing a greater area for the collection of water. In this connection, having in mind the profitability of pruning, since it is only deemed economic to prune final crop trees, it is hardly to be expected that forked or badly branched trees would come into this category. It would seem then that the problem of pruning treatment for such trees would rarely arise since they would usually be removed in thinning.

A study of natural pruning by Gelinsky (quoted from Mayer-Wegelin) gives the following observations. When a branch becomes suppressed the tree prepares for its death by developing a protective layer at the base of the branch, which envelopes it, thus protecting the activity of the living wood. At the base of the branch there is formed a narrow yellow zone which arises through the stopping up of the cells with yellow tyloses. In the spring of the second year the first visible formation of wound gum begins in the parenchyma cells next to the cambium between the cells stopped up with the tyloses. In hardwoods, this layer is completed within two years. The formation of this protective layer begins in the cambium of the branch and penetrates from the outside towards the pith. It only takes place in living cells, so that there is no protective layer developed in the heartwood. It would seem from this that the larger the branch, the greater the area of the heartwood and, by comparison, the lesser the area of active cells forming the protective layer. This natural protective layer might be used to advantage in pruning operations in oak and other hardwoods. For this purpose the pruning would have to be carried out in two stages. Firstly, the branches to be pruned would be shortened to from one to two feet in length, leaving a leafless stump. Such stumps would not form any callus plate over their cut surface and, even if shoots were produced from dormant buds, it is thought that the tree would react in much the same way as a suppressed branch in natural pruning; the nutrients being conducted from the higher crown branches past the lower branch, which would have lost or radically reduced its function, and a protective layer of tyloses being formed at the base of the branch. This first stage in the pruning could be carried out concurrently with thinning.

The second stage, namely that of cutting the stump flush with the stem and the application of antiseptic, could be carried out during the next thinning, by which time the stump would be dead or in such a moribund condition that the natural protective layer at the base of the stump would be formed. Although it is thought that occlusion would be more speedy in the case of the pruning of a live branch, it is for consideration whether the advantage of the natural protective layer created by pruning in two stages, as above, would offset the longer time taken for healing.

The following salient points arise out of the observations made:—

(i) *Size of Branch Pruned.* Branches up to four inches diameter occlude readily, whilst those of greater dimension occlude more slowly. This is because the cell activity is relatively greater in the case of the smaller

branch, i.e., there is more sap wood in relation to the area of the wound, and points to pruning being carried out while the tree is still comparatively young.

(ii) *Vigour of Tree.* It has been established that dominant trees occlude more rapidly than other classes. As the final crop would be composed of dominants making rapid radial growth, which are of the main economic importance, then it is probably profitable to restrict pruning to this class.

(iii) *Season of Pruning.* Pruning should be carried out in the spring so that advantage may be taken of the greater cell activity in the tree at this season, and also to eliminate damage by frost and sun-scorch.

(iv) *Crown.* The removal of live branches should not be too drastic. An over reduction in the crown of a tree results in considerable loss of increment and possibly slows down the healing process. In cases where the removal of a large number of green branches is desired, it is advisable to carry out the pruning in stages so as not to reduce the assimilation area of the tree too much at one time.

(v) *Treatment of Wounds.* Antiseptic should be applied *immediately* pruning has been carried out so as to avoid infection and the effects of frost or sun-scorch on the exposed surface.

REFERENCE

Mayer-Wegelin, H. *Pruning.* Translated from the German by C. P. de Blumenthal. Division of Silvics, U.S. Forest Service, Translation No. 264, 1936. (Forestry Commission Library at Alice Holt.)

OCCLUSION OF PRUNED TREES

Plot E.91 Bradley Hill, Forest of Dean

Tree No.	B.H. Girth inches	Tree class *	Branch No.	Diameter inches	Height of Branch (feet)	Aspect	Remarks on Occlusion
5	39½	132	—	7	15	SW	Occlusion very slight. Rot 2½″ deep at base of scar.
17	44	132	—	9	15	NW	No occlusion. Rot to 2½″ depth. Branch not pruned flush with stem.
24	37	222	—	6	21	—	Occlusion very slight. Rot to 5″ depth.
83	43	132	i	11	13	W	Partial occlusion. Rot to depth of 2″ at base of scar.
—	—	—	ii	—	—	All	Few small branch scars completely occluded.
49	29	323	—	3	19½	N	Occlusion complete except for small slit in centre, ⅛″ wide, in which rot of 1″ depth was present.
35	38	222	—	5	22	—	Occlusion very slight. Incipient rot on surface.
116	61½	121	i	3½	31	SE	Occlusion completed except for very small slit in centre, ⅛″ wide, in which trace of slight rot was found.
—	—	—	ii-viii	1½–2½	17½–34½	All	Branch scars completely occluded.
54	37½	222	i	2	23½	—	No occlusion. No rot. Wood still sound.
—	—	—	ii	2	27	—	Slight occlusion. No rot. Wood still sound.
34	34½	132	—	2–4	10–26	All	Several small branch scars completely occluded.
51	34½	222	—	—	—	All	Few small branch scars completely occluded.
65	35½	132	i	3	22	S	Completely occluded.
—	—	—	ii	2	27	SW	Completely occluded.
80	25½	323	—	—	—	—	Few small branch scars completely occluded.
97	37½	222	—	—	—	All	Few small branch scars completely occluded.
106	31	313	—	—	—	All	Few small branch scars completely occluded.
130	38½	222	—	1–2	—	All	Few small branch scars completely occluded.
139	47	121	—	2–4	10–22	All	Few small branch scars completely occluded.
143	40	122	—	5½	23	N	Completely occluded.
145	37	112	—	4	22	N	Completely occluded.
149	42½	131	—	2–4	10–23	All	Several branch scars completely occluded.
171	30½	323	—	2	10 & 16	NW	Two branch scars completely occluded.
175	34½	212	—	3	20	N	Completely occluded.
187	43	111	—	1–2	—	All	Several branch scars completely occluded.
15	50½	132	i	6	10	W	Occluded up to small gap 1½″ × 5″. No Rot.
—	—	—	ii	6	14	SW	Occluded up to small gap. 1 ″ × 5″. No Rot.
—	—	—	iii	7	21	SE	Completely occluded.
—	—	—	iv	6	24½	N	Completely occluded.
—	—	—	v	11½	27	NE	Completely occluded.

* *Tree class*:
1*st digit*: =1—Dominant, 2—Co-Dominant, 3—Sub-Dominant, 4—Suppressed
2*nd Digit*=*Stem form*: 1—Good, 2—Medium, 3—Poor
3*rd Digit*=*Crown*: 1—Good, 2—Medium, 3—Poor

PRUNING OF CORSICAN PINE

By D. E. EARL
Foreman, Research Branch

THESE OBSERVATIONS AND opinions are based on visits for sample plot purposes to Corsican pine plantations in the North, South and East of England.

At Gravetye, Sussex, a 58-year-old crop, height 100 feet and stocking at 128 trees per acre, has whorls of branches at 5 feet from the forest floor on most trees; these branches are sound and unlikely to drop off for many years. Whorls of branches persist right up to the live crown at 60 feet.

In sample plots of Corsican pine thinned to various grades, including A grade (which is control, no thinning of live trees), branches persist from the bottom to the tops of the trees unless interfered with artificially; the dead branches simply do not drop. Where plantations of clean Corsican exist some pruning has been carried out.

Mistakes in silvicultural technique are usually difficult to correct and this is particularly exemplified with regard to pruning; it must begin early. Many of our young plantations are ripe for pruning, and if the decision is taken not to prune, it will be left to posterity to regret our inaction—but not to correct it.

The best time at which to commence pruning in this species appears to be immediately after the first thinning, the forester can then distinguish between the sheep and the goats (I feel like adding wolves here). The final crop cannot be picked out at this stage, so more trees are selected for pruning than will ultimately be required; about 250 to 300 per acre are pruned in our sample plots. For marking, a daub of lime-wash on each tree gives good results and is very cheap. It has the advantage that it washes off again and does not permanently disfigure the tree as paint does.

Provided that brashing has been carried out previously, the pruners can clean 12 to 15 feet of stem from the ground with long-handled saws. On the whole, spurs of branches, colloquially known as "hat-pegs", are not desirable, so the pruners should move around the trees and not do half a tree from one standing position. A further pruning should be carried out after a thinning some years later, when the top height of the crop is about 40 to 45 feet; then the spacing of potential final crop trees must be observed, as fewer trees per acre will get this treatment. At this stage, trees should be pruned a further 10 to 12 feet, probably at the expense of a branch or two of live crown; experience has shown that this does not affect the health of the tree, and that these scars occlude very rapidly.

As before, long-handled saws may be used; additional equipment should be light ladders and safety belts. The ladders must be fixed vertically to the tree and to facilitate this, a chain fixed to one rail of the ladder with a coupling on the other rail is recommended. Right-angle brackets are fixed to the back of the ladder to keep it away from the tree by three or four inches. The pruner can climb the ladder and fix the chain to the coupling around the back of the tree, he can then climb to the top of the ladder, fix his safety belt and commence pruning. A safety belt ensures the safety of the man, and also enables him to lean back and devote his whole attention to the pruning.

In sample plot work we have ten-foot sections of ladders as described; these slot into each other and have chains midway along each section. One man can handle 20 feet of ladder once he has mastered the art of balance.

Actually one 15-foot section with two chains would, I think, be ideal for pruning work.

Operational costs need not be prohibitive. The first pruning is especially suited to piece work and one man should do 50 trees a day, or an acre per week. The second pruning should not cost more than £5-£8 per acre if 100 to 150 trees per acre are tackled, but the actual figure will vary greatly according to circumstances.

If high pruning becomes the vogue, I would like to offer a plea for shrubs and bushes to be left in the plantations, as apart from silvicultural considerations the plantations do tend to look a little more like timber factories when pruned; under-growth does improve the aesthetic value of the woods and also gives more cover to wild life.

In this argument for pruning, I have chosen Corsican pine because it seems to be a particularly good example of the exotics which do well in this country, but tend to need care and attention if we are to market them as equivalent to imported timber. The pruning of other species of better quality such as Sitka spruce and Douglas fir is likely to pay even bigger dividends.

Pruning should result in an increase in revenue to the growers, more than covering the operational costs. Failing adequate financial remuneration, the growers are at least assured of eager buyers, and have the satisfaction of knowing that their produce is as good as it is possible to get. The growers can also commend themselves on enhancing the value of British timber and thereby consolidating the prestige of British forestry.

GROWTH COMPARISONS OF SCOTS AND LODGEPOLE PINES ON HEATHER AREAS AT GWYDYR FOREST

By D. L. SHAW
Foreman, North Wales

AT ELEVATIONS OF between 800 and 950 feet on the Glyn area of Gwydyr Forest, some interesting and indicative comparisons of the growth rate and vigour between Scots and lodgepole pines can be observed. Site factors are almost identical for both species over the area chosen for observation.

Location, General Topography and Vegetation

Before setting out the observations, I will briefly describe the condition and geography of the area. The Glyn area ranges from 650 feet at points nearest the London-Holyhead road (A5) to unplantable bare rock and scree at over 1,400 feet. The planting limit nowhere exceeds 1,100 feet, the ground above being generally unsuitable and too exposed for successful tree growth.

The highest ground is on the west of the area, and consists of a range running almost due north to south. Exposure is severe, particularly from the south-west, and a high rainfall is recorded annually at Capel Curig nearby.

Generally, the area consists of a series of fairly steep gullies divided by heather-clad ridges, with a symmetrical knoll rising to 1,050 feet at the northern end.

Over practically the whole area lies peat of variable depth, from four inches to over seven feet, and the low ground in the bottom of the gullies and sheltered depressions is very sour. Intensive drainage has been necessary. Planting was carried out between 1928 and 1931.

An interesting point has been the change in vegetation. Prior to 1928 the land was grazed, and vegetation was restricted to dwarf furze, bracken and light heather. Shortly after enclosure and the exclusion of stock, dense heather and gorse developed on areas which previously appeared to be grass or grass-bracken communities; and today little bracken can be found. The vegetation is now largely *Calluna*, with *Scirpus caespitosus*, *Molinia caerulea*, and *Nardus stricta* in association; and some *Myrica gale*, *Agrostis canina*, and sedges and *Carex* species on the better ground.

Growth Comparisons at 800 feet

Three separate plots of P.30 were chosen at this elevation, and the measurements taken over an area of one square chain.

PLOT A

Aspect:—West. Exposure:—Moderate.

Vegetation:—*Calluna* dominant with some gorse, *Scirpus* and *Erica tetralix*; *Hypnum cupressiforme* and *Polytrichum commune*. Average annual growth for last two seasons: Scots, 7 in.; lodgepole, 8 in. Average height: Scots, 14 ft.; lodgepole, 15½ feet.

Notes.—Both species showed much check in early years.
Despite only moderate exposure, Scots pine showed a coarser branch formation than lodgepole, and more effect of wind-blast. Good seed from lodgepole pine was collected from this area, although not in any great quantity.

PLOT B

Aspect:—South-west. Exposure:—Not extreme.

Vegetation:—*Calluna* and gorse constant, with casual *Scirpus*.

Average annual growth for last two seasons: Scots, 10 in.; lodgepole, 7 in.

Average height:—Scots, 15ft.; lodgepole, 13 ft.

Notes.—Less exposure at this point; the amount of gorse is greater. Both species are windfirm and vigorous. Scots is at present the faster grower. Lodgepole seemed slower on the sites where gorse occurred to a greater extent than in Plot A.

PLOT C

Aspect:—South-west. Exposure:—Severe.

Vegetation:—Almost pure *Calluna* with accompanying moss *Hypnum cupressiforme*. Average annual growth for last two seasons:—Scots, 6 in.; lodgepole, 11 in. Average height:—Scots, 10 ft.; lodgepole, 16 ft.

Notes.—This plot on the 800-foot contour is particularly severely exposed, being along the crest of a ridge with no shelter from the prevailing south-west winds. Scots coarsely-branched, slow of growth and with a high proportion of malformed stems, have suffered blast effect to a greater degree than lodgepole; again, as at Plot A, abundance of *Calluna* and absence of gorse, seem favourable to lodgepole pine. Many good seed trees of both species.

Growth Comparisons at 900 feet

Two plots were chosen at this altitude, and soil pits taken out within their area. As with measurements on the 800-foot contour, an area of one square chain was examined.

PLOT D

Aspect:—West. Exposure:—Well sheltered by Sitka spruce.

Vegetation:—*Calluna* slight, *Erica*, *Vaccinium* and *Scirpus caespitosus*; *Rhacomitrium* and *Hypnum cupressiforme*.

Average annual growth for last two seasons:—Scots, 10 in.; lodgepole, 12 in. Average height:—Scots, 19 ft.; lodgepole, 18 ft.

Notes.—Here, despite a westerly aspect, there is ample shelter from a belt of twenty-year-old Sitka spruce. There is little to choose between the two species, but lodgepole pine has better stem form with a well-knit and clean branch formation, and its development in later years has been more rapid.

Soil Profile of Plot D

Litter: 4 inches, pine needles, etc., not decomposed.

Duff: 8 inches, partially decomposed organic matter.

Brown peat: 3 inches, a thin crust above main peat layer.

Black Peat: unknown depth, close heavy black peat, completely decomposed.

PLOT E

Aspect:—South. Exposure:—Moderately severe.

Vegetation:—*Calluna* and *Erica* constant. *Scirpus* and *Molinia*; *Polytrichum* and *Hypnum*.

Average annual growth for last two seasons:—Scots, 5 in.; lodgepole, 8 in. Average height:—Scots, 13 ft.; lodgepole, 15 ft.

Notes.—As on the 800-foot contour, Scots pine have been slower growing and are coarser branched, but are showing a quicker growth at present after a period of check. The soil profiles did not vary greatly, but less partially decomposed litter was found in the duff zone of Plot E, and the peat itself was coarser and moister.

Soil Profile of Plot E

Litter: 3 inches (pine needles, etc.).

Duff: 4 inches. Considerably less than in Profile (D).

Light brown peat: 6 inches. Moister than in Profile (D) and denser.

Black Peat: 12 inches. Coarser than in Profile (D).

Summary

Calluna was dominant at nearly all the points chosen. Vegetation in association with it has varied, but *Erica tetralix*, *Scirpus caespitosus* and the moss *Hypnum cupressiforme* have consistently been present. Where gorse has entered as a major part of the vegetation, as in Plot D at 800 feet, lodgepole pine seems to have a slower rate of growth. The following conclusions are arrived at:

(*a*) Lodgepole pine seems much healthier than Scots, particularly on pure *Calluna* in association with *Scirpus caespitosus.*

(*b*) Lodgepole pine stands long, dry periods better. For instance, in the long dry summer of 1949, at nearby Bryn Engan plantation, lodgepole pine survived the drought and other plant forms succumbed.

(*c*) Scots pine is more susceptible to wind blast.

(*d*) Good seed is found on lodgepole pine, although not in any great quantity, where Scots pine seeding was poor.

(*e*) Much cleaner stems on lodgepole pine, with little or no mis-shapen terminals, and good stem form.

(*f*) The most serious damage to Scots pine seems to have been inflicted in the severe ice-storm of January, 1940, when the trees were just emerging from a check period and were still near enough vegetation level on the ground to sustain a good deal of the weight of the ice. This has resulted in bad forking and malformed crowns.

THE SELECTION OF SITES FOR JAPANESE AND HYBRID LARCHES

By JAMES MACDONALD
Director, Research and Education

THE JAPANESE LARCH, so far, has not presented the foresters of Great Britain with any major problem, for throughout the time it has been in cultivation here it has not been the victim of any serious disease or insect attack. What difference lies between it and the European species, preventing the occurrence of anything like the die-back disease, is something which has still to be satisfactorily explained. The silviculture of the Japanese larch, in its early stages, is beginning to be better understood, and its value as a pioneering crop appreciated; it is not difficult to handle in the thinning stage, but we have no experience of it as a mature tree and we do not know what the young plantations will eventually lead to. In this, we have nothing to guide us in the experience of other countries where it has been grown as an exotic, and, oddly enough, it has not been studied in much detail by the Japanese themselves, who do not seem to regard it as a very important tree. A study of the Japanese larch in its native habitat by someone with an up-to-date knowledge of European forestry might give valuable results.

Where European larch will grow and where you want larch timber, then there is no point in growing the Japanese species, but if you want larch timber and are doubtful whether the site you have in mind will quite suit the European tree, then you can try the Japanese. The timber will not be so good, but it may serve the purpose. That is the first use that Japanese larch may be put to in British forestry; it may be employed as a substitute for European larch on certain sites. Among these are sites which are subject to slight atmospheric pollution, and sites which are affected by winds from the sea.

The second use which can be made of Japanese larch is in the afforestation of bare land. This species, though requiring a fertile soil for its fullest development, is remarkably accommodating and will tolerate a wide range of soil conditions. It throws a heavy shade and this, together with its wide-branching habit, makes it a useful tree when there is need to kill off the surface vegetation as soon as possible. It has proved effective on *Calluna* and *Vaccinium* sites and has even grown, though not with striking success, on sites where there was an admixture of *Scirpus caespitosus* in the vegetation.

Thirdly, Japanese larch, because of its rapid initial growth, its habit and heavy shade which it casts, can be used successfully in the afforestation of areas where the weed growth is heavy, such as old coppice land or sites where bracken is abnormally luxuriant.

The Japanese larch is sensitive to drought, and may suffer severe losses in seasons of low rainfall. On the Bunter sands of Nottinghamshire, where it was planted on a fairly large scale in the late twenties and early thirties of this century, mainly because it could resist smoke, it suffered very severely during the dry years of 1932-34 and died in large numbers. This phenomenon was also observed about the same time in parts of East Anglia where the rainfall is low. It is also noticeable in south-eastern England that, although the Japanese larch grows well initially, once it has reached the pole stage it tends to stagnate, to fall off in growth, and to become unresponsive to thinning. It may be that it dislikes the more continental climate of that region, and that high summer temperatures as well as low rainfall may have some part in its relatively unsuccessful development. There are thus good reasons for planting

Japanese larch in the north and west of this country, but even in areas of high rainfall, spells of drought may cause damage to young trees, especially when they are flushing in the spring. Older trees, too, have been known to suffer after prolonged spells of dry, hot weather when their foliage may wilt and then shrivel.

In planting Japanese larch, frosty sites must be avoided because it is easily damaged by frost. It has a great advantage, however, over European larch, (as our Bulletin 18 on Spring Frosts points out) because it has much greater powers of recovery from this kind of injury and can often repair quite severe damage in one growing season. Nevertheless, a prudent forester will keep it out of obviously frosty situations.

One feature of Japanese larch plantations is the extraordinary variation which they show in respect of the form and habit of the individual trees. Many plantations, even in moderately exposed places, are made up of individuals with straight stems and fine branches; others, even in sheltered places, are composed of trees of which the majority are twisted, wavy, forked and otherwise defective. Twist and waviness of the stem are possibly commoner on the more fertile soils, but good types of Japanese larch are not unknown in such circumstances. This feature is one which requires further investigation.

In the management of Japanese larch plantations, heavy thinning in the early stages is the best policy, because this tree is greedy for space and responds rapidly to each opening of the canopy, but on the other hand it will stand closer than European larch, without thinning, before it shows signs of suffering from the crowded competition. Later thinnings should also be on the heavy side, so long as the crop continues to respond actively.

It has been suggested that Japanese larch could be used as a nurse for other species, notably hardwoods. Although there are theoretical arguments in favour of this suggestion, the truth is that Japanese larch is a very dangerous tree to use as a nurse. It grows rapidly, it requires much space, and it throws a shade heavy enough to suppress, and even kill, species like Douglas fir and beech. Even in mixture it is a tree which is difficult to control.

In its youth, the Japanese larch grows rapidly, but until recently we have believed that its height growth slackened at a relatively early age, so that after about thirty years it was exceeded by the height growth of European larch of a comparable quality class. Dr. Anderson, in a paper in 1939, denied that there was any marked falling off in the height growth, and more recent investigations have shown that he was substantially correct. The earlier yield tables were influenced by the fact that a high proportion of the older plot measurements were drawn from stands in the south-east of England where there is an undoubted stagnation round about this age, as I have already pointed out. With a large body of fresh data, and with these particular plots excluded, it is seen now that the age-height curves continue normally without any serious falling-off.

Hybrid Larch

So far as the Hybrid larch is concerned, there is little we can say about its silviculture except that it seems, so far, to have behaved very much like the Japanese larch. Dr. Laing, in a paper on the Genus *Larix*, dealing with the morphology of the three species, concluded that the Hybrid larch was a most variable tree, sometimes resembling (in appearance) one parent, and sometimes the other. It was not a constant. Foresters would do well to keep this in mind. It is possible that, corresponding to differences in appearance, there may be differences in behaviour, and these may lead to some disappointments.

Most of the hybrid larch which we have obtained so far have been raised from seed gathered from the Japanese species, but inspection year by year

of nursery seedbeds of European larch, from collections in this country, shows among them an increasing number of plants which are, or appear to be hybrids. With the extension everywhere of the planting of Japanese and Hybrid larches, there is the possibility that we may arrive one day at a stage when it will be difficult for us to obtain seed of European larch which we can guarantee free from contamination with the other species. Since we have in Scotland a type, or types, of European larch worth preserving, it would be a great pity if this stage were ever reached. It may, therefore, be advisable to consider the exclusion of the Japanese and Hybrid larches from one or more selected areas in which the best types of European larch could be grown reasonably free from the risk of crossing. One such area which suggests itself is the upper Dee Valley in the district of Mar, which is shut off from the north, west and south by the wide tracts of high and treeless land.

EXCEPTIONAL GROWTH OF JAPANESE LARCH

By J. G. WASS
Forester, Research Branch

THE FOREST RECORD NO. 1 entitled *Revised Yield Tables for Japanese Larch in Great Britain*, by F. C. Hummel, has no doubt aroused afresh the interest of foresters in this species. Some have probably checked their crops against the graphs and tables and placed them in the appropriate quality classes. Many were perhaps disappointed to find that the crops they manage do not qualify for the "Super" Quality Class and that their forest showpiece is, after all, only mediocre. However, let us look at some of the characteristics of Japanese larch.

It is a tree that will do well on a wide range of sites, and is quite happy on some of the poorer land; but it prefers a fairly deep, firm soil that is well drained. It thrives in hill country and is admirably suited to a high rainfall area. This of course indicates that Japanese larch will do better in the western half of Britain where these conditions prevail, and the Japanese larch in Compartment 4, Brechfa Forest, Carmarthenshire, certainly bears this out.

In this area Japanese larch has been planted extensively, and some has grown extremely well. During October 1948 the Research Branch established a series of three sample plots thinned to B, D and E grades respectively. In other words the thinning grades were light, heavy and very heavy. The function of these plots is for comparison purposes and to provide information for yield tables. The plots are situated on a steep hillside—the angle of which is 20 degrees—600 feet above sea level. The aspect is southerly and the site is moderately sheltered by the crest of the hill to the north and by other plantations to the east and west.

The geological formation of this area is Silurian, and the soil description and depth of root penetration shown by soil pits is:—

Depth in Inches	
0 — $\frac{1}{2}$	Undecomposed Japanese larch needles and twigs.
$\frac{1}{2}$— 1	Decomposing Japanese larch needles.
1 — $2\frac{1}{2}$	A clearly defined layer of dark brown humus.
$2\frac{1}{2}$— 14	A clearly defined layer of light brown silty-loam containing a few angular shaley stones. Soil structure crumb ($\frac{1}{10}$ to $\frac{1}{8}$ inch), porous, friable and moist. Numerous healthy roots of crop were found throughout the layer, up to half an inch in diameter.
14 — 24	Merging. Grey-brown silty loam with many angular shaley stones. Soil structure crumb ($\frac{1}{10}$ to $\frac{1}{8}$ inch), porous and moist but fairly compact. A few small roots of crop reaching down to a depth of twenty-three inches.
24 — 32	Merging. Blue-grey silt and broken rock mixture—gravel-like.
32	Blue shale.

The site is well drained by numerous streams, and it will be seen from the above that the roots of the crop have made a deep penetration of the soil, having a good medium in which to grow.

Prior to planting, the land was used for sheep grazing, and judged by other grassland in the vicinity, the ground vegetation can be assumed to have

been chiefly *Molinia caerulea* and *Deschampsia flexuosa* with some *Nardus stricta*, *Juncus* and sedges, etc., scattered amongst it.

Under cover of the tree crop, the old vegetation has been completely suppressed and replaced by *Viola riviniana*, *Athyrium filixfoemina*, *Thuidium tamariscinum*, *Catharinea undulata*, *Mnium hornum*, *Hypnum* and *Hylocomium* species. This new vegetation covers about three-tenths of the ground surface and is evenly distributed.

The crop was planted in 1937 at a 5½-feet by 5½-feet spacing, and it is surprising to note that when the plots were established in 1948 less than thirty plants per acre had failed. This of course led to the stocking being very dense before thinning, and though the crowns were in direct competition, the crop had not reached a stage where it was suffering from lack of space.

In other words, the crop received its first thinning just *before* the current girth increment of the crop had begun to fall off, thereby making it possible for the maximum increment to be maintained by every individual tree. This was ascertained from the ring count.

While the severity of thinning must obviously vary between plots of different grades, a general description of the condition of the main crop, covering all three plots, will here suffice.

The stocking, canopy and stand density of each plot varies, but is appropriate to the grade. Crowns are deep and well developed on dominant trees, but are rather small and thin on sub-dominants. Average depth of live crown equals 48 per cent. of the stem. Branching is moderately heavy to persistent. Angle of branching in relation to the stem is approximately 80 degrees (i.e., the branches slope slightly upwards).

Stem form is generally good, with some of that waviness that is characteristic of Japanese larch on the better sites. However, the general appearance of the stems has been improved by the pruning of 280 elite stems per acre.

