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JOURNAL OF THE FORESTRY COMMISSION

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Editorial

RE-ORGANISATION

THE JOURNAL makes its appearance after an interval of nine years. During these years much has happened in the Commission. At the outbreak of the war we were divided into F.M.D., and T.P.D. Those relegated to F.M.D. envied those who were taking a more active part in the prosecution of the war, and after a while those with T.P.D., at times, envied those who were building up instead of cutting down. Each section played its part and we think we may say, played its part very well. The return of those on seconded duty, is now complete, and they bring with them much valuable experience in extraction and utilisation ; on the other hand, the F.M.D., to retain its original abbreviation, may, we feel, fairly claim to have worked out in the interval, improvements in technique and implements, which will be very valuable in dealing with the large planting programmes ahead of us.

It has been usual in this place to comment on changes in personnel ; we would, however, excuse ourselves this task, and refer our readers to the comprehensive lists at the end of this volume. We trust these will be a useful " who's who " to the staff of the Commission.

LORD ROBINSON OF KIELDER AND ADELAIDE

We wish to offer the congratulations of all ranks of the Commission to our Chairman on the signal honour conferred on him in July, 1947, by His Majesty. We feel that this high personal honour also reflects the measure of importance now attaching to Forestry. In choosing his title, Lord Robinson has associated himself with his forests, and with the country of his birth. We feel that such an association could not have been happier.

EMPIRE FORESTRY CONFERENCE, 1947

The Fifth Empire Forestry Conference was held in 1947 in this country. Forest Officers from the United Kingdom, the Dominions, and most of the Colonies attended to discuss the forestry problems of the Commonwealth. Lord Robinson was elected Chairman of the Conference. The matters discussed concerned a wide range—Empire Forests and the War, Forest Policy, Land Use, Survey of Resources, Forest Management, Silviculture and Protection, Forest Products Research, Timber supplies and Marketing, and Education. Four interesting papers on British forestry were presented at the conference—*The Technique of Afforestation* (Lord Robinson), *Forest Policy and Legislation* (Mr. W. L. Taylor), *Private Forestry in Great Britain* (Mr. E. Wynne-Jones), *The Treatment of Devastated Woods* (Mr. M. V. Laurie). In addition to the formal sessions and discussions, the delegates from abroad were enabled to see something of both State and Private Forests. The State Forests visited included Thetford, Kielder, Warke, Kershope, Newcastleton, Findon, Kilcoy, Millbuie, Kessock and Culbin. Forests belonging to the Duke of Buccleuch and the Earl of Moray were also included in the tour. The delegates were particularly interested in the extent and future of our Border Forests. Mr. J. Q. Williamson, as Secretary to the Conference, had a very

busy time, and the fact that all arrangements went without a hitch is sufficient tribute to his work. The Summary Report of this Conference is available from the Stationery Office.

FORESTRY COMMISSION TIE

The brown and green tie of the Commission has now been adopted as the tie of the Foresters of the Commonwealth. This happy arrangement came about as a result of the attention our tie attracted at the Empire Forestry Conference. By this link we may recognise men from other parts of the world who share our affection for the forest soil and the green of the trees that spring from it. (Ties are available from C. H. Munday, Ltd., 7, Irving Street, Leicester Square, London, W.C.2, price 7*s.* 9*d.* post free).

OBITUARY: WILLIAM ANGUS MUIR

We regret the passing of William Angus Muir, M.C., M.A., on 2nd April, 1947. After eight years with the Indian Forest Service, Angus Muir joined the Commission in 1928 and spent most of his service in the South Eastern Counties. He had a very strenuous time during the war as Divisional Officer in the Home Timber Production Department of the Ministry of Supply, and was a member of a small mission sent to Germany to study the German Forest Administration and to ascertain the potentialities of the forests in the British Zone. Ill-health prevented him from joining the Northern German Timber Control which was set up later. He rejoined the Forestry Commission as Conservator, South Wales, only a short time before his death. All who came in contact with Angus Muir felt his kindliness and tact, while his energy and quiet perseverance made him an officer that the Commission could ill-spare. He was held in high regard by all his colleagues.

CONTRIBUTIONS TO THE JOURNAL

The Editing Committee wishes to thank contributors for their articles. The response from all Conservancies has been very good, and we hope that our next volume will meet with the same representative support. We invite you, Reader, to consider now whether you have a contribution to make to our next issue ; articles may be sent in at any time.

CONE STORAGE AND EXTRACTION

BY R. CROZIER

THE WAR has left this country more or less dependent on home collected seed for the purpose of raising the transplants required for carrying out the large planting programmes ahead. A big effort has therefore been made to harvest all available cones both from private estate woodlands, and Commission-owned plantations. This made it necessary to have large improvised storage accommodation where the harvested cones could be stored until despatched to the extracting kilns.

In the West Conservancy a large Nissen Hut was procured for one of our storage places ; size 36 feet by 15 feet. On a staging, in the centre of the hut, shelves were erected 6 feet wide and 12 inches apart, one above the other, running the entire length of the hut and reaching almost to roof height. Leaving 18-inch passages on either side of the centre staging, similar 3 feet wide shelves were constructed against each side of the hut.