Height growth is still rapid, the average leading shoot for 1948 being 30 inches. The average top height for the plots was 35 feet in 12 years, and individual trees were found to have reached a height of 39½ feet. The average true girth breast-height measurement for all plots was 19 inches, but here again some trees had reached 24 inches.

On measuring the thinnings and main crop sample trees, occasional trees were found to contain as much as three cubic feet of timber, and one stem taken out in the thinning was found to contain more than 3½ cubic feet.

Height analysis showed that on each section the average space occupied by the five outer rings, i.e., the last five years' growth, was 1.3 inches in width. Therefore, in the past five years the butt diameter has increased by 2.6 inches. This means that the girth of the average tree has risen from 9½ inches in 1943 to 17 inches true girth in 1948.

The total overbark volume of timber (including thinnings) produced per acre, up to and including 1948 (12 years) is tabled below:—

B grade—1,474 cubic feet quarter girth
D grade—1,430 ,, ,, ,, ,,
C grade—1,394 ,, ,, ,, ,,

I believe this is the best recorded growth of Japanese larch in this country, and maybe the best in Europe, but the crop is still in its infancy and it is therefore premature to make sweeping statements. This is a crop that demands the attention of all who are interested in the possibilities of Japanese larch in Britain, particularly the foresters of the Welsh Directorate.

THE GROWTH OF BEECH IN RELATION TO TYPE

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

DURING THE COURSE of the past ten years at Wendover Forest in Buckinghamshire and at Collingbourne Forest in Wiltshire, I have made a study of beech growth in relation to type. From the commencement of growth, beech appears to show definite characteristics as to form. This form, I believe, can be definitely classified, and the main types can usually be found in most plantations.

This leads us to the possibility, in the future, of excluding the unsuitable types and seeking the best. The difficulty is to recognise the best type in the early stages and also to prevent the planting of the other types. This appears to call for a selective nursery practice, but today all nursery stocks of beech are almost certain to produce diversified types, as I do not think we yet know sufficient about the subject to be able to eliminate the bad strains from our stocks.

The practice of collecting seed only from elite stands would in time improve the strain. But the mere fact that a seed stand comprises tall, clean trees does not, in my opinion, assure that the seed collected from it will produce trees of a like character. From careful observation of young beech plantations, ranging from one to fifteen years of age, I have noted that in nearly every case there are present three distinct types.

These types can be quite easily recognised by the following characteristics:—

Type A

The fastest-growing trees, usually over the main top canopy; generally but not always, heavily branched with short internodes and coarse branches; buds less awl-shaped than usual with beech; leaf texture coarse, with very marked narrow veining; stem generally with tendency to fork.

Type B

Trees forming the general height of the stand and sub-divisible into two categories:—

I. The same form as type A with less height growth.

II. A finely-branched, evenly-tapered, less rigid type, generally possessing slim lateral branches that form an acute angle with the stem; long internodes; fine awl-shaped buds ; delicate leaf texture with wide veining; a definitely slimmer, more supple, and finer type.

Type C

Trees resembling both the above types, but forming the remainder of the plantation; in older stands usually partially suppressed.

It appears to me that if we can eliminate type A and type B.I, and concentrate only on type B.II, we shall be going a long way towards obtaining the best beech type.

The following table, taken from a stand of P.37 beech, gives a marked example of the difference between type B.I and type B.II; and the very significant point is the marked difference in the amount of laterals of one type over the other.

Tree No.	*Length and Number of Laterals*	*Height*
1*	37 feet—18 laterals	13 feet
2	80 feet—26 laterals	9 feet
3*	50 feet—18 laterals	13 feet 6 inches
4	75 feet—24 laterals	12 feet 6 inches
5*	45 feet—16 laterals	12 feet
6	78 feet—20 laterals	11 feet 6 inches
7*	49 feet—18 laterals	13 feet
8	81 feet—22 laterals	13 feet 6 inches

Trees marked so *, i.e. Nos. 1, 3, 5, 7 are obviously type B.II, whilst Trees Nos. 2, 4, 6, 8 are equally obvious as type B.I. It also appears that height growth is definitely affected by the amount of lateral growth and, contrary to some accepted theories, it is not always that vigour is increased by excessive leaf area. The problem appears to be, therefore, how to eliminate types A and B.I, and whether type B.II will revert to either of the other types. I have studied growth in type B.II carefully, and would say definitely that a tree of type B.II will not revert and will remain true to its fine form.

To sum up, it appears that in seedlings or in transplants the main points to look for are:—

Angle of branch to stem
Length and number of laterals
Length of internode
Texture and veining of leaf
Colour—blue-green and not yellow-green

The length of internode is possibly one of the safest guides. Short internodes should be viewed with suspicion; this is difficult with seedlings, but no trouble should be met in eliminating this type from transplants.

Further, may it not be that too much value has been placed in the past on the old adage that a "stocky" plant should be aimed at? This is, no doubt, true of oak and light-demanders generally, but it should not be overlooked that in natural beech plantations Nature sows her seed beneath the shade of the parent, the natural tendency of the seedling being to grow up under heavy shade and with great root competition—this must tend to bring about the more "weedy" type of seedling; and may it not be that Nature is showing us that by encouraging the whippy slender stock we can eliminate heavily branched beech so prevalent in our forests today?

BLACK ITALIAN POPLARS AT THETFORD

By W. T. WATERS
Forester, Research Branch

SOME BLACK ITALIAN POPLARS felled by Messrs. Cranes of Fransham, Norfolk, were measured by the Special Duty Party of the Research Branch for stem analysis and volume table data. There were two distinct sites, i.e., the Thetford-Mundford road and the Brandon-Mundford road, each site consisting of two rows of trees. On the Thetford road, there were approximately 130 trees on one side of the road and 140 on the other. The Brandon road had fewer trees, having about 150 on one side and 50 on the opposite side. Both sites were split into two distinct rows, having a Scots pine plantation on one side and a main road on the other.

Soil

The soil of both sites consisted of a deep sand overlying chalk. At the time of measuring (May, 1949) the top three inches of sand was completely dry, the rough grass growing on the site acting as anchorage for the sand. This was illustrated by the fact that, at the time of measuring, a high wind blowing across a nearby field picked up so much sand that at the end of the day, after the wind had abated, a large ridge of sand about nine inches in depth had formed along one side of the field.

Vegetation

This consisted mainly of couch grass, with an admixture of Italian rye grass, Yorkshire fog, sorrel, nettles, white dead nettle, yarrow, bracken, stitchwort, vetch and ground ivy. The mosses noted included *Brachythecium purum* and *Hylocomium splendens*.

Aspect and Elevation

The Thetford-Mundford road runs approximately from north-west to south-east, and the Brandon-Mundford road from north to south, and the poplars were situated on a plateau at an elevation of 100 feet, between two river valleys.

Rate of Growth

All trees had these points in common. The growth on the plantation side, up to the thirtieth year (as shown by an examination of the annual rings on the stumps) was similar to that on the roadside; from the thirtieth year growth on the plantation side dropped off, until the forty-fifth year when the trees were felled. This seems to indicate that the establishment of the pine plantations on one side of the poplars gradually affected their growth on that side. The last five years' growth on all trees had dropped to a minimum, with all rings packed tightly together.

On the Thetford-Mundford site all trees on one side of the road and approximately ninety per cent. on the other showed signs of Goat Moth attack. These attacks seemed to be confined largely to the tops of the trees, i.e., between fifteen and twenty feet below the tip. The nature of the attack was shown by the presence of two or more holes—normally two to four, measuring quarter of an inch to half an inch approximately; and oval in shape. These holes led

into channels of varying lengths, from six inches to three feet and occasionally up to six feet. Around the edge of these holes a dark brown stain penetrated into the wood to a depth of a quarter of an inch, which was apparent when the top cut of a tree was made through one of these channels; this happened frequently. A large percentage of the branches on many of these trees were either dead or dying, the dead branches being at the base of the crown and the twigs dying back at the top.

The top heights of the trees measured gave an average height of seventy-two feet. Crown depth gave an average of thirty feet although one tree showed forty-six feet from the tip to the lower branches. This particular tree was growing at the end of the line and had therefore the benefit of unrestricted light and air from three sides instead of the usual two. This site differed from the Brandon road site by having a line of horse chestnut between the trees and the road.

On the Brandon road the crowns were larger than on the Thetford road, where the competition from the horse chestnut was probably responsible for restricting crown size; and the rate of growth remained fairly constant.

That the dropping off in ring width was due to the increasing competition from the Scots pine, was supported by the fact that a large tree situated at the end of the line, which was clear on both roadside and plantation side (a large fire ride opposite) showed no such dropping off in ring width.

Goat Moth attacks on these trees appeared as on the other site, although the number attacked was not so great and appeared to be approximately fifty per cent.

On the east side of the Brandon road, four trees were completely dead. Their ages from ring counts ranged from thirty-two to thirty-five years, and growth up to a year or so before death seemed to be consistent with that of the other trees. The cause of the death of the trees was not apparent, although several of the nearby stems that were still alive bore signs of a white paint-like substance on one side, about three feet from the butt down to ground level; and in the bark crevices an orange rust seems to have developed later. The white substance could be the effects of fire, which might have caused the death of the trees.

The following tables of stem analysis and height analysis figures were prepared from the 341 trees measured, and give average figures per tree.

Table A (Stem Analysis). The form of stem analysis used was a simple one, i.e., a butt ring count on four radii to establish age, and a second count at timber height. Counts at intermediate points were not possible because the trees had not been cut into logs.

The first column of the table gives the ages, and the second column the average volume at these ages. The third gives the average annual volume increment between the ages shown. The periodic annual volume increment per cent., which is shown in the fourth column, gives the periodic annual increments expressed as a percentage of the volumes half-way through the periods to which they refer, e.g., the periodic annual increment percentage for the twentieth to thirtieth years $= \frac{1.16}{(6.93+18.57) \times \frac{1}{2}} \times 100 = 9.1$. The fifth column is the average volume per tree (Col. 2) divided by the age (Col. 1). All volumes are expressed as cubic feet, quarter-girth measure, overbark.

STEM ANALYSIS

Table A

Age in Years	Volume per Tree, cubic feet	Periodic Annual Increments		Mean Annual Increment per tree, cu. ft.
		per Tree, cubic feet	%	
(1)	(2)	(3)	(4)	(5)
0	—	.35	—	.35
20	6.93	1.16	9.1	.62
30	18.57	1.15	4.7	.75
40	30.08			

HEIGHT ANALYSIS

Table B Heights in feet

Age in Years	Total Height	Periodic Annual Height Increment
(1)	(2)	(3)
0	—	2.25
22	49½	1.10
44	73	

Points of Interest Emerging from the Tables

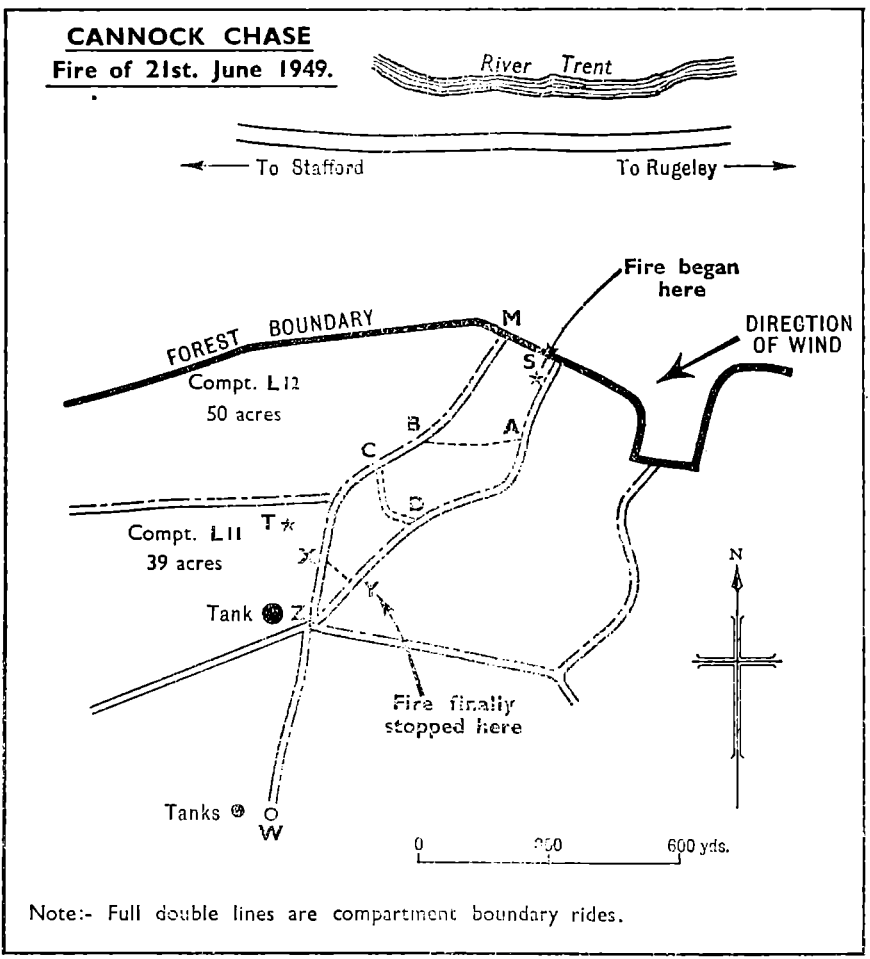
1. Average annual volume increment during the first twenty years has been very small at 0.35 cubic feet. It then remains constant at approximately 1.15 cubic feet from twenty to forty years.
2. Average annual height growth during the first twenty-two years was 2.25 feet compared with only 1.1 feet between the ages of twenty-two and forty-four.

A FIRE AT CANNOCK CHASE FOREST

By W. TRIBE
Forester, North-West England

AT 4.30 P.M. ON TUESDAY, June 21st, 1949, a look-out from the fire watch tower reported signs of a fire about four miles away, in a block of woodland some 800 acres in extent, known as the Lichfield area, and lying at the northern end of Cannock Chase Forest, Staffordshire.

Phone calls from the tower went out to the Foresters and two fire brigade stations for immediate help. A Forestry Commission lorry with full fire-fighting equipment and twenty-one employees were on the scene of the fire within twenty-five minutes, to find that one of the fire brigades had arrived there five minutes before them. The other brigade arrived within a few minutes, with a despatch rider who was immediately sent to phone for more fire tenders.



The total equipment used to fight the fire was:—

(*a*) *Forestry Commission.* A Leyland lorry with Scammel pump and 500 gallon tank. 500 feet of hose and a supply of axes, billhooks slashers and fire brooms.

(*b*) *Fire Services.* Two brigades with 5 fire tenders and 2 water tenders (approx. 500 gallons capacity each).

A good supply of water was available from three static water tanks, one of 800 gallons at point Z (see sketch map) and two of 250 gallons each at point W; and also from the River Trent, 30 chains from the northern boundary of the plantation. Approximately 17,000 gallons of water were used to fight the fire.

The fire had started just inside the plantation alongside a fire line (at point "S") and had obtained a good hold in a crop of Corsican pine planted in 1932, about eighteen feet high, unbrashed and with a thick ground cover of dead and dying heather. A strong north-easterly breeze was blowing across the compartment on rising ground, and the fire had reached a line about a third of the way down the compartment (marked A.B. on the plan). Attempts were made to check the fire along this line with brooms and water, but owing to the intense heat the fire-fighters were repeatedly pressed back.

It was then decided to try and check the flames on a narrow ride (C-D) running across the compartment. Fire tenders moved in and trees were felled, but the flames advanced too rapidly to allow for sufficient felling, and the fire roared overhead, forcing everyone to retreat to safety.

Things now looked very serious and new plans had to be made. By this time the Divisional Officer of the Staffordshire Fire Brigade had arrived and in consultation with the Head Forester, decided on new tactics. The five fire tenders were to be employed on the south-west boundary of the compartment between points C and X, about fifty yards apart, directly in front of the oncoming fire to prevent it from reaching trees in adjoining compartments. Twelve Commission employees were ordered some distance ahead of the fire to cut an alleyway (X-Y) ready to assist the firemen in getting their hoses into action when the fire approached. One fire tender and a Commission pump were placed on this line. Other Commission employees were stationed a chain apart along the line C-X and told to keep a sharp lookout for any sign of fire in the adjoining compartments L.11 and L.12, into which sprays of burning tree tops were being blown by the strong breeze.

The fire tenders were now busy with the flames as they reached the south-west boundary of the compartment (C-X), trying to prevent the fire from reaching the trees on the opposite side of the fire trace. A few moments later the shout went up "Fire over here!" and a spiral of smoke was seen rising about twenty yards inside the adjoining compartment at point "T". Slashers went to work and a way was soon cut for a hose which was held ready to deal with such an emergency. This small fire was quickly extinguished.

By this time the fire had consumed twenty-two acres of the twenty-six in the compartment first involved, but the fire point had been reduced to a fifty yards wide and had reached the alleyway X-Y cut ready for the assault. All the water available was concentrated on the fire front and sides, and to everyone's relief the flames raging thirty feet high and licking twenty feet ahead were subdued.

The main object of confining the fire to the one compartment was achieved by continually facing and fighting the oncoming flames.

All the Commission equipment used was found to be effective, but in a few places on the ride M-Z it was very difficult for two lorries to pass each other owing to the uneven condition of the ground on one side. This fact stresses the importance of keeping the full width of rides in good shape and repair.

Thanks to the Fire Services and Commission employees, a major fire disaster, which could easily have developed, was averted.

FIRE DANGER AT CLIPSTONE

By W. ARNOTT
Forester, North-West England

FIRE DANGER AT CLIPSTONE FOREST can be an exhausting and nerve-wracking affair. Although the most acute period is from early February to mid-May, it is ever present until late October. The soil (amost pure sand) with its accompanying vegetation of gorse, heather, and grass, etc., supplies the tinder for any spark. A low annual rainfall of about twenty-five inches, coupled with frequent high winds, gives a fire an added impetus.

The huge waste tips of the collieries, which touch the fringe of the forest on three sides, burn and smoke incessantly; and the almost constant haze makes it extremely difficult for the look-out to locate fire outbreaks precisely. Added to this, high winds in spring cause severe sand blow, and in some parts visibility is reduced to practically nil. Roads are sometimes blocked with sand drifts up to three feet deep, which severely hamper transport to the scene of an outbreak.

By far the greatest source of fire danger is the railways which bound the main block on three sides and cut through it at other points, so that any change of wind direction gives no respite. Both passenger and goods trains run at frequent intervals throughout the day and night, from about 5.30 a.m. to 11 p.m., or even later when excursion trains run during the summer months from the colliery towns. Touching the north-west edge of the forest, too, is a large concentration siding where colliery waggons are shunted all day without a break, and patrols have a very busy time here. Each train is a potential fire raiser, and can start twenty or more fires on its journey through the forest. Sparks from the engine can be carried eighty to ninety yards from an embankment across the fire belts, to cause fires in the plantations. During bad danger periods fires start as early as 7.30 a.m., usually ending with a Grimsby fish train at 8.50 p.m.

Surrounded as the forest is by collieries, the amount of trespass is large, and just outside the south-west boundary a local model aeroplane club has a weekly rendezvous, bringing large numbers of eager school boys to roam the plantations for lost and wrecked planes. To complete the circuit of danger there is a Royal Air Force bombing range in a section of the east end of the forest, but fortunately, to date, the only damage has been to Forest Workers Holding windows, and a bomb through a farm roof.

Needless to say we welcome any rain, even though it is black with the soot it brings down.

FIRE BEATER STANDS

By J. HISLOP
Forester, North-East England

ON A RECENT VISIT to the North-East England Conservancy the Director of Forestry for England commented favourably on the fire beater stands at Mounces, Kielder Forest. I was therefore asked to make details of the stands available to readers of this *Journal*.

Materials used for one stand were:—

Camouflaged wire netting, one-inch mesh, six feet wide: 46 feet.

Small diameter poles: 1 of 10 feet, 3 of 6 feet, 2 of 5½ feet, 10 of 5 feet, and 16 of 2 feet.

Light spars: 4 of 10 feet, and 1 of 7 feet.

Staples: Tying wire: Four-inch nails: and Rushes.

The netting is cut into two twenty-foot lengths. One ten-foot portion of each is laid out flat and thatched with rushes; the thatch being tied in with wire. The unthatched ten-foot portion is then folded over the thatched portion and suitably tied. This piece forms one side of the roof. Repeat for the other side and form the remaining six feet of netting into a triangle and thatch.

This triangular portion forms the wall on the exposed end. The other end remains open. The above work can be done in wet weather periods, provided one has the thatching material ready for use. When made, the sections are rolled up like carpets to await erection.

The small diameter poles are used to make the supporting structure for the netting. The two five-and-a-half-foot poles are driven into the ground ten feet apart, the ridging pole is then nailed to them. Five two-foot posts are driven in three-and-a-half feet from the five-and-a-half-foot posts, and five five-foot struts are nailed from them up to the ridge pole. Fix four light ten-foot spars over the struts, forming ribs for roof support. Repeat on the other side. The pre-fabricated thatched portions are then stapled on, the result being like a small oblong tent, ten feet long with a sloping roof five feet wide on each side, and a wall one foot high nearly down to ground level, having one end open and the other closed with thatched wire netting.

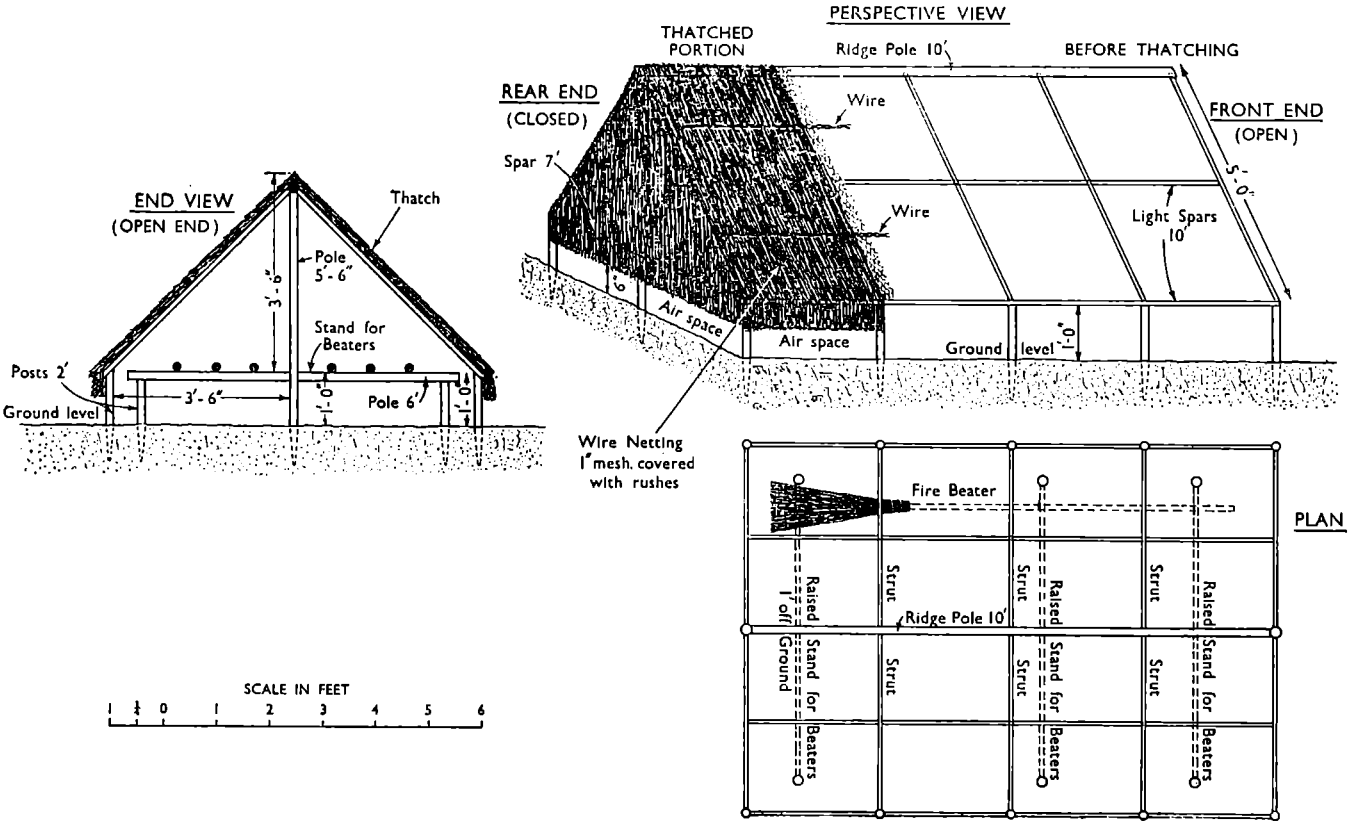
Three short supports, each consisting of two two-foot posts supporting a six-foot cross-bar, are put in to lay the fire beaters on, about a foot from the ground. The beaters are laid in with handles to the open end, to facilitate rapid extraction.

When camouflage netting is used, the resulting erection blends beautifully with the green spruce, and we place a fourteen-foot pole, painted red and white, beside each stand so that strangers can easily find them.

Thatched wire netting can be used for many purposes, such as making ends for ammunition huts now being used for workmen's shelters, and for making shooting butts. The shelters can be made inconspicuous, e.g., by using heather on a heather site. They also have the advantage of material being available on most moorland areas.

On this forest, where the outstanding features of our roads are their lack of width and treacherous verges, there are usually well defined passing and parking places, and it is adjacent to these that we erect most of our fire beater stands.

FIRE BEATER STANDS, MOUNCES.



DEER THROUGH THE EYES OF A NON-FORESTER

By T. CUTHBERT
Clerk of Works, North-East England

I EXPECT QUITE A FEW READERS will have done a bit of deer hunting, but have you ever gone out and watched them at play? I can assure you it is a fine sight. I did this quite often in Germany. Summer nights I have gone out after tea and sat in one of the many hunters' seats built in the forest and just waited for them to come out into the open to feed. The red deer are always led by an old hind, and if you sit very still you will see her head just ease out very quietly and very gently, then a little further until her whole head is out; she will look all round and when sure everything is safe will walk quietly out and start feeding. All that follow her will come straight out, not bothering to look either way. They seem all to trust their leader. I have seen up to twenty in one herd, young and old, and what a lovely picture they make!

When out hunting, never shoot at the first in a herd as it is always an old one. It is the same with the roe or fallow, the female always comes out first and the buck or stag follow. Not very gentleman-like, is it?

I think of all the wild animal life in the forest the red stag takes first place; he looks so proud, and if you can see him during the rutting time I think you then see him at his best. I once saw an old stag bringing in his herd. They had been out feeding in the fields all night and were coming back to the forest just before daybreak; there were about a dozen hinds and three young stags—he had the hinds in front of him driving them on and keeping the young stags behind him. They passed within a few yards of where I was, and I can assure you he looked just what he is, the King of the Forest. The same old stag gave me some very good sport later, stalking him. He had all the cunning and tricks needed, and put them to very good use. I stalked him for weeks, every spare hour I had before I could get a shot at him; he was a lovely animal with a fine head—a sixteen pointer. His antlers hang in my office now.

Another fine sight is to see the young stags fencing; this you can see nearly any early morning when they get back to the forest, their antlers ring like swords, and they can defend themselves. Rather a strange thing about a stag is, if he is wounded in one of the right legs this year, next year it will show on his left antler or vice versa.

All deer do a certain amount of damage in the forest, one bad habit is to nip off the leading shoot of the young trees. I have often seen them do this; they nip it off, chew it, then just let it drop. I have been told the sap they get from this acts as a medicine for them.

RABBITS IN HAZEL COPPICE

ON THE WILTSHIRE-DORSET BORDER, not far from Gardiner Forest, there are extensive areas of hazel coppice, and although the better and more accessible parts are regularly worked and sold at good prices there are considerable areas which are derelict. In these areas it has been the practice for the estate to allow the adjoining tenant farmers to cut the coppice free, for thatching spars and fencing stakes. There was little control of this cutting and the farmers usually cut in small scattered blocks of one quarter to half an acre from the middle of large woods of over-mature hazel coppice. The rabbit population in the woods is high, and the rabbits concentrated on the young hazel shoots, almost exterminating the hazel coppice. Whereas in adjoining areas where the hazel was cut in the normal way, in blocks of two acres or more a year, the damage done by rabbits was almost negligible.

J. F. WILSON
District Officer, South-East England

GREY SQUIRREL DAMAGE

MUCH HAS BEEN WRITTEN about the grey squirrel, the damage it does to plantations, and the various methods of destroying this pest. The presence of the grey squirrel was apparent at Micheldever, and when I took over this Forest in February, 1947, I resolved to employ every possible method of destruction in the hope of at least greatly reducing their number, if not of eliminating them altogether. The methods I employed were chiefly shooting and trapping, the former being the more successful. Every drey to be seen was blasted with shot—many squirrels being killed in this way. By March, 1949, we seemed to have achieved much success. However, this was short lived as by July parts of the plantation had evidently been invaded in force and very extensive damage done, 18-year-old trees suffering very badly. 25 per cent. of one compartment was completely girdled, a further 25 per cent. partly girdled and the branches stripped. A serious view was taken of this damage and methods of destruction were intensified. The County Agricultural Pest Officer co-operated, and adjoining landowners were also asked to do likewise.

It is very noticeable that the damage was done during the prolonged drought, and it seems fairly certain that the grey squirrels move around in packs. Constant watch must, therefore, be maintained not only by Forestry Commission personnel but also by adjoining landowners if this pest is to be kept under control.

B. H. KING,

Forester, South-East England

BIRD SCARING AT SAVERNAKE

By J. T. WILDASH
Forester, South-West England

IT HAS BEEN THE PRACTICE in the last seven years to use Lepco Bird Scarers in the Savernake nurseries to protect the hardwood seedbeds from the ravages of birds. The chief enemies to hardwood sowings here are jackdaws and pigeons which may completely wreck beech and oak beds unless something is done immediately after sowing. "Lepco" Bird Scarers seem to me to be the answer, *provided the gun is used* in conjunction with them. These scarers consist of a slow-burning rope with crackers inserted at intervals. The rope is hung up on a stick and the end lighted, and the crackers go off at intervals of approximately half an hour. It is necessary to have at least three pairs burning on the six acres of seedbeds we have here, and to light them at ten minute intervals so that they go off alternately and in different places. One word of warning, however—put them in places where there is no possibility of the spent rope setting fire to a building, etc.

It is best to hang the rope in a ten gallon inverted drum or else get the proper protectors for them, as if they are exposed to wind they will burn too quickly, and if they get too wet they will be retarded or even extinguished altogether.

Although these scarers are excellent in themselves it is absolutely a waste of time to put them up and never go near the place with a gun. I find that it is necessary to shoot once a week, otherwise the jackdaws in particular will get used to the bangs and go on feeding happily a few yards away from the ropes. If, however, a few jackdaws are shot and their feathers and wings thrown about on the beds the others will not go near for a week or more, provided the scarers are kept going. With approximately six acres of hardwoods sown here this year we have had negligible losses from jackdaws and pigeons, though the local population of both is tremendous. Grey squirrels on the other hand are a different proposition and scarers are useless for these pests. I have yet to find an effective method of keeping squirrels at bay and should be glad to hear of one.

The actual "Lepco Scarer", as sold by the makers, is a tin container in which the ropes are hung to keep them dry and away from the wind, and it costs about 45s.; this should last several years but is not essential, though it is a great advantage in wet and windy weather.

Each rope costs 2s. 5d. and under normal conditions will operate for 5½ to 6 hours; and will go off at intervals of half an hour. As already stated, in my opinion this is too long between the "bangs" and they should be set in pairs to go off alternately at quarter-hour intervals. It is customary here to light two on leaving work in the summer, so that they will go on until dark, e.g., until about 10.30 p.m. If one rope is thought to be too much for the job, it can be cut in half and this will burn for about three hours. It is not usual to have the scarers operating during the working day as generally there are men about and *provided the gun has been used* birds do not come down to feed with men about.

With regards to comparative costs. If a man were to patrol the nursery the whole time for 6 hours at time-and-a-half it would cost 18s. 11d.; operating two scarers for the same costs 4s. 10d., or approximately 10d. per hour instead of nearly 3s. 2d. per hour. In my opinion the scarers are just as effective provided once a week the gun is used.

BEETLE ATTACKS FOLLOWING FIRES AT WAREHAM FOREST

THE WAREHAM FOREST FIRE of May, 1949, burnt an area of about 200 acres—including some adjoining estate woodlands. The south-eastern limit was formed by the bare ground and standing charred trees of the fire of September, 1947, in which over 300 acres of forest were burnt. Thus a situation was produced which was conducive to a serious increase in beetle population.

Observations were made daily following the fire, and the first evidence of beetle attack was seen in the form of frass, at the base of a few trees. This was on May 12th, seven days after the fire. On the following day pine shoot beetles (*Myelophilus piniperda*) were discovered working in burnt Scots pine.

The number of tunnels increased rapidly, and a marked preference was shown for Scots pine over *Pinus pinaster*. In fact no tunnels were seen in *P. pinaster* until May 19th, when Scots pine in the same area had as many as eight pairs of beetles working in one tree. A factor affecting this preference may well be the stronger exudation of resin from a punctured *P. pinaster*. Later, in August and September, when the adult beetles were feeding on the shoots, no such preference was noticeable. After stormy weather in November, the ground in plantations bordering the fire area was littered with the attacked shoots of Scots pine, Corsican pine and *P. pinaster* as evidence of indiscriminate feeding.

Considerable numbers of weevils were observed breeding in an area of large burnt trees, Scots pine up to 50 years, approximately. These were of the species *Pissodes pini*, and the first generation emerged about the middle of August. However, they have not been seen since to be working in great numbers. The species *P. notatus* has also been seen but not in large numbers.

In areas of younger burnt trees, attacks of *Pityogenes bidentatus* were severe, and the first generation of these was seen as adult beetles ready to emerge in early August. Empty pupal chambers were seen later in the same month.

The effects of the increased beetle population on the surrounding living trees has so far been slight, and practically confined to the ravages of *M. piniperda*. There has been no recurrence of *M. minor* discovered in this area earlier in the year. However, the story is continuous and next spring will show (we expect) the full extent and limit of damage to be expected from beetle increase caused by this situation.

P. A. PEARCE
Foreman, South-West England

BARYPEITHES PELLUCIDUS AT HALDON

By G. H. SCOTT
Forester, South-West England

ON THE 26TH OF APRIL, 1949, the nursery ganger came to me and reported that something was eating the beech seedlings in Haldon Nursery and that it wasn't mice. I immediately carried out a thorough investigation and the culprit was found to be a small beetle of the weevil type about an eighth of an inch long, its colour dark chocolate brown to black. Specimens were sent to the Conservator and the beetle was identified as *Barypeithes pellucidus*, hitherto rare in Great Britain.

In view of the extensive damage done to the beech seedlings at Haldon (6,000 seedlings remain from 85 lb. of seed, germination 75%) perhaps a short note on the types of damage found here would be of use to other foresters.

The first type of damage, is that the beetle eats through the radicle of the young seedlings just as the cotyledons are breaking the soil, and before the seed husk is shed. Feeding is continued on the cotyledons.

The second type is that of just eating through the radicle after the seed husk is shed, but not feeding on the cotyledons.

As soon as the young seedlings have hardened off they appear to be immune from attack. During hot spells the beetle feeds underground to a depth of up to half-an-inch, and if any shade is provided the beetles will be found to be thickest under this.

Duration of Attack

This lasted from 26th April until the second week in July. Beetles were more numerous in May when the density was about six beetles per square foot. In June the density dropped to four. The attack petered out in the second week in July.

Control

The only control carried out was picking up the beetles, but owing to their size, colour and sluggish habit this was very difficult.

The foregoing notes refer to the adult beetle only. A search was carried out, even to the extent of sifting the soil, for grubs, but none were found. Therefore the breeding habits could not be determined. Whether the beetles breed in the ground or in old trees is a question which must be left to the future, and another question which must also be left in abeyance is how did the beetle arrive at Haldon. Were there eggs in the beech seed, or beetles?

BARYPEITHES ARANEIFORMIS

DURING JULY, 1949, a sickly yellow colour appeared on certain Sitka spruce one-plus-one plants in Kennington Nursery, Oxford. On examination of the plants a small ring was found to have been eaten round the collar, just below soil level. No insects were immediately apparent, but on lightly removing the top layers of the soil a small beetle was discovered. This has been identified by Dr. R. Chrystal of the Imperial Forestry Institute, Oxford, as *Barypeithes araneiformis*. It measures three millimetres (about one eighth of an inch) in length, and is shining dark brown in colour, with a small snout; it rather resembles a tiny spider, from which likeness it derives its specific name. Other attacks occurred on large second-year seedlings of *Abies nordmanniana* and *Sequoia gigantea*.

Damage occurred to individual plants and not to groups or complete rows as with cockchafer attacks. The girdling eventually causes death. These beetles work and feed at night, lying up in the ground during the daytime. The damage is at present only on a small scale.

J. H. STYLES
Foreman, Research Branch

THE MARKING AND SALE OF THINNINGS

By S. M. PETRIE
District Officer, West Scotland

IN A GOVERNMENT FOREST DEPARTMENT the sale to timber merchants of thinnings standing or "on the hoof" will require to become a recognised practice, as distinct from selling produce after either extraction or extraction and preparation, and also as distinct from clear felling. Although a beginning has been made in this direction, it will take some time before timber merchants, generally accustomed to purchase the lot or none, become acclimatised to this type of trade, particularly in early thinnings, and before a standard system is adopted for the conduct of such sales.

The principal advantage of such a method of disposing of produce is that it leaves the forest staff free for maintenance work, for cultural operations or, in brief, for the growing of timber, and not for the utilisation side. When the tree has reached the stage at which it is marketable, either because it must be removed for cultural reasons or because it has reached maturity, it will be disposed of as it stands to the Timber Trade whose business it is to fell, extract, convert and market it. The Forest Department will be concerned with growing and tending, the Timber Trade with removal and utilisation. This is the practice on the Continent where it seems to work extremely well.

In Scotland, where there is an old and well established native timber trade, long accustomed to the valuation of woods, to purchasing without let or hindrance from the landed proprietor, to the supply and use of its own felling and extraction equipment, and the setting up of its own mills on the sites to be worked, the seller should not experience any serious difficulties in negotiating a sale of thinnings standing, without the need for any harsh restrictions or conditions upon the merchant.

The native Timber Trade in Scotland has had a long experience in the handling of timber on a great variety of sites, but it is used to clear felling and not thinning, particularly thinning of comparatively young crops.

In the negotiation of such a sale it is the job of the vendor as producer and owner of the woodland to mark the trees which he wishes to have removed, and to measure them for valuation or bargaining purposes, and it may be advisable to consider for a little, both of these items. Marking in Forestry Commission stands to date has generally been done with a slasher or hand axe, a blaze on the body of the tree whereby it can easily be spotted by the fellers. Stumps may then be marked or counted after felling as a check on the quantity removed and for comparison with the quantity marked. This is a cumbersome process and not a very accurate one, and can be avoided by the use of an official marking hammer, carrying the vendor's stamp. Such a hammer can conveniently be in the form of a light hand axe, the blade of which is used for blazing the tree and the hammer head opposite, carrying the stamp for imprinting the mark on the timber. The bark must be completely skinned to reveal the timber, and the hammer head stamp must be small in area, no bigger than a florin at most, if a lasting print is to be obtained on the tree. It is recommended that in the marking of thinnings for sale standing, the tree be stamped both on the body so as to be easily picked out by the fellers, and at ground level, on the root bend below the line of saw cut, so that a check of stumps after felling is easily done by the vendor. A condition of sale would be that the saw cut must be above the root hammer mark, and so endless stamping and counting after thinning would be avoided.

The method of measurement of the lot for sale would vary with the type of thinning, whether it was an early one, first or second, or an intermediate one where material is of a larger size and consequently more valuable, or a regeneration felling in large sized timber.

Early thinning of coniferous trees, at least, the first one, should be regarded more as a cultural operation than a commercial transaction, particularly if the stand is difficult of extraction or inaccessible to a merchant, and the value of the work done as such has to be taken into consideration in the method of assessing volume or fixing a price. In some cases there is little to tempt a merchant in an area of first thinnings, where there will be much cutting and handling for small volume. In the marking of the thinning, every twentieth tree can be girthed where numbers are large, and at the end of this operation trees arranged by numbers into say half-inch girth classes. The felling and measurement of one or at the most two trees in each half-inch girth class should suffice for working out by proportion the volume of all trees in each girth class, and so the total volume of marked trees.

As later thinnings are dealt with, so the number of trees girthed at marking can be increased. For instance at the second thinning, every tenth tree might be girthed, at the third thinning every fifth, and subsequently every second tree or possibly every tree. Booking the size of each girthed tree gives the marker, at the end of the day, the total number of trees marked, as he has only to multiply the number girthed by twenty, ten, five or two as the case may be. Further accuracy can be obtained as the trees get larger and more valuable by arranging them in quarter-girth classes, and by felling a larger number of trees in each girth class as samples.—[Methods of sampling thinnings to arrive at an estimate of their cubic contents are now laid down in Technical Instruction No. 1/49, and in S.M. 14—*Editor.*]

In a final thinning, regeneration felling, or removal of an old stand with the exception of standards or amenity groups, it is customary to measure all trees being sold, either standing or jointly with the purchaser after felling. The marking hammer comes in useful for this job too, timber lengths being stamped at both ends after measurement and agreement as to volume. In the marking of regeneration fellings, or in the clearing of all trees except standards, a useful method of marking is to blaze only the trees to be cut, and to hammer-stamp at the root bend those to be reserved. Sale conditions would therefore specify "X number of trees comprising A cubic feet hammer-marked for sale" or "X number of trees comprising A cubic feet marked for sale, Y number hammer-marked to be reserved".

These few suggestions as to marking and measuring lots for sale are set down as it is considered that with the ever-increasing area of plantations falling into a thinning cycle, it will shortly be necessary for the bulk of utilisation work to be done by the private merchant. In an established forest, where the afforestation work is complete and an extensive nursery no longer essential, the forest staff should not be the large battalion which is necessarily employed in the forest's formation and in the first years of its maintenance. As all P. years become established, it should be possible for the Head Forester, who has a series of balanced thinning sales to timber contractors, to manage the area with his local resident staff of holders and house tenants alone, without the need of a hostel or floating labour force. Sales of standing thinnings to merchants will mean that the small forest staff can be relieved of all but silvicultural and maintenance work, such as the marking of thinnings and regeneration fellings, the repairs to boundary fences, to drains and to roads, the measurement of standing and felled trees, and possibly the care of an acre or so of seedbeds and transplants.

As the system of such sales increases, and as the lots coming up for sale become larger and more valuable, thereby commanding a bigger price, it may become possible to put certain charges on the sale, such as the repair to drains on the felling area after extraction, the resurfacing of a length of forest road, or the pruning of marginal trees to be carried out by the merchant; a proportionate reduction on the amount due for the lot being made to compensate the timber merchant for the maintenance work he is asked to do.

Such a system of "charges on the cut", whereby necessary maintenance work would be undertaken by the timber merchant, may seem to be a far off state of affairs, and would mean if carried through to the end, the complete elimination of the forest staff altogether; but with keen competition among merchants for large and valuable lots, it is possible that much of the forest work may be done in this way, although doubtless a departmental staff will always be essential in British forests. With the extension of this method, however, it may be agreed that in established forests, each member of the forest staff could be allotted a beat, say one P. year, for caretaking and maintenance, to be responsible to the Forester for this section of forest, its fire protection, drain repairs, fence repairs, windblows and roads, and to call on the Forester, if necessary, for the assistance of the other beat caretakers for any operation of too large a scale for himself such as brashing, marking for sale, or re-stocking blanks or cleared portions. There is no doubt that the allocation of an area of forest to a good man doubles his interest in the work; he feels responsible for it, begins to take a fatherly interest in it, is keen to improve its condition beyond that of his neighbouring caretakers, and finally acts as if it were his own property. Such working caretakers are all to the benefit of the Forester who is co-ordinating the whole.

This brief statement of a scheme for the conduct of sales of standing thinnings to merchants, the reduction of the amount of work to be done departmentally, and forecast of a layout of the forest into blocks each the responsibility of one man, may seem rather theoretical and too much of an ideal, a form of forest management too good to be true, and too much in the future to be taken very seriously; but there is no reason why it should not be aimed at and the trend of work encouraged in that direction. With one body to grow and tend the trees, and a second body to buy, remove, convert and dispose of the timber, each working hand-in-hand as seller and buyer, forest management will be on the right footing, as Departments with centuries of forestry experience have shown.

METHODS OF EXTRACTION OF THINNINGS AT GLENTRESS FOREST

By T. A. ROBBIE
Education Officer, Glentress School

THE METHOD OF EXTRACTION of thinnings to be adopted depends primarily on the terrain, secondly on the size of the thinnings, and on the type of produce which is being prepared from the thinnings. Before thinnings start, the Forester must decide on the method of extraction to be adopted and so fix his extraction routes. This may even be done before brashing commences. In deciding on the method of extraction the forester must also make up his mind whether or not he is to do part conversion when felling in order to assist extraction. As extraction costs are the most important feature which decide whether or not a thinning will pay, the handling of timber from stump to despatch of final produce must be reduced to a minimum.

In Glentress Forest we have rolling hill country with flat tops and one main narrow valley with a small stream running through it. The extraction from the flat top has presented no great problem, as we have been able to use a rubber-tyred Fordson tractor with pole-waggon for most work. On softer ground, we have used a Clarke Airborne Caterpillar tractor with slipe or sledge to very good advantage. Both these mechanical methods have been used in conjunction with horses. The produce from the thinnings in this case has been short mill cuts for stobs, or stakes, eleven and twelve foot poles for the Lothian oil shale mines, long pitwood, and the tops converted into sheep-net stakes or firewood.

Extraction of thinnings from the slopes which, in places have a gradient of one in three with a rough boulder strewn surface, has presented some problems to horse extraction. In order to overcome some of the problems it was decided to experiment with gravity extraction by wire ropeway. Systems of wire ropeways in use at present have three weaknesses, first, lack of control of speed, loading only possible at one point, and the problem of getting carriages returned to the top of the hill for reloading.

A double cableway supported at every twenty to thirty yards has been erected and found to work satisfactorily, which means that loading can take place anywhere along the line, speed is controlled by a double brake drum at the top of the run, and as these brake drums are wound under one and over the other, this means that the load travelling down one cable brings an empty carriage up the other cable. I shall not describe details of brake drum, carriages or supports for the cables, as they have already been drawn to scale and copies made, and would be available for any officers or foresters who may wish to see them.

When thinning starts, a row of trees is removed every two to three chains apart across the hillside, running up and down the hill. The cables are then pulled off drums up the slope, either by man-power or by horse. We found that five men could get out a three-hundred-yard cable fairly easily, but that a horse was required for six hundred yard lengths. The metal supports for the cables are hung on wooden cross-spars as required. The brake drum is then hung on the carriages and pulled to the top of the run. The cables are anchored round a tree or trees at the top of the run, and fixed to other trees at the foot of the run. The cables can be tensioned together for a three hundred yard

run by a two-ton pull on a Yale pull-lift, but have to be tensioned individually for a six hundred yard run. One man can easily put on a two-ton pull with the Yale.

Thinnings are either drawn into the runway manually or by horse, and loaded on to the carriages for despatch to the bottom of the hill. Five men operate the cableway, two loading, two off-loading and one operating the brakes. Because of loading difficulties the highest load taken has been ten cubic feet, and an average of seven has been maintained. Ten loads per hour can be sent down a three-hundred-yard run, and an average of eight on a six-hundred-yard run. On the longer distance, inter-communication was difficult at first, but has been overcome by using two portable field telephones. A three-hundred-yard run can be erected in five hours by five men, and dismantled in three hours, which includes rolling up cables on to the drums. The two men at the off-loading end can be used to convert the produce, as it comes down, into mill cuts, long pitwood, and tops for sheep-net stakes. The cableway will not run on a gradient less than one in eight.

To overcome the lower gradient and also to get thinnings out of the soft valley bottom, two students at the Forester Training School, D. Watt and D. M. MacGregor, devised a monorail system of extraction. It works on the principle of "Rufflette" curtain rails, using ordinary light railway material supported on cross-spars about five feet from the ground. Special carriages were made to run on the lower flanges of the rails, and to carry the loads. Speed is controlled by a light cable round a braked car wheel, and the empty carriages are wound back by hand, using the brake wheel. Five men can erect over one hundred yards in half a day, and this is worked in the same way as the wire ropeway by the squad of five. Loads averaging six cubic feet were sent down at the rate of one load every four minutes on a three-hundred-yard run.

At the time of writing these methods are still in the experimental stage, but by the time this appears in the *Journal* modifications may have been added, or the systems abandoned or adopted more generally, but I feel that some indication of the methods used at Glentress Forest would be of general interest to others who are faced with large thinning programmes.

DOUGLAS PALE FENCING

BY C. A. CONNELL
Conservator, North-East England

These notes describe the preparation of fencing suitable for use instead of traditional cleft chestnut paling.

Materials

Douglas fir thinnings and tops, not exceeding 3 inches butt diameter. Though freshly cut wood is preferable, partly seasoned is not ruled out. Similarly, long clean internodes are preferable, but coarse and even spiral growth may be utilised. Peeling is essential and should be done at time of cutting.

No. 14 gauge galvanised binding wire.

Specification

This cleft paling should be in 5-yard rolls—

(*a*) 3 feet 6 inches high

(*b*) 5 feet 0 inches high

(*c*) alternately 3 feet 6 inches and 5 feet 0 inch palings

The palings are secured by three rows of twisted binding wire. The completed roll is creosoted by immersion in hot tank.

Method of Production

The peeled poles are cross cut into "bats" of the required length, i.e., 3½ feet or 5 feet. The bats are then quartered or halved according to girth. For instance, a 10 foot 6 inch pole with a 2½ inch/3 inch butt would best be cut to yield

(1) a 2 foot nursery peg from the butt

(2) a 5 foot bat for quartering

(3) a 3 foot 6 inch bat for halving.

If, however, there is no call for any special product from the butt, there is no objection to quartering up to 3 inches diameter. Only cleft bats are acceptable—round (uncleft) pales from tops must not be used—even bats of 1 inch diameter can be successfully halved.

Halving is done by means of a well-worn axe, ground thin, placing the cleave across the medulla, whether this is centrally disposed within the pole or not.

For the quartering, and for halving lighter poles of 2 inches diameter and less, a special cleaving bench, having a worn tractor disc coulter sunk rigidly within it (in a similar position to which a circular saw rides within its bench) should be set up. The halved or round bat is centred over the disc, with the cutting edge about 15 inches from the thickest end and parallel with the grain. A heavy hammer is used to drive it on to the cutting edge, and then down until it lies on the bench with the disc projecting through its centre. The cleave will generally have "run out" to the nearest end of the bat, and is completed by driving the opposite end to force the bat against the cutting edge. The

tendency is for the bat to rise over the disc, but this is overcome by hammering it down again which forces the cleave. It is best to follow the medulla.

After cleaving, the light ends of the pales are slightly edged with the bill-hook, without giving any appearance of being pointed.

Wiring together of the pales is done on an ordinary Lath Seed Bed Shelter machine—sufficient "bite" of the wire into the pales can be obtained to make stapling unnecessary.

Quantities

Approximately 48 pales are required per five-yard roll.
This calls for the following footage of poles:

LINEAL FOOTAGE OF ROUND POLES

Size	Minimum (assuming quartering)	Maximum (assuming halving)	Mean (assuming a quartering and halving from each pole which is usual)
3 feet 6 inches	42 feet	84 feet	56 feet
5 feet 0 inches	60 feet	120 feet	80 feet

Costs

Representative figures (for guidance only) are, per *one roll size 3 feet 6 inches.*

	s.	d.
Binding wire		6
Haulage (average)		6
Peeling (56 feet)	1	0
Cleaving 48 poles	2	0
Wiring up	2	0

To these must be added the value of the poles (e.g., 1d. per foot run), the cost of creosoting, and 20 per cent. of all cash labour charges as overheads.

Markets

It is probable that Agricultural and Highway authorities in localities far removed from sources of cleft chestnut paling will be very interested in this product if a steady delivery rate and reasonable quantities can be assured to them. At a selling price of 15s. to 20s. per roll f.o.r. the product should earn a reasonable profit and provide an outlet for material not otherwise readily saleable.

NOTES ON THE WOOD-USING INDUSTRIES OF NEW YORK

BY JAMES MACDONALD
Director, Research and Education

THE FOLLOWING INFORMATION has been extracted from a review of *Wood-Using Industries of New York*, by R. J. Hoyle and J. R. Stillinger, issued by the New York State College of Forestry in 1946.

New York is essentially a forest state which about the middle of the nineteenth century was one of the leading lumber-producing areas of North America, and it is a natural centre for wood-using industries of all kinds. The great growth of population and industry have led to important changes, particularly in the increased use of wood from outside the state, but there are still a few industries which depend on local supplies for more than 70 per cent. of their requirements; among them are boot and shoe lasts, basket making, flooring, plugs, bungs and rolls, dowels, fencing, fruit and vegetable crates and dairy supplies. Fencing and plugs depend on Eastern white pine (*Pinus strobus*) while the other industries mentioned make use of the indigenous hardwoods among which hard maple (*Acer saccharum*) is outstanding.

The largest wood-consuming industry in the state is furniture making, followed by general sawmilling, box and crate making, railway coach and waggon building, boat and ship building and the manufacture of musical instruments. One of the leading industries is the manufacture of boot and shoe lasts, shoe heels, etc., using 17 million board feet annually, nearly all of which are cut from kiln-dried hard maple grown in New York or neighbouring states.

The manufacture of coffins, etc., ("caskets and burial cases") is also one of the more important wood-using industries, having consumed some 15 million board feet in 1946. We are told, "Hardwoods have always played an important role in the making of wooden caskets. The leading woods used are: mahogany which is dignified, rich, aristocratic and restful; walnut, one of the noblest cabinet woods, beautifully grained, exquisite in its finish, fashionable, impressive, staunch and inspiring; oak, emblem of strength and integrity, sturdy and durable; cypress, the wood "eternal"; birch the pleasing; maple, the colorful; and cherry the rich".

After this it is disturbing to learn that "Bronze, glass, lead and concrete caskets are playing an important role in the industry . . . . It is noticeable that the cheaper trade is gradually being entered by the metal casket manufacturers as a result of extensive advertising which the wood-casket manufacturers must counter".

Among the other numerous and most interesting pieces of information a few may be mentioned. Wood-wool is made only from aspen and basswood or lime (*Tilia americana*); eighty per cent. of the wood used in the manufacture of cigar-boxes is Sitka spruce; almost the same proportion of the timber used for greenhouses is bald-cypress (*Taxodium distichum*); more than ninety per cent. of the pencils are made from incense cedar (*Libocedrus decurrens*); the three timbers most frequently used in the manufacture of radio and television cabinets are red-gum (*Liquidambar styraciflua*), Douglas fir and mahogany, and for toys, ponderosa pine, birches and hard-maple (*Acer saccharum*). Ponderosa and birch have replaced basswood and ash, which were the two most important woods for toy-making thirty years ago.

PRODUCE FROM A TWENTY-THREE YEAR OLD SILVER FIR PLANTATION

IN F.Y. 1950 we thinned for the second time one acre of P.27 silver fir, which was first thinned in F.Y.48. The average felled measurement then was 1 cubic foot, 3 inches per pole. In F.Y.50 it was estimated by the block and circle method of measuring, laid down in Silvicultural Circular No. 22, to be 2 cubic feet, 11 inches. There were 156 poles taken from the plot, which gives a total volume of 455 cubic feet per acre.

The following is the actual produce prepared from the 156 felled poles, the cubic contents being calculated by Smith's Tables for Pitwood.

Description	Number	Cubic Contents (Hoppus feet, inches and parts)		
Telegraph Poles 18 to 26 feet long	56	159	4	—
16 foot Poles 4″–5″ butt × 3″ top	114	118	9	—
13 foot Pitprops....	3	16	5	6p
11 foot ,, ...	6	15	0	—
9 foot ,, ...	1	2	3	—
6½ foot ,, × 4 to 6 inch top	96	80	0	—
5 foot ,, ... × 4 to 6 inch top	83	46	8	3p
4½ foot ,, ...	97	39	8	11p
6 foot Stakes × 2½ to 3 inch top	161	40	3	—
Total	617	518	5	8p

This shows a difference of 63 cubic feet between the estimated cubic contents and the actual contents of prepared produce.

This difference has been frequently found in poles of 3 cubic feet and over, but the reverse is usually the case in the smaller pole, i.e., in a first thinning.

E. C. KIBBLE

Forester, South-West England

ANOTHER ANGLE ON SOILS

BY J. E. JAMES

Assistant Engineer, North-West England

FORESTERS NATURALLY LOOK UPON THE SOIL as the bearer of a crop. They value it in proportion to its fertility. As an engineer I have a different viewpoint. Soils for me are the bearers of structures, such as roads, bridges, piles and a hundred other artificial eyesores (alleged!). I value soil in proportion to its strength and density, and so the subject I want to discuss is the use of soils in roadwork.

The chief requirement in the construction of forest roads is that they should be cheap—that much I have learnt from my brief service with the Commission and from my newspaper. It is therefore the business of a forest engineer to consider possible alternatives to our traditional roadmaking technique. Soil stabilisation is one alternative in which I am interested. For many of our road projects it would be impossible, for many more, impracticable; but, for the few remaining, it could well be the answer to our problems.

Soil stabilisation is not new. Ever since the Romans, the principle has been used unconsciously by our road builders, and more particularly our road menders. The life of a dry-bound or water-bound road largely depends upon the grading of the materials used, i.e., the proportions of the different sized stones and particles. This fact has been known for centuries. Our roadmen judged proportions by eye and from experience. They also knew that compaction of a road was easier when water was applied. A pothole would normally occur where an excess of fine material had accumulated. The roadmen would simply patch it with stone or gravel, and that is stabilisation in its simplest form.

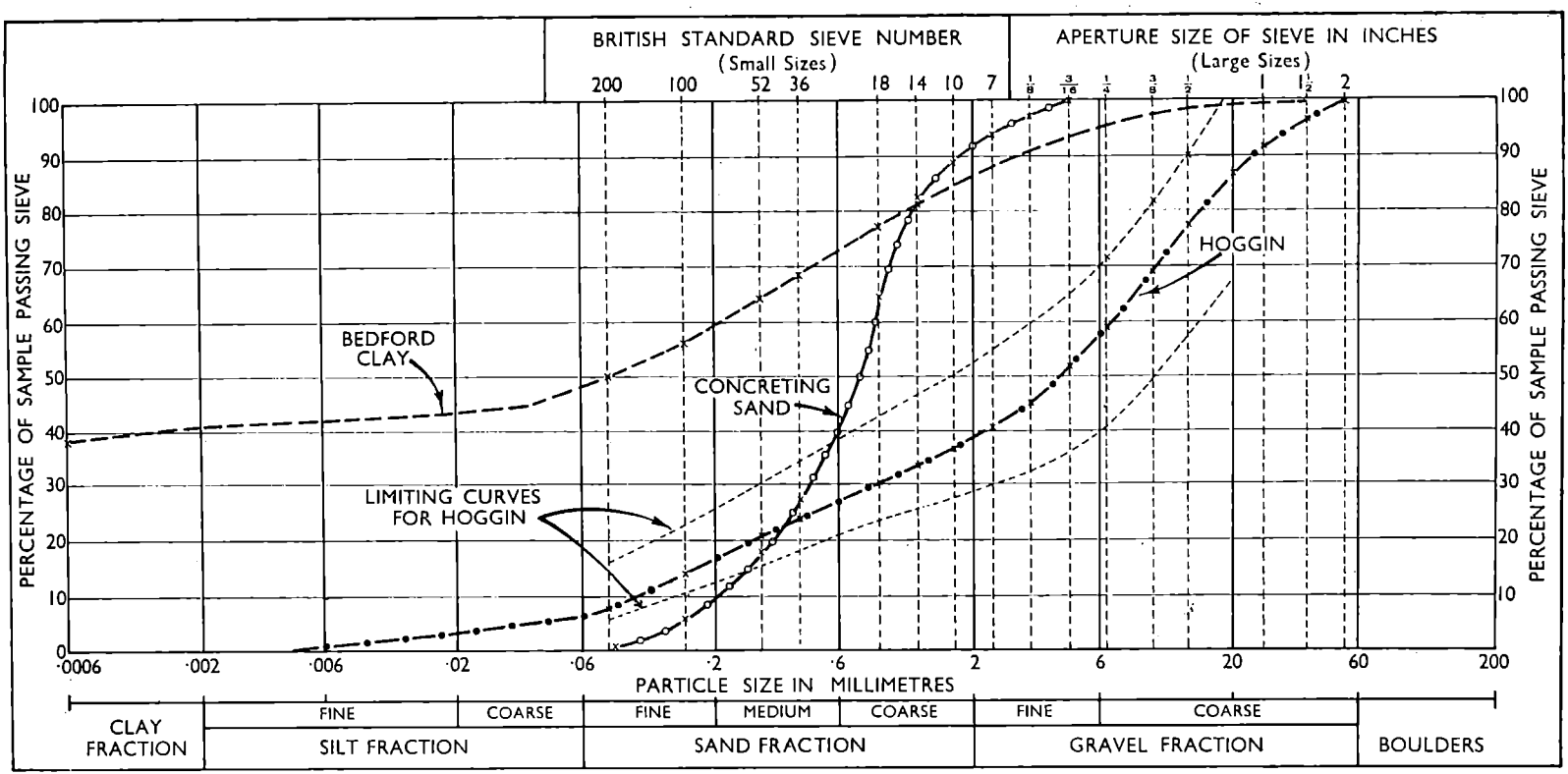
The advances made as a result of our knowledge of soil mechanics are merely those of closer control. Laboratory tests can now show us the existing soil grading; an ideal grading has been established; and so we can find out what must be added to any soil to make it mechanically stable. The Proctor Test* will then show the percentage of water required for the best compaction—this is the "Optimum Moisture Content".

It is therefore possible to stabilise almost any soil—but it is by no means always practicable. For example, a heavy clay, having an abundance of fine particles, will require so much imported coarse material as to make the work impracticable. It would be cheaper to pitch with stone.

The mechanical analysis of soils is done by sieving through a series of British Standard Specification sieves. The amount retained on each sieve is expressed as a percentage (by weight) of the whole sample. Thus a graph can be plotted.

In this country the only additive used in stabilisation is cement, but it may be of interest to note that there are five types of stabilisers. Concerning three of these the British engineer may only dream today, but perhaps some of our descendants, not working under the shadow of an economic crisis, may be

* *Note*: The Proctor Test is a laboratory test to find out at what percentage moisture content, any sample of soil is densest. A standard hammer is allowed to fall, twenty-five times, through a definite height, on to the soil sample contained in a hollow cylinder.



NOTE:- This is the conventional form of graph used both in Britain and the U.S.A. It makes use of a logarithmic scale on its horizontal axis, to allow for the enormous variation in particle size. The curves are produced by plotting the percentage passing each sieve (by dry weight) against the sieve size With practice a soil can readily be seen to have a "good" or "bad" shape.

allowed to experiment with these forbidden dollar products. The known stabilisers are:—

1. Hoggin—a naturally well-graded soil requiring only compaction.
2. Cement—used in "soil-cement" work.
3. Resins—used to drive off water. They must be applied to an acid soil—aluminium sulphate is usually added to ensure this.
4. Bitumens, Cut Back Bitumens and Oils—these protect the soil particles from water. They must be applied to an alkaline soil—lime is usually added to ensure this.
5. Sodium Rosinate—this is sprayed on the soil as a liquid and acts as a water repellent.

As the last three products come almost exclusively from the United States, a fortune awaits anyone who can produce a substitute with a "Made in Britain" label. I understand that Imperial Chemical Industries are working on this problem.

And now, from dreams back to realities and forests! Back to the ideal mechanically stable hoggin so noticeably lacking in my own district (North-West England Conservancy—North). The graph shows the composition of this perfect soil, and it might be useful to set down here the arbitrary definitions of soil particles:—

60 millimetres (2 inches) and above	Boulders.
2 mm. to 60 mm. ($\frac{1}{2}$ to 2 inches)	Gravel Fraction.
0.06 mm. to 2 mm. (200 B.S. Sieve to $\frac{1}{8}$ inch)	Sand Fraction.
Below 0.06 mm. (200 B.S. Sieve and below)	Silt and Clay Fraction.

The curves for a typical concreting sand and a "bad" clay are also sketched on. This method is very important. It is a means whereby the physical composition of soils can be classified and compared, and the plotting of any soils graph gives the answer to that all-important question: "Is stabilisation practicable on this ground?"

TABLE TO SHOW THE COMPOSITION OF THE SOILS SHOWN GRAPHICALLY

Class of Soil	Grading Expressed as a Percentage by Weight							Total
	Clay & Silt	Fine Sand	Medium Sand	Coarse Sand	Fine Gravel	Coarse Gravel	Boulders	
Hoggin	6	11	11	10	19	43	—	100
Bedford Clay	48	12	13	14	8	5	—	100
Concreting Sand	—	10	33	49	8	—	—	100

At present, in our own sphere, it seems to me that "soil cement" work is a little ambitious, as everything depends on adequate control and good weather-forecasting—a heavy shower at the wrong moment will ruin several tons of cement. But in many areas much good work may be done by bringing the natural soil into the hoggin category.

If our particular soil has a curve which falls within the two limiting curves shown on the graph by dotted lines, we have no further worries. The soil is already stable. But if our curve has a similar shape and is reasonably close to the limits there is still hope for us.

Let us assume that we have such a site, and consider the construction procedure. First of all the vegetable layer of turf must be removed, and the drainage must be attended to. French drains or porous concrete pipes will normally serve. Next the roadway should be ploughed to a depth of six inches, large stones should be removed, and any imported material evenly spread. Mixing is the next business, and may be effected by re-ploughing or harrowing, or by both. Then the road must be given its final shape—a grader or bulldozer will do this, but a skilled operator is essential. Here I would like to mention that the shape of the finished road is very important. A good camber or crossfall must be provided to throw off water quickly and prevent it percolating through to weaken the sub-grade. For normal forest roads, less than twelve feet wide, I prefer a straight crossfall, as opposed to the more usual camber with the crown in the centre and channels either side. The final operation is rolling, together with the addition of water. Various types of roller may be used, according to the type of ground; usually an eight-ton roller is quite heavy enough if the moisture content is kept high. Probably the most effective roller for a light gravel is the Pullen Wobbly Wheel, with its nine pneumatic-tyred wheels mounted on five rocking axles. This piece of equipment compacts a strip six feet nine inches wide, and can be filled with ballast to obtain the required weight.

And now for the question of the hour:—"What does it cost?" A series of estate roads in Kent were constructed of soil-cement for 3s. 3d. per square yard in 1947. They successfully carried all the contractor's heavy building traffic when the houses were being built. Finally, when the estate was complete, they were merely swept and treated with a bituminous cold emulsion. This latter I believe cost about 9d. per square yard. As far as I know the roads are still giving complete satisfaction. The cost of a light tarmacadam road with hardcore foundation would be well above 15s. per square yard.

In conclusion I would like to emphasise that soil stabilisation is not the solution to all our troubles—its claims are very modest in this country, although great use has been made of it in America and the Middle East. High and uncertain rainfall is the biggest headache of the soils engineer in Britain.

Vast areas of Western Scotland, North Wales and the Lake District are out of the question for these experiments, and I would not recommend anyone to try and stabilise Kershope's peat, but we have much to learn from this newly developed science.

FOREST ROADWORK IN THE NORTH-WEST ENGLAND CONSERVANCY

By R. R. MESTER
Conservancy Engineer, North-West England

IN COMMON WITH much of the roadwork undertaken by the Commission during F.Y.47, the road programme in the North-West England Conservancy was largely conditioned to labour relief. It was not until halfway through F.Y.48 that work could be run on a normal basis, but since that period, considerable progress has been made both in the technique of forest roadwork and in the economic execution of the work in hand.

The first road scheme undertaken was started in January, 1947, in the main block of Ennerdale Forest in Cumberland, and subsequently the bulk of the work has been in the Scottish Border Forest of Kershope and the Lakeland Forests of Ennerdale (including Blengdale), Thornthwaite and Grizedale. Work was also started in Delamere Forest (Cheshire) but terminated in 1948. In addition engineer roadwork is current in the Welsh Border Forests of Mortimer and Walcot and recently has been extended to Cannock Forest in Staffordshire.

The largest and most responsible undertaking is that at Thornthwaite, where the work is located in mountainous territory. Difficulties of construction are considerable and civil engineer practice is being constantly modified to suit the needs of forest engineering economics. Much of the work has involved considerable side cut in both solid and loose rock on precarious alignments, with the acceptance of some steep gradients, sections of masonry retaining wall, culverts and drainage work in many forms. By the judicious use of mechanical equipment, it has been possible to supplement the basic programme of main extraction and access routes by the timely development of a secondary system of feeders and tracks. The equipment used is almost wholly of departmental origin, the nucleus being two teams each consisting of a T.D.18 angledozer and air compressor with rock drills. Approximately sixty men are employed from the West Cumberland and Bassenthwaite districts of the county, whilst apart from plain and porous concrete pipes, no constructional materials are imported, the bulk of the roadstone and walling stone used being raised in departmentally-worked quarries. The highest point reached on the roadwork is 1,556 feet above sea level.

Kershope Forest has been notorious for its peat, clay and heavy rains, three disturbing factors also encountered all too frequently in the Lakeland forests. After a slow start notable progress has now been made in both shallow and deep peat crossings, involving novel and varied means of construction to suit local conditions. Road labour is substantially Polish and on occasion has been assisted by forest labour. Suitable roadstone has not always been available and rough engine ashes have been imported in quantity from British Railways. A number of quarries have been established, working outcrops of olivine basalt and fell sandstone with increasing output. Roadworks have also involved the underpinning and repair of concrete retaining walls alongside the Kershope Burn, in which river considerable diversion and training work has been necessary. Landslips have also been encountered.

River work on a larger scale was undertaken in the Blengdale section of Ennerdale Forest, where a new course for the River Bleng was cut to enable the construction of the main valley extraction route. In addition this forest

had the distinction of having the first Bailey Bridge to be erected in England in connection with engineer forest roadwork development. This was a fifty-foot single span Bailey across the River Bleng, to which have now been added a seventy-foot double span and, across Scalderskew Beck, a thirty-foot single span; the decking in all three cases was provided from Grizedale Forest. Although a proportion of pitched roads have been built, experiment has been made in lighter specification roads including granular stabilisation in the Bark Butts area. Labour is drawn wholly from the nearby West Cumberland town of Egremont which, together with Cleator Moor and Frizington, supplied road labour to the original road project in Ennerdale where major operations were temporarily closed towards the end of F.Y.48. An interesting development taking place there at present is the construction of three large-span timber footbridges across the River Liza, using selected larch poles from Gillerthwaite plantation.

Work at Grizedale has again been concentrated on main extraction and access routes provision, with full use being made, as elsewhere, of local surfacings with stone raised departmentally in a number of supporting quarries of which the greatest face worked is in excess of fifty feet at Thwaite Head near Rusland. Imported constructional materials have here included precast concrete blocks for experimental use in culvert construction, whilst arrangements were also made to exploit old spoilbanks at a neighbouring disused iron ore mine as being an economical source of roadstone. The material was a medium grey haematised limestone, available in quantity without the need of a quarrying operation and which, when crushed, yielded an eminently suitable road surfacing of some durability at low cost. Labour is drawn from the Furness District of North Lancashire, principally Ulverston and Dalton-in-Furness. The terrain over which most of the roadwork has lain is very exposed, and winter working conditions are particularly severe. In addition to the main logging roads, described in the national press as being "vital transport routes for the timber", a small programme of reconstruction of estate roads has been carried out in Grizedale Forest and Satterthwaite village by engineer roadworkers.

Roadwork in the two Welsh Border Forests of Mortimer and Walcot, although differing considerably from the northern work, has not been without interest or technical difficulty. Ground conditions have permitted a much wider development of light specification roadway, even for the main extraction routes, and considerable progress has been made in elementary stabilisation methods. A larger proportion of roadmaking plant has been hired, and probably in relation to the various projects, there has been a greater degree of mechanisation. Such labour as is employed for roadwork in the two forests is drawn chiefly from Ludlow and Clun in Shropshire and from Knighton in Radnorshire. For certain sites, quantities of roadstone have been imported from nearby privately-owned quarries, whilst experiment has been made with the laying of short sections of improved roadway, notably cold emulsion grouted and tarred macadam (pre-coated) surfacings, particularly on steep gradients or on roads which are also rights of ways for farm traffic and would otherwise be subject to scour.

Although much of the roadwork in the Conservancy has been restricted to construction within the several State Forests, problems have arisen in regard to the establishment of, and negotiation for, rights of way with a subsequent bearing on ways and means of ensuring privacy. This has been a feature of roadwork in Mortimer and Walcot, whilst in Grizedale the forest road system has required consideration being given to the development of certain public highways which have not been maintained for vehicular traffic for many years. Contact has also been necessary with the responsible highway and planning

authorities in order to secure agreed junction details at all points of access to the public road systems, and the design of some of these junctions frequently proved intricate in view of the several technical considerations to be satisfied. Full attention has also been given to amenity considerations in the planning of forest roadwork, and especially has this been necessary in the Lakeland group of forests.

The programme of forest roadwork for existing forest areas alone in the Conservancy is unlikely to be completed for some years; but a total of approximately sixty miles of variously useable road and other access routes has been substantially completed to date.

THE MECHANICAL DEVELOPMENT COMMITTEES

WITH THE OBJECT of reducing costs of production, the possibilities of mechanising forest operations are being kept constantly under review. A Mechanical Development Committee has been set up at Headquarters, having the following composition:—

Director of Research and Education (*Chairman*)
Chief Engineer
Chief Research Officer
Machinery Research Officer,

together with a secretary. This Committee meets, as far as possible, monthly; and its minutes are circulated to the Directorates. Its main purpose is to control research and experiment, and in this work it is assisted by a similar Committee established in each Directorate.

The potential field for mechanisation in forestry is a very wide one, and includes both silviculture and utilisation. The main lines of development now being undertaken are:—

(1) Tests of various kinds of British-made tractors.
(2) The mechanisation of certain nursery operations, particularly the cultivation of ground, the drilling of seed, the transplanting of seedlings, and the turning of compost.
(3) Mechanical methods of brashing.
(4) Extraction methods, including:
    Ropeways,
    Chutes or slides,
    Sulkies (i.e., light two-wheeled timber carriages to assist in tushing logs behind the tractor).
(5) Mechanical means of bark peeling
(6) Equipment for timber depots.

Suggestions for the improvement of mechanical equipment already in use in the forests will always be welcomed, and should be sent in through the usual channels.

R. G. SHAW
Machinery Research Officer

THE UTILISATION OF THE HIGH TOPS

BY J. WEBSTER
Divisional Estate Officer, West Scotland

THE RESUMPTION OF GRAZING LAND for afforestation, either at a break in a lease or termination of a tenancy or from a farm in hand, whilst probably one of the most contentious problems with which either Forest or Estate Officers have to deal, is also one of the most important, for on the decisions taken will depend the shape of the countryside for years to come.

These notes make no attempt to go into all the pros and cons of the question; they are intended merely to give an indication of some of the factors which an Estate Officer must take into consideration in order to present a reasoned case to his Conservator. These are:—

1. The total acreage required for afforestation and proposed location.
2. The total sheep stock on the farm with
   (*a*) the number of hirsels*
   (*b*) the numbers on each hirsel.
3. Whether, after clearance of the stock on the area proposed to be planted, the numbers left would be sufficient to form an economic unit which generally speaking may be taken to be anything round 500 ewes; this number may be slightly less if it be possible to run a dairy stock.
4. The extent of downfall† available, and whether, after say the lowest downfall has been resumed, there is owing to the configuration of the ground what may be termed the upper downfall, as happens for instance all along the south shore of Loch Awe.
5. The position of streams on the grazing, whether these are easily fordable or have sheep bridges; or do they, owing to ravines, constitute a complete barrier which may prevent sheep displaced on part of one area crossing to that adjoining.
6. Whether sheep passes to the low ground can be left along the line of existing fire rides.
7. The usual run of the sheep, and, as far as possible, whether the line of the new fences cuts across these paths.
8. Whether the low ground is sufficient to support the number left. In most cases the stocking per acre will be lighter on a partly resumed farm, as the value of high and low ground has been disturbed.

It will be obvious there is more scope for adjustment where the farm is large. With smaller farms the resumption of even a moderate acreage may upset the whole economy. Where such is the case it is often advisable to resume the whole grazing and alter the status of the holding to that of a small tenancy.

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* *Hirsel.* The term "hirsel" is used to describe a certain section of a hill sheep farm or the flock thereon. The stock on this part of the farm are usually worked separately, and would be under the charge of their own shepherd. They usually also bear their own distinguishing keel mark or brand.

† *Downfall.* This is the term given to the lowest slopes of the hill grazing on which the ewes usually graze in winter. Certain farms may have part of the downfall resumed for afforestation, and above the afforested area have, owing to the configuration of the ground, what may best be described as an "upper downfall".

DEDICATING THE CAWDOR WOODLANDS

BY A. R. CRAWFORD
District Officer, North Scotland

IT MAY BE ENCOURAGING TO HEAR of the progress towards Dedication of an estate that has been interested in the Scheme since the early days of 1946.

The estate of Cawdor in Nairnshire has been chosen as a typical example of several of the large forestry estates in the North Conservancy, that are actively interested in Dedication, mainly because—(1) Cawdor is the first estate in the Conservancy to complete the Dedication Agreement; (2) since the start of Dedication, Cawdor has given much helpful criticism; (3) problems which arose on Cawdor are similar to problems which we might meet on a great many estates, large or small; and (4) the area of woodlands is large and gave plenty of scope to try out methods of tackling dedication inspections, etc.

Preliminary discussions during early 1946 were started with the estate on such subjects as:—

(1) *Basis of Dedication*: Basis 2 was chosen.

(2) *Areas to be dedicated*: About 5,500 acres were proposed; these included some 2,700 acres of bare woodland, mostly war fellings. It was decided to exclude the Policy Woods from the Dedication Scheme; these amount to roughly 700 acres. The aim of the estate in the special management of the Policy Woods is the production of large sized timber and the preservation of amenity. High Forest is maintained permanently in the Policies by a careful Selection System.

(3) *Rate of Replanting*: The encouraging fact in this matter was that the estate were starting immediately to replant, and were aiming at the completion of 900 acres within six years.

(4) *Co-operation with Forestry Commission*: The estate agreed to keep in close touch with the Conservancy Office. The Conservator offered all possible assistance.

(5) *The Plan of Operations*: Naturally, this was discussed in detail and at length. The official form of the plan of operations for the dedication scheme was, in early 1946, only under discussion at the Commission's Headquarters. The Commission's skeleton draft form of plan was given to Cawdor in May, 1946.

The estate were fortunate in having a complete set of twenty-five inch Ordnance Survey maps to cover the estate woodlands. Areas, therefore, could be accurately ascertained for the purposes of the plan once boundaries had been inspected and fixed.

In early 1946, sets of six-inch Ordnance Survey maps were difficult to obtain, and it was not until the end of that year that the estate were able to complete their preliminary mapping of the six-inch plan of operations map. From experience gained from the mapping work on Cawdor, we discovered the advisability of estates doing preliminary map work in light pencil or light colouring of crayon. Alterations can then be made easily, if need be, before the final approval of the map and plan.

Cawdor raised the question of the desirability of being able to vary any plan of operations, e.g., for unforeseen or exceptional circumstances such as fire, or a bad weevil attack, or for temporary grazings, etc. Confirmation that

the plan would, subject to the Commission's approval, be sufficiently elastic to cover such circumstances, was able to be given to the estate later, after a ruling on the matter had been obtained from Commission Headquarters.

(6) *Fire protection methods* were discussed with the estate. The estate has now a mutual aid scheme for emergency fire fighting with the Commission, in conjunction with the surrounding private forests in the county.

(7) *Protection against Vermin*, etc., was also discussed, mainly with regard to the replanting plans.

Formal notice from the estate of their intention to consider Dedication was received on 21st April, 1946.

During spring and early summer of 1947, a detailed joint inspection of the Cawdor woodlands was carried out by the estate Head Forester, and the Conservancy Private Woodlands Officer.

For recording data, an ordinary Stationery Office notebook was used by the Private Woodlands Officer, which had attached to the front fly leaf a typed sheet with the following headings:—

Report Data

1. Name of Wood.
2. Total area of Wood.
3. Unplantable area (if any).
4. Elevation: Aspect: Exposure.
5. Soil.
6. Present crop: Age and description of crop or existing conditions.
7. Treatment in force or suggested:
   (*a*) Brush or scrub clearing.
   (*b*) Drains and Fences.
   (*c*) Planting: Species: Methods, etc.
   (*d*) Weeding and Cleaning.
   (*e*) Brashing, thinning and felling.
   (*f*) Natural Regeneration.
   (*g*) Any other observations.
8. Protection—Fire: Vermin: Weevil.
9. Accessibility.

Notes made against those headings for each wood or compartment gave material for a report containing a full record of the woodlands. From the data, the schedule on page 131 was drawn up:—

Area figures in acres for Columns 1 to 20 should balance out. The remaining columns are for handy information. This method of recording information at and after inspections was first tried out by the Commission's officers on Cawdor. It is now used at initial dedication inspections in the North Conservancy. The schedule contains all the information required for the completion and the checking of an official Plan of Operations classification.

Following the field inspections on Cawdor, areas were agreed at the Estate Office. The calculation of those was simplified by the use of the estate's twenty-five-inch Ordnance Survey sheets. The accuracy of the areas stated on the Cawdor plan is due to the use of the twenty-five-inch Ordnance Survey maps.

.....Estate. Classification and Description of Woodlands as at.....

Name of Wood	Total Area of Wood	Compt. No.	Compt. Area	Unproductive Bare Land		Scrub etc.	Unplantable	Planted since 1939		Planted 1920—39		Planted 1900—19		Planted 1880—1900		Planted before 1880		Uneven Aged		Bare felled, etc.		Young Plantations		Thinning Stage		Remarks
				Felled	Other			B.L.	Cfs.	B.L.	Cfs.	B.L.	Cfs.	B.L.	Cfs.	B.L.	Cfs.	B.L.	Cfs.	Ready to plant	Brush or Scrub to be cleared or burnt	No treatment required	Treatment required	Not Urgent	Thinning Urgent	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20							

This initial accuracy has proved most useful in the later working of the plan.

The terms of the Dedication Agreement were not published until February, 1948, but the Cawdor Estate had by that time advanced the preparation of their Plan of Operations to an extent that enabled the Conservator to submit the draft of the plan with its relative six-inch Ordnance Survey maps to the Director for final approval on 16th June, 1948, and the Cawdor plan was approved by the Director before the end of that Forest Year.

Preparation of the Dedication Agreement by the Commission's solicitors was commenced in December, 1948, and the Agreement was completed and signed by both parties by March, 1949. The principal copies of the plan were prepared by the estate, and the signed principal copies were in the hands of the Commission and the estate by early July.

The Dedication Scheme on Cawdor was the first to be completed in the North (Scotland) Conservancy. It is a large area, and the collection of data and the preparation of maps and schedules, along with the checking of them, necessitated a great deal of work and took some time. The experience gained, however, has been helpful, and will be of value in cutting down work and time in dealing with future schemes.

PUTTING IT ON PAPER

By H. L. EDLIN
Publications Officer

ANYONE WHO SETS OUT TO WRITE a scientific or technical article has to follow a set of unwritten rules in order to convey a complete picture of his subject matter. However well composed his article may be, it is of little value to its professional readers unless it includes enough information to answer what have been called "the fundamental scientific questions". In brief, these are:

What? . . . . When? . . . . Where? . . . . How much? . . . . How? . . . . Why? .

The answers to them should be implicit in the construction of the article, clear, and unambiguous, so that neither the editor nor the readers of the article need to ask these or any similar questions to complete their knowledge of the events or objects described.

All this looks obvious enough, but because forestry is a complex applied science, having roots in, and contacts with, many other sciences and fields of knowledge, the answers to these hypothetical questions have to be set out in a particular manner, and it is worth while to examine the rules that should be observed. The more elementary points of style were outlined in my article "Manuscripts for the Press", which appeared on page 169 of the 1948 *Journal.*

One fundamental rule should be followed right through: *The article should be written in English.* I stress this because most of us, when we get to work on our own special subject, tend to drift off subconsciously into a jargon that includes foreign words or literal abbreviations that are meaningless to the layman. If that worthy figure, the man in the street, was asked to explain what "S.P." means, the odds are that he would answer "Starting price", instead of "Scots pine". Likewise you cannot expect all your readers, even if they are foresters, to appreciate the difference between *Plenterwald* (or, as some do call it, *Blenderwald*) and *Saumschlag*; only a privileged few would realise that these terms are roughly equivalent to "selection system" and "strip felling" respectively. If you wish to reach a wider audience, do not use such unusual words without some brief explanation. Aim to make your ideas intelligible to as many people as you can.

English, by the way, includes a broad range of English and Scottish dialects ; but pure Gaelic and Welsh words and phrases, which follow rules of spelling and syntax quite different from those of English, should be distinguished by the use of italics. The same applies to French, Italian, or Latin expressions which have not become absorbed into colloquial English.

Explaining the "What"

In any technical article, the writer should not only say what he is talking about, but define it fairly closely. It is not enough to say, for example, "spruce", unless you deliberately intend it to mean all or any of the various sorts of spruce trees. If "Norway spruce" is intended, say so. Say it in full (not abbreviated to "Norway"), and repeat it, again in full, as often as is necessary. Such repetition may become a little tedious, but it is far, far, better than ambiguity.

Avoid the trick known to writers as "elegant variation". Local newspaper reporters delight in such phrases as "the immortal bard" or the "swan of Avon"

when they mean "Shakespeare", because this avoids repetition. But in a scientific article, say "Scots pine" every time; never call it "Scots" in one line "pine" in another, and "the lofty monarch of the glen" in a third. A foreigner would probably think three quite different trees were implied.

English names of plants and animals should always be given if they exist, but it is often advisable to reinforce this definition by including the scientific name also; sometimes only the scientific name is known. One need not, of course, in every simple forestry article, add "*Pinus sylvestris L.*" to "Scots pine", but in a botanical article, or an article likely to be read abroad, one certainly should. Articles on forestry often refer to plants, fungi, or insects that are less well known, and which must therefore be defined by their scientific names. Here lies a pitfall. Latin is used indifferently by botanists, zoologists, doctors and lawyers. "*Habeas corpus*" could, to the uninstructed, mean an insect, a fungus, or a rare disease; actually, of course, it is a legal term implying the setting free or production of an individual in person. So, if you introduce any scientific name for an organism, make it quite clear whether it is a tree, a smaller plant, a fungus, an insect, or an animal of some other group.

If a good English name exists, use it in the main text, giving the scientific name once only, when the organism is first mentioned.

In passing, remember to underline all Latin names, so that the printer will set them in italics. But do not underline the name of the authority that follows them, nor the symbol "×" for hybrid, nor the abbreviation "var." for variety. Remember to use up-to-date scientific names; changes are, unfortunately, rather frequent. For this reason, Forestry Commission standard names, or *nomina conservanda* have been laid down for use in all official records; where these names differ from the current scientific name, both versions should be given in publications; a list of such cases follows this article. Capitals are used for the first letter of all *generic* names, but the former practice of starting certain *specific* names with capitals has now been discontinued, even at Kew.

Another kind of "what", with which forestry writers often have to deal, is the site description. It is rarely necessary to go into great detail, which soon becomes tedious, but a brief word picture of the ground you are writing about helps the reader enormously. If he has never been to Wareham Forest, the statement that it "lies on the infertile heathland of South Dorset, at elevations ranging from sea level to two hundred feet", gives him an immediate clue to conditions there; one can elaborate this by describing the hardpan beneath the surface soil, difficulties of drainage, etc., but it is the brief topographical description that matters most.

Trade names should be used with care, and only where it is necessary to specify the product of a particular firm. For example, a "Caterpillar" tractor is one made by a particular American firm, and if the machine used in a particular instance was not made by that firm, it is preferable to employ some alternative description, such as "track-laying" or "crawler" which can be accurately applied to any machine of that type.

Explaining the "When"

Scientific information gains greatly in value by being accurately dated, and in forestry, owing to the length of the crop rotation, definition of all relevant time factors is essential. These are, perhaps, more numerous than appears at first sight. Consider whether it is necessary to mention:

Actual dates,
Times of year, or
Hours of day,

at which the events or observations you are describing occurred.

The duration of the event or observation is also of importance. Give some idea of this, wherever it will help the reader. If, as so often happens, you were not there when it all began, estimate the length of time, but make it clear that you are giving an estimate.

Ages of trees and tree crops are all-important, and as a safeguard it is advisable to give them in two forms—by age in years, and by year of planting. For example: "In the spring of 1948 a severe attack of canker was observed on a crop of European larch, planted in 1910, and then thirty-eight years old. It was estimated that this attack must have begun ten years previously, i.e. about 1938".

Remember to give a date and, if possible, an age, for every measurement in which the time factor matters—especially those of tree size and volume. Do not forget to put dates, wherever appropriate, on incidental press matter, such as graphs or tables. All photographs should be dated, though not necessarily for publication.

Explaining the "Where"

Enough information should always be given to enable the average reader to identify the place about which you are writing, with the aid of a good atlas or some standard work of reference. If you are writing about a Forestry Commission area, the official name of the unit, as listed and mapped in the *Annual Report*, should always be stated. When a private estate is mentioned, the name of the county in which it lies should always be given; and in the case of a large county it is a good plan to give the name of the nearest town also.

You may, of course, wish to give closer details, such as the name of the forest block, the compartment number, or even a National Grid reference or Ordnance Sheet number. But the broad details set out in the previous paragraph should always go in.

Queries sometimes arise on the spelling of place names, and the simplest rule to follow is to confirm them with an Ordnance Survey map. This is not the final authority for spellings; purists complain that its renderings of Welsh and Gaelic names are often obsolete or inconsistent; but for the purpose of ordinary geographical description it is a pretty safe guide.

If you use foreign place names, remember that wherever they are used in an English context they must conform to English usage; foreign inflexions and mutations must be dropped.

Explaining the "How Much"

It is surprising how many technical articles are incomplete simply because their author has forgotten to put in the dimensions of the objects he is writing about.

Wherever possible, these should be given in the usual British Imperial units, e.g., inches, feet, and miles for length and distance; square feet, square yards or acres for areas; cubic feet or gallons for volume or capacity; and pounds, hundredweights, and tons for weight. The metric equivalents may be added, if thought necessary; but it is only in a few specialised fields that metric units are sufficient on their own. Above all, never mix your systems of measurement; do not say "the tree was thirty *feet* tall and had a diameter of thirty *centimetres* at breast-height". Be consistent in your use of units of the same system; avoid giving distances in *feet* in one paragraph and distances in *yards* in the next.

Timber measure is rather a tricky field. Be careful to specify the system of measurement you are using, such as Hoppus, or True Measure. Always say whether volumes are given "over bark" or "under bark". Whenever a girth or diameter is given, always specify where it was taken—at breast height, mid-point, butt, or tip of log, etc. State also the diameter down to which the trees, logs, or poles are measured. All these points affect the value of your figures. Remember, too, that the age of the trees or tree crops should always be mentioned to complete the picture.

Costs and prices are another source of difficulty. Everyone knows how wages, and the value of the pound, fluctuate from time to time. The statement that "tree planting cost £2 an acre" means next to nothing unless the year in which the work was done is added; even if the year is known, it may take an economist to work out what the same job would cost in 1950. Therefore, on all costs of work done, give the wage rate on which the costs were calculated, e.g., 1s. per hour, or £4 per week; or else express the results in "man-days".

Make sure that your series of dimensions is complete, and do not forget the derived measures such as:

Stems per acre
Volumes per acre
Increments per acre per annum
Height growth in feet per annum.

Sometimes these figures are implicit in the simple measures already given, but if they will serve a useful purpose, work them out and include them. This will save your readers—and there may be thousands of them—from doing the necessary calculations themselves.

Spell the names of units out in full; leave it to the editor to decide whether he has to compress "quarter girth" to "q.g.", to save space.

Answering the "How"

If there are two or more ways in which a job could have been done, let your readers know, if you can, just how it actually *was* done. For example, if you say "the trees were planted in 1926", you leave open the question of the method used. Were they:

(*a*) Pit planted?
(*b*) Notch planted?
(*c*) Turf planted?

This is just an example of the "open questions", "moot points", or "loose ends" with which some articles abound. Try to forestall queries of this kind.

If you are describing an actual process that you have tried out yourself, put yourself in the position of a man coming newly to the job, and imagine what he would need to know in order to do it thoroughly. For example, what tools would he require?

Answering the "Why"

Although most scientific articles deal with simple facts, it is sometimes helpful to know the motives that prompted a choice of method or planting site, particularly if something unusual has been done. If you read, for example, that all the young ash trees in a plantation had been cut back to ground level, you might well ask why. Were they attacked by disease, or did the owner consider that the resulting coppice shoots would ultimately develop into better trees?

Drafting and Checking the Text

Before you actually sit down to compose your article, assemble the facts that you will need to give the answers to these six possible questions. See that you have correct descriptions for your subject matter, particularly if scientific names are involved. Draw up lists of necessary dates and dimensions, and details of situations, methods, and, where appropriate, the motives of the people concerned. When you have done this, you will have the framework of your story all ready to hand, and will only need to clothe these bare bones with the living flesh of words and phrases. If some details are lacking, do not delay putting your thoughts on paper until all these details have come to hand. Go ahead and write what you can, leaving blanks at appropriate places, to be filled in later.

Once the story has been written, leave it for a day or two and then come back with an open mind, and check it through to see if any of the six questions remain unanswered. Imagine that a reader is looking over your shoulder—a keen young student, for instance, or some forester from a foreign country eager to find out all he can about conditions, methods and results, in the part of the country where you are working. Would such a man want to know more? Is it all quite clear to him? Remember that you have a thousand or more potential readers like that, separated from you by long miles of distance, and possibly by long years of time. You cannot take them all out into the woods and let the facts explain themselves, but you can and should make your account so clear and complete that they can visualise the scene for themselves, and that is the aim of all good writing.

FORESTRY COMMISSION STANDARD NAMES AND CURRENT SCIENTIFIC NAMES OF CERTAIN COMMON FOREST TREES

English Name	*Forestry Commission Standard Name*	*Current Scientific Name*
Corsican pine	*Pinus laricio* Poir.	*Pinus nigra* var. *calabrica* Schneid.
Austrian pine	*Pinus laricio* var. *austriaca* Endl.	*Pinus nigra* var. *austriaca* Asch. & Graeb.
European larch	*Larix europaea* D.C.	*Larix decidua* Mill.
Douglas fir....	*Pseudotsuga douglasii* Carr.	*Pseudotsuga taxifolia* Britt.
Norway spruce	*Picea excelsa* Link.	*Picea abies* Karst.
Silver fir	*Abies pectinata* D.C.	*Abies alba* Mill.
Pedunculate oak	*Quercus pedunculata* Ehrh.	*Quercus robur* L.
Sessile oak	*Quercus sessiliflora* Salis.	*Quercus petraea* Lieb.
Birch	*Betula verrucosa* Ehrh.	*Betula pendula* Roth.
Black Italian Poplar	*Populus serotina* Hartig	*Populus canadensis* var. *serotina* Rehd.
Wych elm	*Ulmus montana* Stokes.	*U. glabra* Huds.

A NOTE ON SILVICULTURAL LITERATURE IN THE UNITED STATES OF AMERICA

By G. D. KITCHINGMAN
Librarian, Alice Holt

I AM OFTEN ASKED about the forest literature of the United States. I myself find it very confusing, and so perhaps a few notes on what sources we find the most useful in this library would be helpful.

The Americans produce an enormous amount of literature on forest subjects and, considering the size of their country and the area under forest (National forest—180 million acres: Private forests—261 million acres), this is not altogether surprising. But not all of this literature is of interest in this country; it needs a good deal of sifting before it can be recommended for reading. The titles of the articles are so often misleading that it is essential, in the search for information, to know the names of the men who are working on the subjects in which we are interested, the institutions where they work and in which publications their writings are most likely to be found. Half the battle of finding information is to know where to look for it.

Periodicals. The best of the journals for technical articles on silviculture is undoubtedly the *Journal of Forestry*. This is the official organ of the Society of American Foresters, and is published monthly in Washington at six dollars a year. Originally there were two major periodicals: the *Forestry Quarterly*, which ran from 1902 to 1916 and the *Proceedings of the Society of American Foresters*, which ran from 1905 to 1917. In 1917 these two were combined under the title of the *Journal of Forestry*, as today.

The best of the popular magazines is *American Forests*—published monthly by the American Forestry Association at five dollars a year (and now in its 50th year). This magazine is good light reading, and often a pointer to where something more learned can be found.

Federal Literature. The Federal Forest Service, founded in 1905, is part of the Department of Agriculture, and publishes most of its technical reports in that department's series of technical bulletins, circulars, etc. So next time you are studying Forestry Abstracts and come across the mysterious abbreviation "Tech. Bull. U.S. Dept. Agric." you will know that this is a bulletin of the Federal Forest Service. This series is an important source of information, for reports on forestry matters have been appearing in it, on and off, since 1887.

The Federal Service is divided into five administrative branches of which the Research Branch is, from the point of view of literature, perhaps the most important. It is decentralised in twelve Forest Experimental Stations, each covering a geographical region. These stations are concerned, not only with the National forests within their region, but also with problems arising in Private and Public forests.

To follow a particular line of research, therefore, it is necessary to know at which station the problem is being studied. The twelve stations and the subjects which may be of interest to foresters in the United Kingdom are as follows:—

(1) Northeastern For. Exp. Sta., Philadelphia, Pennsylvania.
(Silviculture and genetics of hardwoods.)

(2) Southeastern (formerly Appalachian) For. Exp. Sta., Ashville, N. Carolina.
(Fire control in hill conifers, effects of forests on streamflow and water utilisation.)

(3) Central States For. Exp. Sta., Columbus, Ohio.
(Private forestry, afforestation of derelict woodlands and slag heaps.)

(4) California For. Exp. Sta., Berkeley, California.
(Erosion control, forest genetics, bark beetles.)

(5) Intermountain For. Exp. Sta., Ogden, Utah.
(Erosion and flood control in the Colorado river watershed.)

(6) Lake States For. Exp., Sta., St. Paul, Minnesota.
(Nursery and planting practice with hardwoods.)

(7) Northern Rocky Mountain For. Exp., Sta., Missoula, Montana.
(Fire behaviour and fire weather evaluation in western white pine (*Pinus monticola*).)

(8) Pacific Northwest For. Exp. Sta., Portland, Oregon.
(Silviculture and Management of Douglas fir.)

(9) Rocky Mountain For. Exp. Sta., Fort Collins, Colorado.
(Effects of forest type, cutting, etc., on snow and rainfall interception, run off, etc.)

(10) Southern For. Exp., Sta., New Orleans, Los Angeles.
(Silviculture and fire protection in southern pines.)

(11) South West For. Exp. Sta., Tucson, Arizona.

(12) Tropical For. Exp. Sta., Rio Piedras, Puerto Rico.
(Tropical forestry and survey of forest resources of Central America.)

All these stations produce reports, research notes, etc., which require watching, for every now and then there is something of real interest to us in Britain. A point worth mentioning here is that a great many of the technical articles in the *Journal of Forestry* are written by men on the staff of these Experimental Stations.

Soil Conservation Service. This Service, established in 1935, is quite a separate federal agency to the Forest Service. Its publications often contain useful material on private forestry, and in particular shelterbelts on what are known as farm woodlots.

Forestry in States. About 48 of the States have their own forest departments, each publishing annual reports and numerous odd pamphlets in which we often find interesting matter about State and National Parks. Where forest schools are located at the State University, the publications of the State forest service often emanate from the university, or from an agricultural experimental station attached to it.

Schools of Forestry. "The year 1898 marked the beginning of systematic education in forestry" (Graves), but by 1949 there were no less than 34 schools of forestry with 8,212 undergraduates attending—an extraordinary development for only half a century. From the literary point of view the four most important of these schools would seem to be:

Yale University. This is now the oldest forestry school in the United States and dates from 1900. (Biltmore and Cornell started in 1898, but both had closed down by 1912.)

Harvard University. Since 1904.
Syracuse University, New York State. Since 1911.
Duke University. Since 1931.

All these publish a series of technical bulletins of a high quality.

Demonstration Forests. The American schools are particularly well equipped with Demonstration Forests—model forests to demonstrate the practice of forestry. (Compare Oxford with her Bagley Wood.) Yale owns 3 forests (Yale, Keene and Bowen) with a total acreage of 9,600 acres, and has the privilege of using the Eli Whitney forest (2,200 acres) which "has been under sustained yield management since 1900—longer than any other forest tract in America" (Hawley). Harvard owns the famous Harvard forest (2,292 acres) which has been under continuous intensive management since 1907; and the Duke school has a 6,000 acre forest adjoining the University. Another well-known forest of this class is the Charles Lathrop Pack area (2,328 acres) managed by the forestry school at Syracuse.

The occasional reports on Demonstration forests (there are about 85 in the U.S.A.) are important in that they probably furnish the best description of American silvicultural practice: this because they have generally been managed more intensively than any other class of forest. One must remember that, on account of the large areas involved in the States, intensive silviculture is not yet very widespread.

Associations and Organisations Interested in Forestry. Of the numerous associations (over 100) interested in forestry and allied subjects, the best known are perhaps the American Forestry Association (1895) which publishes *American Forests*, and the American Tree Association (1922) which specialises in the task of mass education for forest conservation. The Charles Lathrop Pack Foundation is another one, and "promotes educational and scientific work and the publication of forestry material contributing to the advancement of forestry".

Text-books. America did not begin to produce text-books of her own till well into the present century, and the few that did appear in the 19th century (Pinchot, Fernow) were not much more than descriptions of European methods. As late as 1911, Fernow could write "until the first book of silviculture based on American data and conditions is written, Dr. Schlich's volume will remain the American forester's handbook". But gradually, as in British India and in Great Britain, foresters came to realise that the classical French and German methods needed to be modified (if not forsaken) to suit local conditions. It is only then that a country will begin to build up a literature on its own. There have been plenty of text-books in the last 30 years and, among the best of the silvicultural ones I would place the following:—

General: *Elements of Forestry*, Moon & Brown
Wiley, New York, 3rd Edn., 1937.
Introduction to American Forestry, Shirley W. Allen.
McGraw-Hill, New York, 1938.

Botanical: *Text-book of Dendrology*, Harlow & Harrar.
McGraw-Hill, 2nd Edn., 1941.

Silviculture: *Foundations of Silviculture*, Toumey.
Wiley, 2nd. Edn. (by C. F. Korstian), 1947.
Seeding and Planting in the Practice of Forestry, Toumey & Korstian.
Wiley, 3rd Edn., 1942.

Other Text-books. Among text-books for other branches of forestry, the following can be recommended:—

Forest Soils and Forest Growth, Wilde.
Chronica Botanica. 1946.

Forest Tree Seed, Baldwin.
Chronica Botanica. 1942.

Forest Protection, Hawley & Stickle.
Wiley, 2nd Edn. 1948. (Excellent sections on Fire Protection.)

Forest Pathology, Boyce.
McGraw-Hill, 2nd Edn. 1948.

Elements of Forest Mensuration, Chapman & Demerrit.
Tryon, Albany, 2nd Edn. 1936.

Logging, N. C. Brown.
Wiley. 1949.

Harvesting Timber Crops, Wackerman.
McGraw-Hill. 1949.

ADDITIONS TO THE FORESTRY COMMISSION LIBRARY

By G. D. KITCHINGMAN
Librarian, Alice Holt

THE FOLLOWING LIST of selected items added to the Departmental Library at Alice Holt Research Station between 1st July, 1948 and 30th September, 1949, is intended mainly to give an idea of the scope and variety of literature available there. A duplicated list of additions is circulated periodically, and may be consulted at Directorate and Conservancy Offices. Applications for the loan of books should be addressed to:—

The Librarian,
Forestry Commission,
Alice Holt Lodge,
Wrecclesham,
Farnham,
Surrey.

Title and Author	*Publisher and Year*
Die Buchenwalder Europas. (The beech forests of Europe.) E. Rubel. A collection of studies on beech forests by European experts (English and German).	Huber, Bern, 1932
L'Introduction des essences exotiques dans les forêts de l'Europe occidentale. L. Farde.	Paris, 1929.
Timber: its structure and properties. H. E. Desch.	Macmillan, London, 2nd edn., 1947.
Conservation of Nature in England and Wales. J. S. Huxley & A. G. Tansley. The report of the Wild Life Conservation Special Committee (England and Wales) presented by the Minister of Town and Country Planning to Parliament.	H.M.S.O., London, Cmd.7122, 1947.
Working Conditions in the Civil Service. H.M. Treasury.	H.M.S.O., London, 1947.
British Grasses and their employment in agriculture. S. F. Armstrong.	Camb. Univ. Press, 3rd edn., 1948.
The Mountains of Snowdonia. H. R. C. Carr and G. A. Lister.	Crosby Lockwood, London, 2nd edn., 1948.
Boomzaden (Tree seeds). Dutch Forestry Society. A guide to seed collection, treatment, storage and sowing for 73 different species. (In Dutch).	Ponsen & Looven, Wageningen, 1946.
Propagation of trees shrubs and conifers. W. G. Sheat. A valuable reference book on the propagation by seed, cuttings, budding and grafting of a large number of plants.	Macmillan, London, 1948.
Wild Animals and the Land. F. H. Lancum. With one passing reference to forestry, deals with the relationship to agriculture of British mammals, reptiles and amphibia.	Crosby Lockwood, London, 1947.

Title and Author	*Publisher and Year*
Report of the National Parks Committee (England and Wales). Sir A. Hobhouse.	H.M.S.O., Cmd.7121, 1947.
Aerial Photographs in Forestry. S. H. Spurr.	Ronald Press, New York, 1948.
Genetics in Swedish Forestry. B. Lindquist. An account of the scope of genetics in Swedish forestry practice, with particular reference to the survey and use of elite trees for improving the quality of the forests.	Chronica Botanica, Mass., 1948.
Forest Pathology. J. S. Boyce. Although written by an American for American conditions, this is certainly the best general text book of forest pathology in the English language.	McGraw-Hill, New York, 2nd edn., 1948.
Conifers and their Characteristics. C. C. Rogers.	Murray, London, 1920.
Woods, Forests and Estates of Perthshire. T. Hunter.	Henderson, Perth, 1883.
The Forests of Sweden. T. Streyffert. A small handbook (71 pages and written in English) which gives a general description of the different forest regions, utilisation methods, yield, etc., of the country.	Stockholm, 1938.
Lauvskogen (Deciduous forests). K. Skinnemoen. A short description (in Norwegian) of the hardwood forests of Norway.	Oslo, 2nd edn., 1947.
Home Timber Production (1939-1945). R. Meiggs. An authoritative survey of the work of the Home Timber Production Department.	Crosby Lockwood, 1949.
International Rules of Botanical Nomenclature. W. H. Camp et al. Enumerates the 74 articles or rules and the 49 recommendations that have governed international botanical nomenclature since the 1935 conference in Amsterdam.	Chronica Botanica, 1948.
Logging. N. C. Brown. Covers the whole field of recently developed mechanical devices, e.g., logging, felling and cross-cutting, skidding and loading, etc.	John Wiley, New York, 1949.
The Scientific Paper. S. F. Trelease. Hints on how to write a thesis or scientific paper.	Williams & Wilkins, Baltimore, 1947.
Sampling methods for Censuses and Surveys. F. Yates. Primarily written for those undertaking census or survey work, but of value to all foresters who use sampling techniques.	Griffen, London, 1949.
Animal Ecology. C. Elton.	Sidgwick & Jackson, London, 1947.
The Soil and the Plant. E. Vanstone	Macmillan, London, 1947.
Fertilisers and Manures. E. Vanstone	Macmillan, London, 1947.
Manual of Map Reading, Photo Reading and Field Sketching. (War Office, London.)	H.M.S.O., London, 1939.

Title and Author	*Publisher and Year*
Tree and Shrub Growing. W. H. Rowe	Faber and Faber, London, 1949.
The Life Forms of Plants. C. Raunkiaer. Professor Raunkiaer's work on the life-forms of plants has long been known to British botanists and ecologists through the excellent translation by Mr. Gilbert Carter. This book, bringing together all Raunkiaer's publications on this and kindred subjects, is a mine of information for all who are interested in the life histories and distribution of plants and their special adaptations to environment.	Clarendon Press, Oxford, 1934.
The Shorter British Flora. C. T. Prime and R. J. Deacock.	Methuen, London, 1948.
The Care and Repair of Ornamental Trees. A. D. C. Le Sueur.	Country Life, London Rev. edn., 1949.
Modern Mechanical Saw Practice. J. R. Foyster.	Crosby Lockwood London, 1947.
Breaking New Ground. G. Pinchot. An autobiography of Gifford Pinchot—one of the creators of the United States Forest Service.	Harcourt Brace, New York, 1947.

UNITED NATIONS SCIENTIFIC CONFERENCE ON THE CONSERVATION AND UTILISATION OF RESOURCES—1949

BY JAMES MACDONALD
Director, Research and Education

THIS CONFERENCE WAS HELD at Lake Success, on Long Island, near New York. It opened on Wednesday, 17th August, and concluded on Tuesday, 6th September.

Organisation

For working purposes, the Conference was divided into six sections, each dealing with one of the following subjects—Minerals, Fuels and Energy, Water, Forests, Land, Wildlife.

The meetings were of two kinds, Plenary meetings, at which the full Conference assembled, and Sectional meetings, at which delegates dealt with matters referring to the sections in which they were interested. All meetings were open to the public, who attended the Plenary meetings, sometimes in large numbers, and who helped to make up respectable attendances for many of the Sectional meetings.

Plenary Meetings

The Conference opened with two days of Plenary sessions in which the situation was reviewed generally. One of the subjects dealt with was shortages, and among the papers presented was one by Monsieur Marcel Leloup, of Food and Agricultural Organisation of the United Nations, on the forestry situation. At the concluding Plenary sessions, which likewise lasted two days, a summary of the work of the Conference was undertaken, and here, forestry was dealt with by Monsieur René Jolain, Inspector General of Forests in France. Each afternoon, while the Conference was in session, Plenary sessions were held, and although forestry matters were dealt with in individual papers such as that by Dr. J. A. Hall, Director of the Pacific North-west Forestry Experimental Station on "Wood Fibre—a Creatable Resource of Wide Utility", and referred to in other statements, there was no Plenary session allocated wholly to forestry.

The Plenary meetings, on the whole, were disappointing as there was inadequate time for discussion. Each author read his paper in full, which seemed unnecessary in view of the distribution at the beginning of every session of typewritten copies of each paper, and it would have been better if these documents had been circulated in advance, the papers presented in summary form, and more time made available for discussion.

Sectional Meetings—Forestry.

The following meetings were held:—

1. Forest Inventories—
   (*a*) Sampling Methods.
   (*b*) Air Surveys.

Chairman—Mr. P. C. Mahalonibis, F.R.S. (India)

2. Protection—
   (*a*) Fire Control.
   (*b*) Insects and Diseases.

Chairman—Lord Robinson (United Kingdom).

3. Management—
   (*a*) Management Practices.
   (*b*) Silvicultural Techniques.

Chairman—Monsieur R. Jolain (France).

4. Protective Function—
   (*a*) Water supplies, wildlife, etc.
   (*b*) Torrent and avalanche control.

Chairman—Mr. Reed W. Bailey (United States of America).

5. Administration—
   (*a*) Policy and Law.
   (*b*) Organisation of Services.

Chairman—Mr. M. P. Price, M.P. (United Kingdom).

6. Harvesting—
   (*a*) Logging Methods.
   (*b*) Log transportation.
   (*c*) Saw Mill Techniques.

Chairman—Mr. S. B. Show (United Nations).

7. Wood Chemistry—
   (*a*) Pulping processes.
   (*b*) Utilisation of waste.
   (*c*) Preservation of wood.

Chairman—Mr. J. D. Hale (Canada).

The meetings were fairly well attended, but the number of forestry delegates was not large and many countries, particularly in Europe, were not represented. This was, no doubt, due to the World Forestry Congress at Helsinki, which finished its session shortly before this Conference began.

The British Commonwealth was represented, in the Forestry sections, by a varying number of delegates from Canada, three from Great Britain, one from India, one from the Middle-East, and one from Australia. New Zealand sent a number of papers but no forestry delegate and the same applied to several other countries.

The papers presented at the sectional meetings were variable in quality and several were little more than general essays of a fairly elementary character. On the other hand, there were one or two valuable experience papers on different subjects.

Public Interest

The American public appeared to take much interest in the Conference, to judge by the attendances and by the references in the Press.

The Government of the United States also appeared to consider it of importance, as at one stage two ministers were present, Mr. C. F. Brannon, Secretary of Agriculture, and Mr. J. A. Krug, Secretary of the Interior. Mr. Secretary Krug was present throughout most of the meeting.

Visits

During the Conference, Lord Robinson was able to pay visits to Washington, to Ottawa, and to the New York State College of Forestry at Syracuse. I attended excursions to Millbrook, New York, and to Saratoga and the Pack Memorial Forest. I was also able to visit the North Eastern States Forest Experimental Station at Upper Darby, Philadelphia, and to spend two days in the forests of the anthracite region of Pennsylvania.

ORGANISATION AND METHODS IN A CONSERVANCY OFFICE

THE HUMAN FACTOR

BY T. FARMER
Chief Clerk, West Scotland

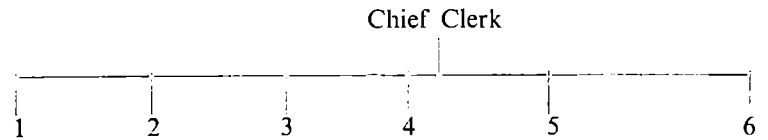
ENCOURAGED BY THE PUBLICATION in the 1948 and 1949 issues of the *Journal of the Forestry Commission* of articles on this subject, I offer for the consideration of indulgent readers a third instalment. It may be remembered that the first article attempted to deal in broad outline with the organisation structure of the new Conservancy office as it appeared to be taking shape in 1946 and 1947, and to draw attention to certain general principles of organisation and responsibility which seemed to be important in developing the desirable structure. Mention was also made of a number of points of doubt which required consideration for the future, e.g., did the State Forest Officer require separate whole-time office assistance, and should clerical work connected with Forest Produce continue to be performed in the Accounts Section or be transferred elsewhere?

The second article claimed that during the eighteen months following the general re-organisation of the Forestry Commission at 1st January, 1946, the main emphasis at Conservancy level had probably been on organisation rather than on methods, but by mid-1947 the accent would be changing over to method. The evolution of the organisation structure in one Conservancy office was reviewed briefly, and attention was drawn to the fact that certain points of doubt or difficulty remained unsolved, including the two mentioned above. The claim was made that it seemed to be necessary to divide the work and staff into five main sections, although the best functional grouping of the work among and within these sections was still uncertain. The article then went on to deal at greater length with the progress made with defining staff duties and responsibilities, and preparing detailed Procedure Records. The importance of these items was stressed as a means of (*a*) training staff (*b*) achieving greater simplification and standardisation and (*c*) ensuring some continuity of control. It is now proposed to review briefly developments as regards organisation and methods, and then move on (with some deference) to the all-important question of the human factor.

Organisation

In this office, a further year's experience has tended to confirm the need for grouping the work into five or six main sections, and *ipso facto* the need for five or six competent Section Heads of appropriate grade. But with only five Section Heads, it has not been possible to try out the organisation believed to be needed—at least at the present stage. The problem has been complicated, moreover, by the addition of a further function, viz., Mechanical Engineering controlled by an Assistant Engineer. The creation of Conservancy Workshops, and the development of a direct inspection and maintenance function, with specialist field staff, have brought an inevitable increase of clerical work in their train. The volume of paper work increases steadily and growth is particularly noticeable in connection with Private Woodlands and Utilisation.

It is now clear that, despite the seasonal nature of the work, the State Forest Officer does in fact require whole-time assistance of office staff; possibly one clerk would suffice. It is also highly desirable that the Finance Section and Accountant should be relieved of all other work such as Forest Produce and be confined to their proper accounting/costing function. And it seems to be undeniable that the composite Stores/Engineer/State Forest/Utilisation-and-Sales Section mentioned last year is now beyond the powers of one Executive Officer and three clerks, besides exceeding the range of attention of the Executive Officer in charge. The inevitable conclusion is that this Section must be divided in two, and that a sixth Section Head should be provided. The last word cannot yet be said about the consequent re-grouping, but the following structure is suggested:—



1	2	3	4	5	6
Estate and Land Agency	Finance	Establishment	State Forest and Utilisation	Private Woodlands	Supply and Common Services (Mechanical Engineering, Stores and Stationery, Drawing Office and Common Services)

Notes:

(i) Section 1 would work in consultation with Divisional Officer (Estate) and Conservancy Engineer (Civil).

(ii) Section 4 would work in consultation with State Forest Officer.

(iii) Section 5 would work in consultation with Private Woodlands Officer.

(iv) Section 6 would work in consultation with Assistant Engineer (Mechanical).

(v) Typing Pool, Registry/Despatch and Messenger (i.e., Common Services other than Drawing Office) might be grouped with Section 3 (Establishment) instead of Section 6 (Supply and Common Services), but this is not considered so suitable.

(vi) As the volume of timber sales increases, it will probably become necessary to provide the State Forest Officer with a Utilisation Officer to assist him; and perhaps even to separate eventually the Production and Sales functions, as is normally done in industrial concerns.

(vii) There is probably much to be said for developing the organisation under control of Conservators along strictly functional lines, and making the "Field Officers" directly responsible for controlling *all* the work and staff employed in their function, both field and office. This course would demand considerable re-grouping, not to mention re-education of the staff concerned, and should probably be delayed until the volume of work in each function requires at least three of a staff. Specialised sections less than three strong create difficulties during annual leave and sick absence.

The problems of organisation at Conservancy level are by no means solved as yet, but it seems clear that a desirable pattern is gradually emerging in the light of experience. Of course no permanent, static and uniform structure can ever be reached, but careful foresight and planning can probably attain the necessary flexibility, achieve the best possible grouping at each stage in the future, and above all prevent any major break-down through unpreparedness or loss of control and co-ordination because of inappropriate and unworkable organisation.

Methods

The principles and procedures described in the first article in connection with the filing system and correspondence appear to have been sound, and they have worked out reasonably well in practice. No major improvement can be suggested in the light of experience, but it would probably be helpful if the duties and responsibilities of the Chief Clerk were authoritatively and realistically defined. Such definition has been made for most other grades, and it is somewhat surprising that Conservators and Conservancy Chief Clerks themselves have been left so much to work out their own salvation in this respect.

The preparation of Staff Duty and Responsibility Schedules and of Procedure Records described in last year's article has been found helpful; although much new ground remains to be covered, and an effort is necessary to keep all existing records under continuous review. It is, however, much easier to review a written record than it is to make a first investigation by questioning the staff concerned and checking their answers against actual practice. For purposes of revision it is better to refer to a written record than to depend on a hazy recollection. Written records provide permanence and continuity, whereas human memory is short and appointments are often transient. Such records are a useful aid to training of new staff, and a constant challenge to junior staff to suggest improved methods. They have, it is believed, materially helped to bring some order out of potential chaos—not only in the minds of comparatively inexperienced supervisors, but also in actual "brass-tacks" practice.

These records are not, of course, an end in themselves; they are merely operating aids and tools of management. The staff itself is the all-important factor. Given the best organisation structure science and ingenuity can invent, the most detailed and carefully prepared procedures which knowledge and experience can devise, a poor staff will not succeed. On the other hand a good staff with high morale will make even the worst organisation work somehow, even if they are without a single written procedure record; but it is doubtful if in such circumstances they will work so effectively as they might do otherwise. As Elton Mayo, the famous industrial psychologist put it: "The task of management in an industrial organisation may be summarised in three phrases:

(1) The application of science and technical skill to some material good or product. (Planning and Methods.)
(2) The systematic ordering of operations. (Organisation and Control.)
(3) The organisation of team-work—that is, of sustained co-operation. (Leadership and Co-ordination.)"

Assuming, then, that in the development of our Conservancy offices due attention has been, and is being paid, firstly, to the organisation structure (a somewhat static concept), and secondly, to the systematic ordering of operations (definition of duties and preparation of procedure records), what further steps ought to be taken to organise the team-work and secure the "sustained co-operation" of the staff? Without this last element, the first two are obviously

barren and sterile; whereas by suitably motivating the staff, engendering high morale, and effective team-work, all things are possible.

The Human Factor

The human factor, the staff, we have always had; and no doubt this factor has always been carefully considered and has received a great deal of attention by supervisors at all levels. But has it always had all the effective attention it deserves and needs? In the Civil Service the staff is fortunate in many respects as to conditions of service, pay, leave, pension, security, etc., and such matters are outwith the scope of this paper. Have, however, the most up-to-date lessons of personnel management research been fully appreciated and applied in our offices, especially by immediate supervisors at the lowest levels? For example, could we not all learn much from such research as is revealed in the published reports of the Hawthorne Investigations in the Western Electric Company (Urwick and Brech, 1948)? Would it not pay supervisors at all levels and in all sections to study carefully Sections Q.40 (*a*) to (*e*) inclusive, R. and S. of Estacode, consider the principles defined, and endeavour to apply them? It is claimed that life and service in industry or in an office are primarily a social process, and that management and supervision, to be fully effective, must appreciate the implications of this philosophy and adapt their attitude towards their staffs—subordinates, equals and superiors—accordingly. Scientific research has done much to establish the factors governing the will-to-work and co-operate on the part of men and women, and is stressing the dictum that "the whole man" is employed—not just the hands or brain. Modern writers on personnel management emphasise, as their common doctrine, the great importance of such factors as: positive training; encouragement of initiative and responsibility in subordinates; consultation (preferably intimate, informal and continuous between immediate colleagues rather than, or in addition to, the highly formalised and somewhat two-sided consultation of the Whitley Councils or Joint Production Councils); and democracy in industry (and in the office) in place of the old-fashioned autocratic attitude of "masters" and "bosses". Might not closer attention by us all to these recent developments produce a more enlightened and effective leadership, and secure in our office and department that high standard of morale, effective and economical conduct of our business? This point is stressed by A. P. Young in his book *The World of Industry* (Young, 1946), in which he writes:—

> "It is abundantly clear to anyone who has had experience in the vast realm of production planning that the human factor is of supreme importance; and that any production plan must embrace planned action to guard effectively this factor, and all that this means in social and human well-being and happiness. Thus, whilst it is not generally assumed to be the case, the personnel, welfare and training departments which now form part of every well-run organisation of any size do, in fact, constitute a limb of growing importance in the whole planning structure which enlightened management is ever eager to develop and perfect."

Conclusion

Our organisation will continue to evolve, and there is now every sign that it will do so along the right lines. Clerical techniques and practice will no doubt change as time goes on, and we may well hope that they will improve with change and the development of mechanisation, simplification and standardisation. Is it not also to be hoped that our appreciation and practice of management as a "*social skill* (i.e., our ability to secure co-operation between people)" will at last keep step with our more technical skills, and produce all the immeasurable benefits of sound working relations in the conduct of

our business? Mere hard work and enthusiasm (of which we have plenty in the Forestry Commission) are not really in themselves enough. The ideal to aim at, surely, is the effective and efficient team-work produced by the willing co-operation of contented individuals, each finding satisfaction in giving the best and the most of which he is capable, working harmoniously within the most appropriate organisation structure and according to the best possible procedures, inspired and motivated by friendly and enlightened management—in short, dynamic democracy in action in our office.

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THE REPLACEMENT OF FOREST CLERICAL STAFF BY AREA OFFICERS

By I. J. ROBERTSON
Clerical Officer, East Scotland

IT WOULD APPEAR to be possible to exercise a great saving in clerical costs if the present clerical staff employed at individual forest units were replaced by a Clerical Officer who would be responsible for all accounting in a particular district.

So far as the East (Scotland) Conservancy is concerned a ratio of one Clerical Officer (or Area Officer) per District Forest Officer would appear to be feasible, each District Officer having an average of 8.5 forests under his charge. In view of the fact that a Clerical Officer employed in the Conservancy Office is responsible for all secondary accounting necessary for approximately seventeen units, the volume of work involved in both primary and secondary accounting for eight units would appear to be similar.

The duties of the Area Officer can be broadly outlined as follows:—

1. *Paylists*

The compilation of all paylists and the payment of staff. Time books or sheets to be supplied by Forester. It would, of course, be necessary to arrange a different pay day for each forest excepting when two or more forests are in close proximity.

2. *Income Tax*

The remittance monthly of all Income Tax deducted direct to the Collector of Taxes. All tax matters to be dealt with direct and not through the Conservancy Office.

3. *Forester's Cash Account*

The maintenance of separate Cash Accounts for each forest in the area. The payment of debts incurred locally (it may be possible to increase the limit to say £10 and thus reduce Conservancy Office payments). The collection of all amounts due to the Forestry Commission.

4. *Produce Account*

Compilation of Form A.71. Details to be supplied by forest staff.

5. *Produce Advice*

Orders for produce sent from Conservancy Office to be in duplicate, one Forester, one Area Officer. After despatch Foresters send copy to Area Officer for Advice Note.

6. *Stores*

All matters referring to stores with the exception of the Stores Ledger (the non-consumable stores being the Forester's responsibility).

7. *Suspense Ledger*

All labour charges appearing on Progress Reports to be invoiced on Form A.35 and collected by Area Officer. Summary of Ledger to be forwarded to Conservancy Office with account.

F. W. HAMILTON, O.B.E.

D. W. YOUNG, O.B.E.

A. D. HOPKINSON, O.B.E.

THE PARENT LARCH TREES AT KENNEL BANK, DUNKELD, PERTHSHIRE

On the left, European larch, 201 years old, 123 feet high; on the right, Japanese larch 66 years old, over 81 feet high (in 1950). For articles on these trees, and on the hybrid larch, see 1949 *Journal*, pages 150-153.

8. **Monthly Account**

The Area Officer to be responsible for the costing to Standard Head Ledgers both Payment and Receipt and for the compilation of Forms A.106, 107, IIIa and b, 116 and a summary containing totals of each form. An abstract of cash book entries would require to be supplied by the Conservancy Office and in turn all amounts chargeable against Tractors, Ploughs, Forest General, etc. supplied to Conservancy Office.

This system would relieve the Forester of all financial responsibility and he would at no time require to handle cash apart from a local cash sale for which he would issue a form A.35.

The saving in costs can perhaps be visualised from the figures shown below. It is appreciated that the figures do not include the initial cost of the necessary motor transport, but as that is not a yearly figure an estimate can be added. The saving in the first year would appear to be over £2,500, which would cover the initial cost of six motor cars.

In the larger forests it may be necessary to retain a clerk on part time clerical duties, but each case could be reviewed on its merits and the result would not alter the financial aspect greatly.

Forests	£	*Forests*	£
21 F. Clerks Average £3 14s. 0d.	4,040	6 C.Os. (Area) £350....	2,100
3 M. Clerks Average £4 15s. 0d.	740	(Estimated cost of Subsistence £25)	
Conservancy Office		Travelling £75	600
3 M.C.O. Average £350	1,050	Offices £10	60
1 F.C.O. Average £325	325	*Conservancy Office* 1 C.O. (Cash Book and summaries)	350
	6,155		3,110
		Difference	3,045
	6,155		6,155

The Conservancy Office Accountant, being equal to both sides, has not been included.

The average C.O. salary of £350 per annum is actually higher than exists in the present accounts staff.

The Controller of Finance says:—

The idea of relieving the Foresters of Clerical Work and replacing Foresters' Clerks by Area Officers—one per District—is an interesting one. As a matter of fact, there has already been some discussion about the possibility of setting up District Offices which could take over some of the foresters' clerical work and thus relieve the foresters on the one hand and the Conservancy Office on the other.

A re-organization of clerical work on these lines has much to recommend it, but it involves wider considerations than perhaps the writer of the article appreciates.

Certainly it is not clear that he appreciates what is involved in his proposal to transfer the posting of the ledgers and the preparation of the forest monthly accounts from the Conservancy to his Area Officers. Before any such schemes could be considered, it would have to be worked out in much greater detail than is done in this paper.

PUBLICATIONS WORK

BY H. L. EDLIN
District Officer, Publications

THE PUBLICATIONS BRANCH is numerically a small section of the Department, but it forms a channel through which passes the printed record of the work of the Commission's staff, on its way to reach and influence a very large public. Publishers are not authors, and it is not their function to advance their own thoughts or ideas. Their job is to give a wide and effective circulation to the discoveries, reports, and proposals of other people. They do this in three stages, as follows:

Editorial Work
Production
Distribution and Publicity

Of these, the Editorial stage is by far the most important, and exercises control over the other two. Production and Distribution are nevertheless distinct operations, involving contacts with distinct sets of people, and in a large publishing concern they are handled by separate staffs.

To show how the work is done, let us take as an example a contribution from a member of the Research Branch staff, such as a Forest Record, and follow it through to the day when it finally arrives in the letter box of a District Officer in an outlying station.

The spade work—the actual research—will probably be done as part of the Research Branch programme, and at the outset there may, indeed, be no thought of publication.

But eventually the research man is required to put his findings into a form suitable for publication, and to furnish the photographs, maps, and diagrams required to make his written text clearer. In this form the contribution reaches the Director of Research and Education, on whom rests the responsibility of deciding whether it merits publication. If so, the other stages follow.

The Editorial Stage

The first steps in editing a publication are to ascertain in what form and in which series it should appear, e.g., as a Forest Record or a Leaflet, etc. Longer contributions, such as Bulletins, are of course written with a definite series in view.

Next it is examined for any possible difficulties in production, such as unwieldy tables or pictures that may be hard to reproduce.

The third and most important step is to read through the text and assess its general suitability for publication. The editor may suggest amendments, deletions, or additions to make it more acceptable as a printed record. In case of doubt he may refer to the author for further information, or in some cases consult an expert on the subject concerned.

When this scrutiny has been completed, the contribution goes forward to a higher level for further consideration. Changes are frequently suggested at this stage, but eventually the work is returned to the Publications Branch with instructions to proceed to press, subject, as a rule, to a final sub-editing.

This sub-editing, which makes a great deal of difference to the appearance of the finished publication, consists in a close examination of the text to make sure that everything is "set" consistently in the style followed by the Department. Familiar points are the setting of all scientific names in italics, or the writing out in full of dimensions such as inches. But there are many finer points, such as the use of hyphens, in which every publisher likes to follow a definite rule, because inconsistencies that get by unobserved in manuscript have a habit of attracting attention in print.

At the sub-editing stage, too, the manuscript is marked with indications for the use of headlines, or bold type. A contents sheet is prepared, and the publisher's "imprint" or name of his concern is added. Captions, unless already provided by the author, are prepared for the illustrations, and all cross-references in the text are checked. For example, if the author declares that "Figure six" is a picture of an oak tree, the sub-editor must check both picture and caption before he passes that reference. At this point, too, the copyright position is examined; if part of the text or illustrations are not the copyright of the Department, the permission of the copyright owners must be obtained before they can be reproduced, and in some cases a fee has to be paid. Once the material has been thoroughly sub-edited, it passes on to the production stage.

The Production Stage

Editorial work is solely the responsibility of the Forestry Commission, but the actual physical production of the copies from the manuscript and illustrations is carried out through the agency of H.M. Stationery Office. Nevertheless, before the publication can go forward to them, the Publications Branch must be satisfied that it is in a form fit for production. Printers demand reasonably clear copy, on one side of the paper only, and as a result of editorial corrections the first manuscript will no doubt have to be re-typed, and then re-checked. Diagrams and maps may have to be re-drawn, or better prints of photographs secured.

All "copy", as material for the press is collectively called, must be suited to the method of reproduction required, and the publications staff must, therefore, be familiar with the printing processes involved. These include letterpress, line blocks, half-tone blocks, photo-lithographic plates, laid-on tints, and colour work, and it is quite usual for two or three processes to be used in one small publication. The final size for each illustration must also be decided, and often its position in the book. These ideas have then to be expressed in short instructions for the printers, bearing in mind the fact that a number of trades are involved in producing the finished result; the block-makers who deal with the pictures, for example, work quite apart from the compositors who set the type printed alongside them.

Eventually, the component parts of the publication are assembled and given a final check, and the parcel, often quite a bulky one, is ready for despatch to H.M. Stationery Office. With it goes a formal Demand Note from the Department, stating the number of copies needed by us, and the number of copies we expect the general public to buy.

On arrival at the Stationery Office, a number of further operations are put in train, of which the most interesting is probably the "lay-out" work. Skilled typographers plan the best arrangement of type and illustrations, and specify the actual "fount" of type to be used for each class of work. Then contracts are placed with the firms who supply the paper, make the blocks, or do the actual printing, or else arrangements are made for the job to be handled by one of the Stationery Office's own presses. Unless queries arise, however,

these stages do not directly concern the Publications Branch, who next appear in the picture when the proofs arrive.

Proofs are intended primarily to enable mistakes in printing to be checked, and while major errors are happily rare, minor misprints occur in virtually every publication. Close checking is needed to spot such slight slips as misplaced commas or individual letters or figures, and all proofs are read at least twice. The corrections required are then indicated in a simple code in the margin. Proofs of most technical publications are referred to their authors, and their special knowledge of the subject often enables them to spot mis-statements that appear satisfactory to the non-specialist reader.

Proofs are *not* intended to enable the author or editors to revise their work, but most of us have second thoughts when we see our work actually in print. Small changes are, of course, acceptable, but major revisions are not welcomed since they involve expensive manual work in resetting type, and can cause serious delay.

Often two sets of proofs are required. Then the first set are usually "galley" proofs, and serve to check the correctness of the type. The second set are page or book proofs, and are used to check the arrangement of illustrations, etc., and the general "make-up" of the book. They also enable page number references to be inserted in the text and on the contents page.

Once the proofs have been checked they are returned to the Stationery Office, with instructions to proceed to the final printing, and no further action is required until, a few weeks later, a bulky parcel is delivered at No. 25 Savile Row. With the arrival of the actual copies, the Production Stage ends, but nevertheless, the item concerned is still not yet actually published.

Publication, Distribution, and Publicity

Publication is effected when copies are made available to the public, which is always done on a fixed date, which applies throughout the country. To make this possible, the first step is to agree this date with the Stationery Office. While supplies are being sent to our Headquarters, other stocks are being despatched by the Stationery Office to their several sales offices, so that when the date of publication arrives, the book may be purchased immediately in London, Edinburgh or Cardiff, or through any bookseller anywhere. The Stationery Office is, in fact, our main channel for public distribution, and we encourage purchasers to go to them as they are well equipped to stock and sell our publications promptly and economically. A small stock of sale publications is kept at Savile Row, but mainly for the convenience of enquirers.

Three other distributions, however, are made direct from the Secretary's stocks at Headquarters. The first and best known is the Staff Distribution, which usually extends to all technical officers down to and including the District Officer grade; many items go to Foresters and Foremen also. A mailing list with individual addresses is maintained at Headquarters, and every effort is made to send out copies promptly, but naturally the despatch of a thousand copies by a small staff takes some little time.

The second Headquarters distribution is the Exchange one. By arrangement, we despatch a copy of each publication to some 250 research centres, technical publications, and educational institutions, mostly overseas. In return we receive copies of their publications, which are deposited in our library and so become available to all our staff. A second advantage of these exchange arrangements is that they give a world publicity to our work, particularly by means of reviews in foreign forestry journals.

If a publication is of interest to the general public, a third and purely Publicity distribution is arranged by the Information Officer. This is naturally

planned to fit in with the publication date, and reaches the popular press. Sometimes a nation-wide cover is given, but in other cases only the local papers are likely to be interested in a publication that describes some particular forest. Press publicity of this kind has a considerable effect on public sales.

There is, of course, a limit to the number of copies that can be given away free of charge, and to maintain sales and spread interest in forestry we make use of other channels of publicity, particularly displays at agricultural shows, the Sectional List No. 31 issued by the Stationery Office, and a modest amount of advertisement in the forestry journals.

Revision and Reprinting

The demand for our publications continues for long after their first appearance, and sooner or later the stock of each item becomes exhausted. When this becomes imminent the Stationery Office report their stock position, and a decision is taken whether to revise or reprint the item, or to end its career by declaring it "Out of Print". At the moment the record for longevity is held by the little booklet now entitled *Forestry Commission Yield Tables for Scots Pine and other Conifers*, which was born in 1920 and is still going strong.

Control and Record Keeping

All the stages described above have to be gone through for each publication, but of course a Publications Branch cannot keep going on one publication, any more than a forester can make his living by growing one tree! We have to handle, simultaneously, a large number of publications, and at any given time there will be several at each stage of preparation. At the moment of writing the position is:—

Published and available on demand	49	items
Of which, under consideration for revision	5	,,
In the press, Production stage	7	,,
At the Editorial stage	10	,,
Total requiring current attention	22	,,

In addition, we have had advance warning of three major publications due to arrive any day!

To handle this work, all of which must be kept moving forward smoothly from one stage to the next without unnecessary delay, careful planning and control is essential. If too many publications go off the press together, their proofs will return about the same time, and some must be put aside whilst others are dealt with. Our aim is to send one job to press each month, and to divide the working time fairly between each phase of the work thereon. At present, however, the printing trade is working right up to capacity, and to our foreseen delays there must often be added—alas!—long and quite unforeseen ones. But nobody is more pleased than the publications staff when a job goes through quickly and without a hitch.

With so many separate jobs in hand, each following, more or less, its own appointed time-table, very full progress records must be kept. At any given time we can usually say, almost at once, just which stage each publication has reached, and with whom—the Stationery Office or one of our own staff, the next move lies.

As far as possible, the progress of each manuscript is registered right through. Records do not cease with publication, for questions may arise years later, and we have to be able to say when each previous publication was

issued, to whom copies were sent, how many copies were ordered, and what its sales and revision records have been since.

Thus a good deal of the work is administrative in character, and would be much the same if our publications dealt with shoes, ships, or sealing-wax, instead of with forest trees. Though the Stationery Office staff are experts on their side of book production, they cannot, in the nature of things, spot errors or suggest amendments in points of forestry technique; such checking is the responsibility of the Publications Branch. The printer's rule is to "follow copy", so if any slips inadvertently reach the press they are faithfully reproduced. For example, a statement that some of our pine trees grew eighteen feet a year (instead of eighteen inches) once reached the proof stage, without query from the printer. In the same way, scientific names and symbols with which the compositor may be unfamiliar, have to be closely checked.

To sum up, the functions of the Publications Branch are firstly to examine all work agreed for printing for accuracy, clarity, and consistency; secondly, get it produced, making sure that the best available technical processes are employed; and thirdly, to arrange for the distribution of copies within the Department and for adequate publicity. The printed record that results will be kept available at sales offices for many years; and it will be permanently preserved in all the principal forest libraries of the world.

ON SHOWING OFF FORESTS

By JAMES MACDONALD
Director, Research and Education

OUR FORESTS ARE daily arousing more and more interest and one result is that visitors are becoming more numerous. This means more work for Foresters and District Officers and more interruptions to the duties of the day, but it is work which is worth doing well because the impressions of our forests and of our activities which are taken away by the visitors depend almost entirely on the skill with which the local officer has conducted them through the plantations.

Individual visitors can be catered for quite easily, especially if their special subjects of enquiry or study are known in advance; therefore, if a forester is told that Signor A. or Monsieur B. is coming to see his forest, he should find out beforehand, if he has not already been told, what aspects of our work the distinguished visitor is most interested in.

Greater difficulty is experienced with parties of visitors and this note is written with such visits in mind. I am urged to write it because I have visited several of our forests in recent years as a member of a party, and I must say that on one or two occasions the manner in which the company was conducted round was far from ideal.

In planning a tour in a forest for a party of visitors, the first thing is to ensure that it is well within their physical capacity. One can take a party of Boy Scouts further and faster in a given time than a society of elderly scientists. Some of the tours I have been on seem to have been designed for Boy Scouts in the pink of condition, and one course which the Technical Committee were asked to cover not so long ago would have been judged severe by Olympic standards. Most parties are composed of people of different ages, some young, many middle aged, some quite elderly. If the pace is too hot, the younger members keep up with the guide while the older members fall further and further behind. Then at the first stop the younger people and the guide, who don't really need it, get a nice long rest while waiting on the older men and women to come up. These unfortunates are hustled all the time and end up tired and in a bad temper, having seen little and heard less. This is unkind to them and sometimes not too good for the forest or the forester, because they are often the most important of the visitors. A slow pace should always be set, slower in hot weather, and the slowest members should be considered first of all.

The setting of too savage a pace is a common fault and it springs in almost every case from the natural desire to show as much as possible in the time allotted. This temptation should be sternly resisted. When you have made a preliminary draft of the proposed tour, it is not a bad idea sometimes to strike out half the items.

Halts for explanation and discussion should be frequent. Frequent stops make it easier for the guide to explain and for the visitors to comprehend and to ask questions about what they have seen. They also enable the guide to keep the party together. Much of the walking has to be done in single file and the longer the distance between halts, the more the party straggles and the longer the wait at the stopping place before they all get together again.

At a halt, the officer who is leading the party must never start talking until everyone has caught up and the whole party is assembled round about him.

Nothing is more annoying to the visitor who is near the tail of the procession than to get up to the stopping place and find that the guide is halfway through his discourse. The speaker must talk in a voice loud enough to be easily heard by the whole party. Before moving on he should tell the visitors what they will see on the way to the next stopping place and draw attention to any features of particular interest.

I have been on tours of plantations, in a party when, at the end, we have wondered why we were taken to see the particular things we had just left. When the party arrives to begin the tour, the introductory speech, in addition to telling them about the forest generally, should also inform them what they are going to see and why they are going to see it. This is very important, especially for a non-technical audience, and even to a party of foresters it gives the visit a purpose which it might otherwise lack.

These are some thoughts which come to me after reflecting on a few of the visits I have made as a tourist in the not too distant past. They are put forward in the hope that they will arouse the interest of foresters and district officers on whom the important responsibility falls of demonstrating the Commission's achievements to the public.

RAINY WEATHER

BY S. G. MOXSOM
Student, Lynford School

WHAT ABOUT RAIN?

Well, of course, everybody grumbles about rain—except the mackintosh makers. For farmers it comes always too early or too late, too much or too little. For the townsman it's sure to begin when he's out without a coat, and for holiday makers—darn it, the stuff should never have been invented!

For the forester rain is at best a mixed blessing. His parched seedlings may clap their cotyledons or express their joy in some other manner appropriate to a parched seedling, but what about the forest worker, tools downed, shivering under the trees? What can we do about *him*? Remember, all the time rain is coming down, the money is going out.

Of course, if it's only a short spell of wet our particular squad can go to one of the shelters their employer has provided in every part of the forest but the bit in which they happen to be working. From there they return to work when the rain stops, and the zealous custodians of the Forestry Fund can relax again, more or less, among their money bags.

What a different story, though, when the rain comes to stay! There's our squad assembled in a rough shelter in the woods. Either they are annoyed at losing their piecework earnings, or if they're on daywork, they are annoyed at being wet. Sometimes both. In any case they are annoyed. After a smoke they chat, they discuss, they argue; the stoical sleep. But whatever they may do, the point is that good hard cash is going out a darned sight easier than it comes in, and so far we've nothing to show for it.

Well, it's a cert. our workers will produce nothing in a woodland shelter. So, Forester, in words of fire, "BRING 'EM IN!"

Out with the truck to all the sites where men were working, and have them brought to base. Once back, Forester, in bigger, better, brighter words of fire, "GIVE 'EM USEFUL WORK!"

Here now is the crux of the matter, and the operative word is "useful". A little word, but how varied the meaning to different minds. To our worker, a useful job could mean filling in his football coupon. He's right. But in working hours, please, No!

A general order "tools maintenance" does not produce the best result, and twenty men encased in a Nissen hut or barn, presented with a shower of broken tools, may be almost as useless, productively, as they were in the woodland shelter. The only difference is that they can be unproductive in greater comfort.

Forester Halo, however (obviously a man marked for promotion), knows that among those twenty men there are two or three who are really competent at mending tools, making handles and fitting them. The other men are not so good at the game, would produce shaky work, and probably ruin more ash clefts than they fitted as handles. So, sensible Forester Halo gives his shower of mendable tools to those who can deal with them. Good for him.

He's still got a lot more bodies about without the requisite useful job, and to tell seventeen men to grind all their edged tools on two grindstones would not be very bright.

Casting around in his mind, a mental picture arises in Halo of an irate mobile mechanist cursing over Halo's equipment. Sad to say the equipment had been in a horrible state. Not, of course, Halo's fault, never let it be said; it had been returned to him in that condition. Still, the mechanist had been only too definite in his advice on cleaning and greasing, checking and painting valuable mechanical equipment. So Halo gets his driver working on a mechanical check-up and greasing the lorry, the tractor and the water pump. That'll keep him busy, and he can have a couple of men in addition to clean everything thoroughly. The ganger, a bright bod, can deal with the rotary hoe.

The barn in which the men are sheltering is itself in not too good shape. A nail here and there is needed, the tool rack wants mending, all those old sacks in a heap could do with straightening up, the store of firewood is a shambles and taking up far too much space. There are a lot of jobs here that could be done, and a final grand sweep up of the floor wouldn't do any harm. So Halo puts another four men on barnstorming.

Now it is that Happy Harry Halo shows evidence of forethought. (Really this man *must* be promoted soon.) Some time ago he had prepared for wet weather work by storing some produce in the barn. With the other nine jobless men chattering eagerly at his heels, he goes over to the other barn and sets three of them on sawing firewood, three on making fencing stakes, two on making new lift-gates, and one on working-up thatching spars, and pea and bean sticks.

Having now put all his men to useful work, all under shelter, it might reasonably be supposed that Halo can relax. But no, not for him the quiet despair of nursery forms! Here he is, with all his men assembled close at hand, all cosily convenient. What a wonderful opportunity for a little unostentatious welfare work. How happy an occasion and fortunate the circumstances for clearing up queries, getting and giving information. It's raining, they can't escape!

So Halo, God bless him, with genial face and bonhomie well to the fore, visits his men. He clears up all their queries, listens to their complaints, and puts out meanwhile his own little homilies. Finished at last, everybody is now as joyous as Happy Harry himself. Everybody is doing useful work. No longer are idle hands and tongues making mischief.

Finally, for those birdbrains who must have a moral driven in with a bludgeon, money saved in the forest is money saved on income tax, ultimately.

Why am I, a poor student, worried?

I begin paying income tax next month.

THE WEATHER IN FOREST YEAR 1949

By W. G. ROBERTS
District Officer, North-West England

IN THE SOUTH MIDLANDS exceptional climatic conditions were experienced in Forest Year 1949. The total rainfall for the Forest Year was twenty-one inches, as against an average rainfall over the past seventeen years of twenty-eight inches. It is interesting to try to assess the disadvantages and advantages resulting from these exceptional conditions as compared with the usual weather.

Taking the disadvantages; fire danger stands out. Lasting from February till October, it certainly tried the outside staff. The forests near industrial areas had their full quota of visitors and picnic parties. The petrol ration just allowed for this. Fire protection costs soared, but perhaps thanks to this effort, or to the general public being more fire-conscious, the losses were only about half those of F.Y.48. The French forest fires most probably had a big propaganda effect in 1949. Taking Britain as a whole, 1947 was the worst peace time year for fires ever experienced, and the estimated damage to factories and warehouses, homes, and crops was £21,000,000.

Nurseries suffered severely from the drought, especially the heathland nurseries on sandy soil. Seedlings suffered worse than lined-out plants, but the plants that survived made good growth.

The plantations suffered, but losses were much heavier on the late-planted areas than on those planted early.

On the credit side, the largest saving was on produce extraction in the heavy soil forests. Provided gradients were not too severe, lorries could be taken anywhere. Every ride was "roadside" as far as produce was concerned.

Then the saving on wages paid for wet time as against a normal year must have been considerable. One full wet day means a loss of approximately £85 per 100 employees.

In the nurseries there was a saving on weeding costs, as there was very little weed growth after the spring growth had been cleared.

So, perhaps, when everything is considered F.Y.49 was not such a bad year after all.

THE STAFF SUGGESTION SCHEME

IN THE *Journal* FOR 1949 the main provisions of this scheme were outlined, and it is gratifying to report that many useful suggestions have already come in. The position up to the 16th February, 1950, may be summarised as follows:—

Suggestions received to date	44
Suggestions submitted to the Committee for consideration	40
Suggestions accepted	11
Suggestions partially accepted	5
Suggestions referred back for further consideration	5
Suggestions rejected	19
Awards made	13

Suggestions have come in from all parts of the country, and from all grades of technical staff from Foremen to Divisional Officers; the Executive and Clerical grades have also been well represented.

As examples of suggestions received, and awards made, we quote the following:—

Name	*Grade*	*Location*	*Amount*	*Brief Details of Suggestion*
R. A. Allison	Forester II	East Scotland	£2—2—0	That arrangements be made with local Fire Services to sound the fire alarm in two blasts on receiving a call from the Forestry Commission.
E. F. Whiting	Executive Officer	South West England.	£3—3—0	Designed form for the control of Return of Containers.
W. Evans	Higher Executive Officer.	South Wales	£3—3—0	The pre-punching of Stationery and Forms.
G. J. Boxer	Clerical Officer	Headquarters	£2—2—0	That a slogan "Prevent Forest Fires" be printed on Official Paid envelopes.

Readers are reminded that suggestions may be sent in at any time direct to: The Secretary of the Suggestions Committee, Forestry Commission, 25 Savile Row, London, W.1.

A. J. SEARLE

Secretary, Suggestions Committee Headquarters

A COURSE AT NORTHERWOOD HOUSE

By W. J. RAVEN
Estate Officer, North-West England

I BELIEVE THE PRIMARY OBJECTIVE of the *Journal* is the dissemination of technical information in connection with forestry. To an Estate Officer (or is it Land Agent these days?) I find this most distracting. I cannot appreciate to the full the doubtless absorbing task of recording the activities of the large Larch Sawfly or similar pest, and as for mycorrhiza—this word almost reduces me to a complete jelly.

I have wondered how I can fit in with the wealth of journalistic talent which will doubtless appear in this *Journal*; should I plump for the Town and Country Planning Act or some dusty legal statute, or maybe a discourse on farm tenants (this could be interesting) or should I confine it to that homely animal—the sheep—which you all love so much. No, I think you would give up half way, provided that I did not weaken first, so I am taking a plunge into a little light silviculture *vis-a-vis* Northerwood House, and, mark you, from the layman's point of view.

My first recollection of the Northerwood trip is that of the train journey and picking up the Sunday newspaper. Right before my eyes was a large advertisement from an Insurance Company asking whether I would like £4,000 for nothing, or next to it. Would I not! That was the first mistake, and I cannot think what time and effort it has cost me since, driving away Insurance Officials from my door-step. The second mistake was not mine, but emanated from somebody's office (I suspect Organisation and Methods) in the shape of an out-of-date list of trains which was evidently specially designed to keep me on Waterloo Station for a couple of hours or so. However, that was the end of my misfortune, and I eventually arrived at Northerwood with considerable expectation. I was not disappointed.

Lectures in the morning and visits in the afternoon seemed to be the order of the day, and on Monday morning a number of rather sombre and anxious looking gentlemen filed into the Lecture Room on the stroke of a gong. We started off with "Forests and Men"; offhand I am not quite sure who got the better of this battle, but I believe it was the latter. It was not very long before I began to realise that some of my Estate Officer colleagues were really very knowledgeable. One of them peered very hard over his horn-rimmed spectacles, and took the Instructor to task very severely on the activity of a certain gentleman called "Lysenko". I gather this fellow has some very original ideas on the love-life of trees, but it may be safer to leave him to develop his own theories.

One of the beauties of forestry is that there is very little you can say for certain about anything. This, of course, helps the Instructor a great deal, but I must pay credit to their forbearance (there were two of them) and the amount of hard work they put in on our behalf. Assailed with curious questions by a lot of incredulous gentlemen they held up nobly under the strain, and really made things very interesting.

During the week we plodded on with identification of species, preparation of ground, planting, nursery technique, thinnings, forest protection and a host of allied subjects concerning which I have pages of notes. Our visits were interesting and well arranged; possibly we saw most of the show spots in the New Forest where forestry students are taken. I could not help being impressed by the fertility built up in this age-old forest, the extraordinary growth of Douglas fir, and the natural regeneration which abounded almost everywhere.

A visit to a private estate near Salisbury showed us an example of a keen owner who was running what I would term a "forest farm". Here we became interested in some lovely stands of Japanese larch which in a few years time will be ready for further thinning and, later on, for underplanting; much discussion ensued on this point, and on yet another visit the relative merits of planting beech and larch in groups or lines. The heathland nursery we were taken to truly showed remarkable results. If we can produce plants like this on apparently nothing but spent hops then one wonders why we ever spend money on less satisfactory areas. My old friend mycorrhiza popped its head up again here, but nobody seems to have a very satisfactory explanation of what functions it performs. However, it seems to be doing a good job of work so I will leave it at that.

One evening we had an interesting talk from the Deputy Surveyor on the history of the New Forest. This was most useful for appreciating the problems that we have to face, and amongst other things I was surprised to learn that the New Forest oak is not of first quality, owing to the soil conditions not being entirely suitable.

Our bodily comforts at Northerwood were well looked after, and being mainly used to more sparing meals in these hard times I was not too well equipped for all the victuals they managed to produce. I know one poor chap who always gave up after tea, he simply could not face his dinner. Never will I forget the teas, and in particular doughnuts!

It is always interesting to meet colleagues from other parts of the country, the Scotsmen were very dour and true to type (I bet no farm tenant ever twisted one of them for as much as a halfpenny) but they always broadened out a bit in the evening and enjoyed the fun.

Well perhaps I should end on a more serious note and say that the course was of value for appreciating the problems of a Forest Officer and for obtaining a better insight towards the common objective for which we all strive, no matter what our particular job. I think all those with me will agree it was an enjoyable and profitable experience.

A TRIBUTE TO THE PIONEERS

By M. NIMMO
District Officer, Research Branch

APART FROM A FEW MONTHS' EMPLOYMENT at Ringwood Forest during 1927-28, I have been serving in the Research Branch ever since leaving the Dean Forestry School in 1930. In the course of visiting experimental areas I have naturally seen a great deal of normal forest operations over the years, and have long wanted to express my admiration for the work done by many of the older foresters.

During the past three years I have been very fortunate in having had the opportunity of visiting, both in England and Wales, several forests that I had seen little of since before the war; and what I saw recently, prompted me to write this short note. I feel that the immensely improved working conditions of today tend to make us rather easily satisfied with our own efforts and sometimes a little forgetful of the advantages we now possess, which were denied earlier workers in forestry.

In the past, foresters' charges were usually larger than they are today and there were fewer gangers and foremen. Few foresters had any clerical assistance, and much midnight oil was consumed in efforts to keep records and accounts up to date. It was *oil*, not gas or electricity! Only a small number had official motor cycles, and such aids to time saving (and dry skins) as Utility Vans were as yet unheard of!

Even allowing for the difference in cost of living, wages were far lower then than they are now, and in the years round about 1930 estimates were so cut that great care had to be exercised to ensure that everywhere only the minimum essential work was done, but even so many nurseries and newly planted compartments were less carefully tended than we would have wished.

Crawler tractors, Bulldozers, Graders, Rototillers, Autoscythes, etc., were not in use and no ploughing of the rougher ground types was attempted; almost all preparation for planting, on ground other than deep peats and exceptionally level areas, had to be carried out slowly and laboriously by spade and mattock.

Forest roads were usually absent or appallingly bad, and there was a great deal of man-handling of plants and materials. Another point was that there were very few shelters, even in the Welsh forests, and in rough weather conditions were trying, more especially as there was usually nothing higher than heather for miles around!

Well—these are but those points that impressed me at different times: no doubt there are many others that some of our our old-stagers could mention.

Several times, of recent years, when visiting officers have complimented a young forester on the appearance of his plantations, my mind has gone back to the long, discouraging period of check that had been experienced there in earlier days, and I have thought how glad the old forester would have been to see the good growth in his time. Now, with a wider experience of the choice of species, mechanical cultivation and the increasing use of nurse crops, not many foresters will have to endure those long early years of waiting for growth to start.

So let us salute our older foresters and remember that though we still have our troubles (and ventilate them with undiminished vigour!) their load was in most cases far heavier than ours.

FORESTRY COMMISSION STAFF
1950

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ENGLAND, NORTH-WEST CONSERVANCY

Upton Grange,
Upton-by-Chester,
Cheshire

Telephone: Chester 4006-7

CONSERVATOR:	Ross, A. H. H.	
DIVISIONAL OFFICERS:	Barrington, C. A. J.	Chester (Private Woodlands)
	Chard, J. S. R.	Chester (State Forests)
	Raven, W. J.	Chester (Estate)
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	Bell, H. W.	Kendal (State Forests)
	Chard, R.	Chester (Utilisation)
	Crosland, J. V.	Shifnal (Private Woodlands)
	Flynn, A. E. G.	Chester (Acquisition)
	Moir, D. D.	Chester (Estate)
	Roberts, W. G.	Shifnal (State Forests)
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(Civil):	James, J. E.	Carlisle
(Civil):	Priestley, J. B.	Thornthwaite
SENIOR EXECUTIVE OFFICER:	Eadie, T. L.	

FORESTERS

1.	Delamere:	Jones, H. W. (Head); Brandon, J. W. (II).
2.	Thornthwaite:	Walton, W. (I); Wells, H. (II); Fuller, H. (II).
3.	Cannock:	Tribe, W. (Head); Hall, D. (II); Morgan, L. G. (II).

4.	Mortimer:	Adams, I. (I); Shelley, W. R. (II); Stokoe, J. (II); Lloyd, J. C. (II); McMillan, J. R. (II).
5.	Walcot:	Rees, T. J. R. (I); (Also at Long Mynd).
6.	Clipstone:	Simpson, G. A. (Head); Arnott, W. (I); Hall, W. (II); Garner, W. (II); Rowlands, I. G. (II); Sarsby, O. R. (II); Thomas, D. R. (II).
7.	Ennerdale:	Nelson, D. (II); Close, F. (II) (Blengdale).
8.	Hope:	Gilson, R. B. (I); Hodgson, C. A. (II).
9.	Bawtry:	Day, J. (II).
10.	Sherwood:	Tucker, E. J. (I).
11.	Kershope:	Sharp, G. A. (I); Anderson, R. D. (II); Jones, G. (II); Pemberton, F. (II); Power, R. J. (II).
12.	Hardknott:	Murray, M. (II).
13.	Grizedale:	Morley, D. S. (I); Backhouse, C. H. (II).
14.	Greystoke:	Guthrie, F. H. (II).
15.	Cotgrave:	Keens, D. W. (II).
16.	Dalton:	Francis, E. R. (II).
17.	Kinver:	Stockley, G. H. (II).
18.	Gisburn:	Hughes, D. J. (Foreman).
19.	Long Mynd:	Rees, T. J. R. (I) (Also at Walcot).
20.	Swynnerton:	Everitt, W. (I).
21.	Bagot:	Wilson, W. J. (II).
22.	Longtown:	Parker, F. H. (I).
23.	Spadeadam:	(New Unit.)
Private Woodlands:		
Beeston:		Gwilliam, G. T. S. (I).
Satterthwaite:		Small, J. R. M. (I).

ENGLAND, NORTH-EAST CONSERVANCY

Briar House,
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York.

Telephone: York 4684

CONSERVATOR:	Connell, C. A.	
DIVISIONAL OFFICER:	Portlock, W. J. J.	York (Estate)
DISTRICT OFFICERS I:	Conder, E. M.	Pickering (State Forests)
	Garthwaite, P. F.	Kielder (State Forests)
	Haldane, W. D.	York (Private Woodlands)
	Maund, J. E.	York (Utilisation)
DISTRICT OFFICERS II:	Forrester, S.	Hexham (State Forests)
	Marshall, I. R. B.	Kielder (State Forests)
	Rowan, A. A.	Hexham (Private Woodlands)
	Rowntree, J. R. B.	Pickering
	Selby, B. C.	York (Acquisitions)
	Smith, W. T.	Hexham (Private Woodlands)
	White, A. H. H.	York (Estate)
	Wood, T. G.	York (State Forests)
CONSERVANCY ENGINEER:	Sargeant, T. J.	York

ASSISTANT ENGINEERS

(Civil):	Cooper, D.	Kielder
(Civil):	Perkins, J. S.	Bellingham
(Civil):	Preston, G. W.	Pickering
(Mech.):	Wortley, A.	York

HIGHER EXECUTIVE OFFICER: Chaplin, L. A. — York

FORESTERS:

1.	Chopwell:	Harbin, W. B. (II).
2.	Allerston:	Anderson, T. E. (Head) (Also at Langdale); Kirby, C. (II) (Estate).
	Dalby:	Snowdon, L. (I); Rayner, D. A. R. (II).
	Wykeham:	Gough, W. R. (I); Stanley, W. E. (II).
	Bickley:	Bolam, T. W. (II).
	Harwood Dale:	Yeomans, F. W. J. (II)
	Staindale:	Woodward, F. G. (II).
3.	Rothbury:	
	Thrunton:	Johnstone, T. (Foreman).
	Swarland:	Gledson, J. G. (II).
4.	Selby:	Wood, W. (II).
5.	Kielder:	Weir, A. B. (Head).
	Kielder:	Daglish, T. E. (I); Tait, J. (II); Turnbull, M. T. (II); Stokoe, G. (II).
	Whickhope:	McCavish, W. L. (I); Martindale, J. M. (II).
	Mounces:	Hislop, J. J. (II); Fox, T. F. (II).
	Tarset:	Scott, J. J. O. (II).
	Chirdon:	Straughan, J. G. (II).
	Plashetts:	Parker, G. W. (II).
	Smales:	MacDonald, R. (II); Simpson, C. N. (II).
6.	Hamsterley:	Bewick, T. (II).
7.	Ampleforth:	Cumming, J. (II).
8.	Rosedale:	
	Cropton:	Frank, H. (I); Nicholson, J. A. (II).
	Newton Dale:	Young, R. E. (II).
9.	Harwood:	Masson, R. H. (II).
10.	Slaley:	Cawcett, E. (II).
11.	Arkengarthdale:	Hird, J. T. (Foreman).
12.	Redesdale:	Scott, J. F. (I).
13.	Langdale:	Anderson, T. E. (Head) (Also at Allerston).
	Langdale:	Marsh, E. W. (II).
	Broxa:	Mennell, J. (II).
	Broxa Nurseries:	Chisholm, J. D. (II); Baird, R. L. (II).
14.	Widehaugh:	Davy, J. H. (I).
15.	Wark:	
	Wark:	Brown, W. C. (I).
	Pundershaw:	Marshall, J. A. (II).
16.	Scardale:	Bewick, W. J. (I).
17.	York:	Terry, T. N. (II).
Private Woodlands:		
	York:	MacDonald, I. A. D. (Head).

ENGLAND, EAST CONSERVANCY

Shaftesbury Road,
Brooklands Avenue,
Cambridge
Telephone: Cambridge 54495

CONSERVATOR:	Backhouse, G. W.	
DIVISIONAL OFFICERS:	Ballance, G. F.	Cambridge (State Forests)
	Morrish, C. G.	Cambridge (Estate)
	Paterson, A.	Cambridge
DISTRICT OFFICERS I:	Dent, T. V.	Cambridge (Private Woodlands)
	Grant, D.	(Utilisation)
	Payne, S. R.	Tealby (State Forests)
DISTRICT OFFICERS II:	Anderson, J. W.	Cambridge (Utilisation)
	Brett, I.	Santon Downham (State Forests)
	Chapman, E. S. B.	Cambridge (Private Woodlands)
	Davidson, J. L.	Santon Downham (State Forests)
	Halton, K.	Cambridge (Acquisitions)
	Harrison, J. C.	Cambridge (Utilisation)
	Hobbs, W. F.	Cambridge (Estate)
	Lochrie, J. H.	Cambridge (Private Woodlands)
	Mackay, D.	Santon Downham (State Forests)
	Rogers, S. W.	Santon Downham (State Forests)
CONSERVANCY ENGINEER:	Dufton, F. G.	Cambridge
ASSISTANT ENGINEER (Mech.):	Cook, G. O.	Santon Downham
HIGHER EXECUTIVE OFFICER:	Clark, G. H.	

FORESTERS:

1.	Hazelborough:	Beasley, G. F. (Head).
2.	Salcey:	Clark, J. F. (I).
3.	Ampthill:	Ingram, L. D. (II).
4.	Rendlesham:	Wellington, C. R. (Head) (also at Dunwich and Tunstall); Bewick, R. (I); Gracie, A. (II).
5.	Rockingham:	
	Apethorpe:	Acott, E. J. (II).
	Fermyn:	Williams, J. (Head) (Also at Fineshade); Morris, A. M. (II).
	Fineshade:	Williams, J. (Head) (Also at Fermyn).
6.	Swaffham:	Lawson, G. E. (I); Keeler, B. (II).
7.	Thetford:	
	Cranwich:	Walton, R. (II).
	Croxton:	Woodrow, R. B. (II).
	Didlington and Buckenham	Camp, R. G. (II).
	Downham:	Marsh, L. E. (Foreman).
	Elveden:	Cameron, A. H. (I); Parker, J. W. (II).
	Harling:	Steel, W. H. (I).

	High Lodge:	Redford, C. W. (Head); Williams, J. H. (II).
	Hockham:	Anderson, J. T. (Head).
	Lynford:	Deal, W. (II); McNamara, N. A. G. (II).
	Methwold:	Mitchell, A. L. (I).
	Mildenhall:	Roberts, G. (II).
	Roudham:	Pywell, A. C. (II).
	Santon:	Page, J. (Foreman).
	Brandon:	Bruce, J. M. (I); Axton, C. B. (II); Burnie, H. W. (II); Field, H. C. (II).
	West Tofts:	McNamara, N. A. G. (II); Davis, S. (II).
Stationed at Santon		
	Downham:	Button, G. H. (Head) (Utilisation); Salisbury, E. J. A. (I) (State Forests); Birkitt, A. (I) (State Forests); Hinton, F. I. (II) (State Forests); Shinn, F. (II) (Seed Store and Fire Control).
8.	Bourne:	Wyatt, L. (II); Ling, J. (II); Stott, W. S. (II).
9.	Laughton:	Adams, H. (I).
10.	Swanton:	Jones, F. B. (II).
11.	Dunwich:	Wellington, C. R. (Head); Paulley, H. W. (II).
12.	Yardley Chase:	Marston, W. H. (II).
13.	Bardney:	Jones, G. (I): Eckton, J. A. (II).
14.	The King's Forest:	Smith, J. J. (I); Reid, D. (II).
15.	Wigsley:	Hall, V. B. (I).
16.	Willingham:	Marshall, D. F. (I).
17.	Wendover:	Bloor, C. A. (II); Johnson, H. (II).
18.	Hevingham:	King, S. G. (II).
19.	Shouldham:	Woolard, R. P. C. (II).
20.	Watlington:	Hendrie, J. A. (II).
21.	Bramfield:	White, S. L. (II).
22.	Burwell:	Hardy, R. B. (II).
23.	Gaywood:	Smith, W. P. (II).
24.	Tunstall:	Wellington, C. R. (Head); Mortlock, R. F. (II).
Private Woodlands:		
	Thetford:	Pritchard, R. (I).

ENGLAND, SOUTH-EAST CONSERVANCY

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Woking
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CONSERVATOR:	Smith, R. H.	
DIVISIONAL OFFICER:	Ross, J. M.	Woking, (State Forests)
DISTRICT OFFICERS I:	Dixon, E. E.	,, (Private Woodlands)
	Snook, K. R.	,, (Estate)
	Wallington, A. W.	,, (Utilisation)
	Wilson, J. F.	,, (Acquisitions)
DISTRICT OFFICERS II:	Burton, E. S. V.	Woodchurch (State Forests)
	Coode, J.	Woking (Private Woodlands)
	Keen, J. E. A.	,, (State Forests)
	Skinner, J. R.	,, (Private Woodlands)
	Sutton, A. R.	Farnham, (Private Woodlands)
	Troope, L. C.	Farnham
	Wyatt, J.	Gravetye (State Forests)

ASSISTANT ENGINEER (Mech.): Crawford, P. C. R. Woking
HIGHER EXECUTIVE OFFICER: Gulliver, H. W.

FORESTERS:

1.	Alice Holt:	Aston, T. H. (I) (and at Woolmer); Barden, J. T. (II).
2.	Bere:	Watts, F. C. (II).
3.	Woolmer:	Aston, T. H. (I) (and at Alice Holt).
4.	Bedgebury:	Nelmes, F. J. (Head); Awbery, P. P. (II).
5.	Bramshill:	Lingwood, N. J. (Head); Vickery, F. J. (II).
6.	Chiddingfold:	Francis, R. E. (I).
7.	Lyminge:	Watkins, S. (I).
8.	Friston:	Holter, G. E. (II).
9.	Micheldever:	King, B. H. (I).
10.	Buriton:	Laney, H. (I) (also at Westbury).
11.	Westbury:	Laney, H. (I) (also at Buriton).
12.	Challock:	Cross, L. G. F. (II).
13.	Goodwood:	Cooper, J. H. (I).
14.	Vinehall:	Barling, F. C. (II).
15.	Gravetye:	Craft, J. H. (I).
16.	Marden:	Shepherd, W. R. (II).
17.	Arundel:	Middleton, W. F. C. (I).
18.	Orlestone:	Bashall, J. R. C. (Foreman)
19.	Alton:	Offord, P. J. (II) (and at Basing).
20.	Andover:	Law, S. J. (Foreman).
21.	Southwater:	Moseley, J. (II).
22.	Basing:	Offord, P. J. (II) (and at Alton)
23.	Bishopstoke:	(New Unit.)
24.	Abinger:	Wilkinson, E. J. G. (II).
25.	Shipbourne:	Hyett, S. (I).
26.	Crawley:	Hann, F. G. (II).
27.	Hemsted:	Hart, G. C. (II).
28.	Slindon:	Davies, G. S. (I).
Private Woodlands:		
	Arundel:	Hollis, G. W. (Head).

ENGLAND, SOUTH-WEST CONSERVANCY
Flowers Hill,
Brislington,
Bristol, 4
Telephone: Bristol 78041-5

CONSERVATOR: Popert, A. H.

DIVISIONAL OFFICERS:	Stileman, D. F.	Bristol (Private Woodlands)
	Stocks, J. B.	,, (State Forests)
DISTRICT OFFICER I:	Good, F. G.	,, (Estate)
DISTRICT OFFICERS II:	Carnell, R.	,, (Utilisation)
	Dickenson, M. E. S.	Ledbury (State Forests)
	Drummond, J. A.	Bristol (Private Woodlands)
	Dyson, W. G.	Presteign (Private Woodlands)
	Guile, A. W. L.	Bristol (State Forests)
	Hughson, T. A.	,, (Estate)
	MacIver, I. F.	Exeter (Private Woodlands)
	Purser, F. B. K.	Devizes (State Forests)

	Semple, R. N. G.	Launceston (State Forests)
	Vetch, C. F.	Bristol (Private Woodlands)
	Williams, D. N.	Dunster (State Forests)
CONSERVANCY ENGINEER:	Gladwell, L. B.	Bristol
ASSISTANT ENGINEERS (Civil):	Bromley, A. R.	Bristol
(Civil):	Hughes, R. E.	,,
(Mech.):	Inglis, E. J.	,,
(Civil):	Martin, D. R.	Launceston
(Civil):	Shillito, P. E.	Bristol
HIGHER EXECUTIVE OFFICER:	Taylor, G. F.	

FORESTERS:

1.	Dymock:	Beard, A. C. (II).
2.	Brendon:	Bowdler, T. C. (II).
		Burton, H. J. (II).
3.	Eggesford:	Kibble, E. C. (I)
4.	Haldon:	Scott, G. H. J. (II).
5.	Halwill:	Wilkinson, W. E. (I).
		Ball, W. F. (II).
6.	Quantocks:	Humphries, W. J. (I).
		Jenkinson, G. A. (II).
7.	Bodmin:	Bowman, P. (II).
8.	Haugh:	Milne, D. G. (Foreman).
9.	Wyre:	Fairman, E. (I).
10.	Wilsey:	Brain, R. G. (II).
11.	Bruton:	Stannard, A. J. (II).
12.	Dartmoor:	Poll, E. A. (II).
13.	Herodsfoot:	Strong, T. G. (II).
14.	West Woods:	Dyer, H. C. (I).
15.	Lydford:	Jane, T. A. (II).
16.	Collingbourne:	Hammond, B. R. G. (II).
17.	Hartland:	Fife, R. G. (II).
18.	Mendip:	Fowler, J. (II).
19.	Savernake:	Wildash, J. T. (I).
		Everitt, E. C. W. (II).
		Mills, E. W. (II).
20.	Stanway:	Bultitude, R. (II).
21.	Braydon:	Wills, K. G. (II).
22.	Okehampton:	Smale, E. R. (II).
23.	Neroche:	Law, H. G. (II).
24.	Culmhead:	Rayner, J. R. (II).
25.	Plym:	Whale, R. S. (II).
26.	Wareham:	Parsons, F. F. G. (I).
	Puddletown:	Fulford, A. G. (II).
27.	Gardiner:	Lewis, C. J. (I).
28.	Charmouth:	Cox, D. J. (II).
29.	Purbeck:	Butchers, H. J. (II).
30.	Blandford:	Green, W. J. (II).
31.	Fernworthy:	Wray, N. (I).
32.	Glynn:	Everitt, F. W. (I).
33.	Poorstock:	Coles, L. H. (II).
34.	Stokeleigh:	Bullaid, J. F. (II).

ENGLAND, NEW FOREST

The King's House,
Lyndhurst,
Hants.
Telephone: Lyndhurst 300

DEPUTY SURVEYOR: Wynne-Jones, E. Conservator
DIVISIONAL OFFICER: de Uphaugh, F. E. B. Lyndhurst
DISTRICT OFFICERS II: Kendall, R. H. Lyndhurst (State Forests)
Simmonds, S. A. Lyndhurst (Estate)
Winchester, P. L. Lyndhurst (State Forests)
ASSISTANT ENGINEER (Mech.): Sandwell, A. C. Lyndhurst
CHIEF CLERK: Coote, R.

FORESTERS:

1.	New Forest:	Young, H. C. (Head).
	Rhinefield:	Williams, L. H. (I); Leutscher, E. H. (II).
	Stockley:	Adams, J. H. (I).
	Lyndhurst:	Liddell, J. (Head):.
	Lodgehill:	Broomfield, G. B. (II); Palmer, C. H. (II).
	Holmsley:	Cuff, E. W. (II); Sainsbury, B. H. (II).
	Holidays Hill:	Green, F. J. (I).
	Burley:	James, H. B. S. (II).
	Shave Green:	Holloway, A. T. (II).
	Roe:	James, A. L. (II).
	Godshill:	Longman, F. C. J. (II).
2.	Parkhurst:	Parry, A. A. (Head Forester for Isle of Wight Units)
3.	Ringwood:	McNab, C. (Head) (also at Ferndown); Harvey, D. R. (II); Brinsley, D. A. (II).
4.	Ferndown:	McNab, C. (Head) (also at Ringwood); Middleton, J. W. (II).
5.	Brighstone:	Parry, A. A. (Head); Freeman, J. E. D. (II).
6.	Combley:	Parry, A. A. (Head).
7.	Osborne:	Parry, A. A. (Head).
8.	Shalfleet:	Parry, A. A. (Head).

KEEPERS:

New Forest (North): Blake, W. G.
New Forest (South): Cutler, T. H.

ENGLAND, DEAN FOREST

Whitemead Park,
Parkend,
Nr. Lydney, Glos.
Telephone: Whitecroft 305

DEPUTY SURVEYOR: Williamson, J. Q., Divisional Officer.
DEPUTY GAVELLER, MINES: Herdman, H. P.
DISTRICT OFFICERS II: Osmaston, J. F. Parkend
Taylor, G. J. N. Parkend
CHIEF CLERK: Morris, T. W.

FORESTERS:

1.	Dean Forest:	Walker, A. E. (Head); Hooper, P. V. R. (Head).
	North:	Lees, G. (I).
	Lea Bailey:	Roberts, G. E. J. (Foreman).

	South:	Lewis, A. E. (II).
	East:	Davies, D. J. (I).
	West:	Daniels, P. R. (I).
	Centre:	Lee, J. J. (II).
	Nagshead:	Davies, C. H. (I).
	Cockshoot:	Lloyd, F. O. (II).
	Highmeadow:	Watson, F. (I); Russell, C. F. (II).
	Serridge:	Phelps, S. E. (I).
	Nagshead Nursery:	Parry, H. M. (II).
2.	Tidenham Chase:	Jones, H. (Foreman).

DIRECTORATE FOR SCOTLAND

OFFICE OF DIRECTOR:	25 DRUMSHEUGH GARDEN, EDINBURGH Telephone: Edinburgh 33561	
Director:	SIR HENRY BERESFORD-PIERSE, BT.	
Conservators:	MACKIE WHYTE, J.P.	(Estate)
	NEWTON, L. A.	(Private Woodlands and Acquisitions)
	WATT, A.	(State Forests)
District Officer Grade I:	FORREST, G.	(Acquisitions)
District Officers Grade II:	CASSELS, K. A. H.	(Acquisitions)
	FEAVER, B. R.	(Acquisitions)
	ROBERTSON, I. O.	(Nurseries)
Directorate Engineer:	PACKWOOD, R. H.	
Planning Officer:	CRANE, W. A.	
Mechanical Engineer:	BLANE, J. W.	
Assistant Engineers (Mech.):	DRIVER, A. W.	
	JOHNSTONE, G. M.	Blair Athol
Chief Clerk to Director:	HANDFORD, F. C., M.B.E.	
Senior Executive Officer:	CHILDS, G.	
Higher Executive Officers:	BROOKS, Miss A.	
	EADIE, T. L.	
	JONES, N. R.	
	KINNAIRD, B.	
Senior Temporary Assistant:	FERENS, J. R.	

SCOTLAND, NORTH CONSERVANCY

	60 Church Street, Inverness Telephone: Inverness 223, 608-9	
CONSERVATOR:	Fraser, J., O.B.E.	
DIVISIONAL OFFICER:	Crawford, A. R.	Inverness
DISTRICT OFFICERS I:	Dickson, J. A.	Inverness (State Forests)
	Drummond, R. O.	Fort Augustus (State Forests)
	Fraser, A. M.	Inverness (State Forests)
	Gascoigne, C. A. H.	Inverness (Estate)
	Richards, E. G.	Beauly (State Forests)
DISTRICT OFFICERS II:	Campbell, D. Graham	Dingwall (State Forests)
	Craig, T. D. Cotter	Beauly (State Forests)
	Hardcastle, E. J. B.	Fort William (State Forests)
	Innes, R. A.	Dingwall (State Forests)
	McIntyre, P. F.	Fort Augustus (State Forests)
	MacLean, J. D.	Fort William (State Forests)
	McNab, J. D.	Dornoch (State Forests)

CONSERVANCY

ENGINEER: Mullowney, V. L. Inverness

ASSISTANT ENGINEERS

(Civil): Beattie, G. H. Fort William

(Civil): McMahon, C. D. Inverness

(Mech.): Ross, R. B. Inverness

HIGHER EXECUTIVE OFFICER: Nicolson, M.

FORESTERS:

1.	Borgie:	Phipps, N. (II).
2.	Inchnacardoch:	Macdonald, D. (Head).
3.	Portclair:	Lambie, H. (II).
4.	South Laggan:	Murray, R. (I).
5.	Achnashellach:	Mackenzie, A. (I).
6.	Ratagan:	Mackay, A. (I) (also at Glen Shiel).
7.	Slattadale:	Mackenzie, A. (II).
8.	Glen Righ:	Murray, A. R. (I).
9.	Glen Hurich:	MacClymont, W. (I).
10.	Glen Urquhart:	Munro, G. (I).
11.	Culloden:	Mackay, W. (I).
12.	Nevis:	Mackie, A. (I).
13.	The Queen's Forest:	Fraser, J. (II); Robertson, D. D. C. (II).
14.	Creag nan Eun:	Fell, J. B. (II).
15.	Craig Phadrig:	Murray, D. (II).
16.	Glen Shiel:	Mackay, A. (I) (also at Ratagan).
17.	North Strome:	MacLeman, A. (I) (also at South Strome). MacPherson, E. (II).
18.	Salen:	Mackay, J. A. (I).
19.	South Strome:	MacLeman, A. (I) (also at North Strome). Mackay, J. (II).
20.	Findon:	Gordon, J. (I).
21.	Glengarry:	Grant, J. D. (II).
22.	Kessock:	Ross, D. M. (Foreman).
23.	Eilanreach:	Smith, D. R. (II).
24.	Dornoch:	Gunn, J. (I).
25.	Inverinate:	Mackintosh, C. O. (II).
26.	Balblair (including Carbisdale):	Sutherland, R. A. R. (II).
27.	Clunes:	Officer, A. W. (I).
28.	Lael:	Macrae, D. J. (I).
29.	Fiunary:	Drysdale, A. (I).
30.	Glen Loy:	Grant, A. (I).
31.	Glen Brittle:	Macdonald, C. (I).
32.	Longart:	Brown, R. S. (II).
33.	Leanachan:	Campbell, R. W. (I).
34.	Guisachan:	Macintosh, W. (I).
35.	Ardross:	Mackay, K. (I).
36.	Inshriach:	Thom, A. B. (II).
37.	Millbuie:	Murray, W. (Head); Mackenzie, A. S. (II).
38.	Assich:	Macleod, D. M. (I).
39.	Morangie:	Small, G. (I).
40.	Kilcoy:	Frater, J. R. A. (I).
41.	Strath Nairn:	Fraser, W. A. (II).
42.	Ferness:	Stobie, F. D. (II).

43.	Strath Conon:	Mackenzie, J.
44.	Strath Dearn:	Sutherland, D. R. (Foreman).
45.	Farigaig:	Macrae, M. (I).
46.	Urray:	Watt, D. (Foreman).
47.	Battan:	Taylor, C. A. (II) (also at Boblainy).
48.	Rumster:	Morris, H. D. (Foreman).
49.	Laiken:	Black, D. F. D. (Foreman).
50.	Clach Liath:	McAllen, F. M. (Foreman).
51.	Shin:	Maclean, A. R. (Foreman).
52.	Torrachilty:	Nicholson, W. J. (II).
53.	Raasay:	Macrae, H. (Foreman).
54.	Boblainy:	Taylor, C. A. (II) (Also at Battan).
Private Woodlands:		Macleod, D. (Head). Stationed at Munlochy.

SCOTLAND, EAST CONSERVANCY

6 Queen's Gate,
Aberdeen
Telephone: Aberdeen 33361

CONSERVATOR:	Oliver, F. W. A.	
DIVISIONAL OFFICERS:	Bird, D. H.	Aberdeen (Private Woodlands)
	Bennett, A. P.	Aberdeen (Estate)
	Woolridge, T. H.	Aberdeen (State Forests)
DISTRICT OFFICERS I:	Gillespie, I.	Aberdeen (Acquisitions)
	Maxwell, H. A.	Laurencekirk (State Forests)
	Murray, G. K.	Speymouth (Estate)
	Stewart, I. J.	Aberdeen (Private Woodlands)
DISTRICT OFFICERS II:	Fergusson, J. L. F.	Perth (Private Woodlands)
	French, W. F.	Fochabers (State Forests)
	Horne, R. J. G.	Kinellar (State Forests)
	Kennedy, J. A. M.	Forres (State Forests)
	Rennie, J.	Perth (Estate)
	Shaw, R.	Dunkeld (State Forests)
	Watt, I. S.	Perth (State Forests)
	Williams, M. R. W.	Banchory (State Forests)
CONSERVANCY ENGINEER:	Blenkinsop, R. I. C.	Aberdeen
ASSISTANT ENGINEERS (Civil):	Clarkson, W. H.	Aberdeen
(Mech.):	Moncrieff, J. C.	Aberdeen
HIGHER EXECUTIVE OFFICER:	Lenman, J. P.	

FORESTERS:

1.	Monaughty:	Watt, D. M. (I); McLeod, E. (II).
2.	Kirkhill:	Gilbert, G. (I).
3.	Montreathmont:	McConnell, J. (I).
4.	Culbin:	Milne, W. G. (Head); Linder, R. (II).
5.	Edensmuir:	Scott, J. (I).
6.	Tentsmuir:	McDonald, W. (I).
7.	Drummond Hill:	Ross, W. L. (Head); Maxtone, J. R. (II).
8.	Teindland:	Reid, J. G. M. (II).
9.	The Bin:	Urquhart, D. J. (I).
10.	Speymouth:	Allison, R. A. (I); Clark, J. F. (II).
11.	Blairadam:	Ritchie, M. A. (I) (also at Glen Devon).
12.	Drumtochty:	McDonald, W. (I).

13.	Kemnay:	Allan, J. (I).
14.	Midmar:	Innes, G. C. (II).
15.	Deer:	Thow, J. B. (II).
16.	Scootmore:	Murray, G. J. A. M. (I); Seaton, J. A. (II).
17.	Clashindarroch:	Kennedy, J. M. (Head); Guild, J. (II).
18.	Roseisle:	Mason, W. (I).
19.	Blackcraig:	Pacey, R. H. (II).
20.	Carden:	Mitchell, F. M. (II).
21.	Inglismaldie:	Mackay, W. (I).
22.	Durris:	Paterson, S. H. A. (Head); Stewart, G. (II).
23.	Newton:	Lamb, J. A. (Head); Coull, G. (II).
24.	Newtyle:	Douglas, W. S. (II).
25.	Alltcailleach:	Marnoch, D. M. (II).
26.	Kinfauns:	Russell, J. C. (I).
27.	Whitehaugh:	Duguid, C. (II).
28.	Craig Vinean:	Corbett, J. (Head).
29.	Glen Devon:	Richie, M. A. (I) (also at Blairadam).
30.	Lossie:	Scaife, C. (II).
31.	Keillour:	Whyte, C. M. (II).
32.	Tilliefoure:	Anderson, F. (I).
33.	Blackhall:	Robbie, J. D. (Head).
34.	Rosarie:	Pennet, H. (I).
35.	Pitfichie:	McDowall, C. (I).
36.	Fetteresso:	Anderson, D. (II).
37.	Strathord:	Anderson, J. A. (II).
38.	Allean:	Reid, J. (I).
39.	Auchernach:	McMaster, A. J. (II).
40.	Dallas:	Stewart, E. A. (II).
41.	Countesswells:	Cassie, A. (II).
42.	Pitmedden:	Crawford, D. B. (II).
43.	Rannoch:	Whayman, A. (I).
44.	Tomintoul:	McRae, J. (II).
45.	Hallyburton:	Hepburn, N. R. (II).
46.	Corrennie:	Biggar, A. W. (Foreman).
47.	Delgaty:	Skene, W. F. (Foreman).
48.	Glen Isla:	Grigor, E. (II).
49.	Glen Doll:	Watt, W. J. (II).
50.	Glen Errochty:	Reid, J. K. (II).
51.	Ledmore:	Rose, A. (II).

HEAD KEEPER:

Clashindarroch: MacDonald, S.

SCOTLAND, SOUTH CONSERVANCY

Greystone Park,
Moffat Road,
Dumfries
Telephone: Dumfries 1156

CONSERVATOR:	Thom, J. R.	
DIVISIONAL OFFICERS:	Fossey, R. E.	Dumfries (State Forests)
	Penistan, M. J.	Dumfries (PrivateWoodlands)
DISTRICT OFFICERS I:	Donald, R. R.	Palnure (State Forests)
	Gibson, W. N.	Dumfries (State Forests)
	Spraggan, D. S.	Peebles (State Forests)

DISTRICT OFFICERS II:	Devitt, J. G.	
	Fergusson, W. S.	Mabie (State Forests)
	Grant, G.	Dumfries (Estate)
	Legard, P. H.	Newton Stewart (State Forests)
	Stewart, G. G.	Langholm (State Forests)
	Sutherland, W. B.	Moffat (Private Woodlands)
	Wilson, K. W.	Dalry (State Forests)
ASSISTANT ENGINEER (Civil):	Rodger, R.	Dumfries
HIGHER EXECUTIVE OFFICER:	McGeorge, T. H.	

FORESTERS:

1.	Glentress:	Mackay, W. H. (I).
2.	Cairn Edward:	
	Bennan:	Parley, C. W. (I).
	Clatteringshaws:	Towns, K. W. (II).
3.	Newcastleton:	MacIntyre, J. F. (Head).
4.	Dalbeattie:	Watson, J. (Head).
5.	Forest of Ae:	Reid, J. M. (Head); Dick, C. R. (II).
6.	Edgarhope:	Slater, J. (II).
7.	Greskine:	Hunter, J. (I) (also at Auchenroddan).
8.	Auchenroddan:	Hunter, J. (I) (also at Greskine).
9.	Kirroughtree:	MacMillan, H. (Head); Cannon, F. J. (II).
10.	Fleet:	MacDonald, J. D. (I); Gallacher, J. M. (II).
11.	Kilsture:	Robertson, D. (II).
12.	Changue:	Clark, D. (II).
13.	Dundeugh:	Craig, J. S. (II).
14.	Tinnisburn:	Broll, J. L. (II).
15.	Corriedoo:	Mowat, J. (II).
16.	Garcrogo:	Parkinson, J. W. (II).
17.	Laurieston:	Kirk, D. M. (II).
18.	Twiglees:	Robertson, W. J. (II).
19.	Castle O'er:	Irving, R. H. (II).
20.	Glen Trool:	MacRae, A. D. (Head).
21.	Clauchrie:	Melville, J. (II).
22.	Shielswood:	(New Unit.)
23.	Mabie:	Graham, A. (Head).
24.	Wauchope:	McNicol, F. (also at Leithope).
25.	Carrick:	Chisholm, M. R. (II).
26.	Elibank:	Urquhart, G. (I)
27.	Glengap:	Carruthers, M. F. (II).
28.	Craik:	Harkness, J. R. (I).
29.	Cardrona:	Peddie, A. S. (I).
30.	Craigieburn:	Brown, P. (I).
31.	Leithope:	McNicol, F. (I) (also at Wauchope).
32.	Brownmoor:	(New Unit.)
33.	Dalmacallan:	McNaught, D. J. (II).
34.	Kilgrammie:	Garrioch, I. M. (II).
35.	Bareagle:	Grubb, J. A. (II).
Private Woodlands:		
	Cardrona:	Steel, R. P. (I).
	Laurieston:	Cameron, D. M. (I).
	Greskine:	Jamieson, R. A. (II).

SCOTLAND, WEST CONSERVANCY

53 Bothwell Street,
Glasgow, C.2
Telephone: Central 6994-5-6

CONSERVATOR: James, J. E.

DIVISIONAL OFFICERS: Dier, H. V. S. Glasgow (State Forests)
Webster, J. Strone, Argyll (Estate)

DISTRICT OFFICERS I: Long, M. Glasgow (Private Woodlands)
Petrie, S. M. Benmore (State Forests)
Thomson, W. P. Alloa (State Forests)

DISTRICT OFFICERS II: Chrystall, J. Lochgilphead
Chrystall, J. G. Aberfoyle
Innes, P. A. Kilmun, Argyll
Johnson, W. A. J. Lochgilphead
Robertson, S. U. Barcaldine
Townsend, K. N. V. Benmore
Woodburn, D. A. Lochgilphead

CONSERVANCY ENGINEER: Green, A. M. Glasgow

ASSISTANT ENGINEERS (Mech.): Deveria, N. W. Glasgow
(Civil): Phillips, W. M. Glen Finart

SENIOR EXECUTIVE OFFICER: Kinnaird, B.

FORESTERS:

1. Inverliever:
   Ford: Crozier, R. (I).
   Eredine: Murray, R. G. (I).
2. Glen Duror:
   Duror: Sinclair, L. (I); Robertson, D. A. (II); Dye, W. E. (II).
   Ballachulish: Campbell, A. (II); Beaton, K. A. (II).
3. Glen Branter: McLean, A. (II); Gillies, A. (II).
4. Ardgartan: Mackay, A. (Head); McCaskill, D. A. (II); McRorie, J. P. (II).
5. Barcaldine: Cameron, H. (Head).
6. Benmore:
   Main: Jackson, J. (I); Robertson, N. (II).
   Island: Stuart, A. M. (I).
7. Glen Finart: Ferguson, J. M. (I); McKay, J. F. (II).
8. Fearnoch: MacPhee, C. B. (II).
9. Lennox: Penry, T. (II).
10. Loch Ard:
    Main: Fraser, E. D. (Head); Fraser, T. S. (II); Campbell, W. W. (II); Gilmour, W. (II).
    Achray: Ross, D. H. (I).
11. Devilla: Fairbairn, W. (I).
12. Achaglachgach: McCallum, D. M. (II).
13. Knapdale: Mackinnon, H. (I); Calder, A. (II).
14. Strathyre:
    Main: Cameron, A. (Head) (also at Torrie); Simpson, A. A. C. (II).
    Tulloch: Polward, A. (II).
5. Tulliallan: Simpson, A. N. (Head); Martin, W. C. (II).
6. Garadhban: Mitchell, R. F. (II).

17.	Inverinan:	Rattray, W. D. (II).
18.	Asknish:	Mackay, D. J. (II).
19.	Carron Valley:	Calder, J. M. (Head).
20.	Carradale:	Munro, D. (I); Morrison, A. (II).
21.	Minard:	Kennedy, J. (Head).
22.	Saddell:	Hamilton, J. (II).
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