The staging was made from larch and spruce thinnings, 2 inches to 3 inches in diameter, and consisted of uprights and cross pieces. Rabbit netting 3 feet wide was stretched across and stapled to the cross pieces, the netting running the full length of the shelves on either side of the hut, while centre shelves were made up of two lengths of 3-feet-wide netting joined together with tying wire at 3-inch intervals to cover the full area of these shelves.

The netting was then covered by hessian to prevent the cones falling through to the ones below. Were mouse netting procurable, it would eliminate the need for hessian for all but the smaller species of cones, e.g., tsuga, thuya, and the cones which break up, e.g., *Abies nobilis.*

As the cones were received they were spread out 4 inches to 6 inches deep on the shelves, a record of the quantity and the origin of each consignment being kept. An ordinary iron rake was used to turn the cones periodically to prevent heating and mould formation.

In the shed there is a free circulation of air through the windows and the ventilators at each end ; paraffin heaters were also used to dry up condensation in damp weather. This shed should house at least 1,000 bushels of cones.

TREATMENT OF SILVER FIR CONES

These cones were first of all spread out on the shelves, and turned over periodically until dry enough to break up. They were then broken up by hand and put through a home-made $\frac{1}{2}$-inch riddle consisting of mouse-proof netting stapled to a wooden frame, 3 feet square and 4 inches deep.

This process got rid of most of the big scales. The seed and smaller scales left were then put on a $\frac{1}{8}$-inch riddle, and rubbed by hand in order to break off the wings from the seed. This mixture of seed and impurities was then put through ordinary farm fanners or blowers, which left the seed clean and ready for weighing, and putting into carboys for storage.

We soon discovered the appropriate slow steady pace for turning the fanner so that the seed was not blown over the top riddle along with the scales, but allowed to fall through this riddle and then down a chute into a sack ; the scales, being larger, fall off the top riddle and down a chute at the opposite side, while the wings (chaff) and light dirt are blown out at the front.

Over a large quantity of *Abies nobilis* cones the average yield of seed was $1\frac{1}{2}$ lb. per bushel of cones. A knife test was carried out on one consignment, giving a fertility percentage of 20 per cent. Labour costs of storage and extraction of *Abies nobilis* approximated 3s. 6d. per lb. of seed.

CONE PICKING LADDER

BY G. A. SHARP

IN MAKING my cone picking ladder I decided that the main points for consideration were :—

1. The projection of a man or boy forty feet into the air by the cheapest and quickest possible means. As no material improvement on that age old medium—the ladder—has been devised, I decided to use this means as a basis for further experiment and development.

2. Trees which grow on absolutely flat land or near road sides are more the exception than the rule, therefore to make the ladder mobile any supporting vehicle must have more than ordinary means for cross-country travel.

3. Any ladder mounted rigidly on a vehicle would be doomed to failure because of the loss of time in positioning the transporter on a level plane.

4. In using a ladder with only horizontal to vertical action the usefulness would be very limited due to the slope of the land which at forty feet from the ground on a one-in-four gradient would probably throw the picker ten feet off his target.

5. Any such implement should not count on support from the tree, as in leaning the ladder against the branches, half the cones are obscured from the picker's view.

With the foregoing in mind, I therefore came to the conclusion that for maximum scope the ladder would have to be mounted on a turntable and capable of adjustment to any angle. For transporting the ladder I selected the Windsor carrier since it has tracks, wide base and is capable of being manoeuvred into awkward places. The place and method of fixing the turntable was more complicated as, having decided to make a ladder of tubular steel in two twenty-feet lengths on the extension principle, it was very necessary that the total length of the carrier be available for dropping the ladder on for travelling. I finally favoured four girder arms arranged in pairs reaching forward from the nose of the vehicle for a distance of about three and a half feet. Each pair of arms was bolted to the carrier to form a framework into which three three-ply circular steel plates were slid horizontally. The thickness

of the plates when riveted together was one and a quarter inches. As a means of turning the table, gaps were cut in the centre plate at twelve-inch intervals, into any one of which could be slipped a three foot by two inch lever. Onto this table both the ladder and the ladder's anchoring girder were bolted. The height of the girder was approximately seven feet and to the top of this a pulley system was attached. The ladder's angle was determined by hand winch and ⅜-inch diameter wire rope fixed to each side of the ladder. A hand winch was also attached to the base of the ladder for extension purposes. Various safety bars were added without interference to the rotation of the base plate, so that in picking cones from ride trees both sides could be picked by the simple process of inserting the base lever and turning the table. The possibilities of using this machine as a mobile fire tower are being considered.

. . . .

Forester Sharp's Conservator adds the following note.

I should like to add a word or two to Forester Sharp's unvarnished tale. He says nothing about the actual work involved in the construction of this prototype, but I happen to know that it cost him very many hours of spare-time toil, both in planning and manual labour in the blacksmith's shop. Much midnight oil was burned. Its cost in other respects was ridiculously small, since almost all the material required was with much ingenuity converted from scrap and little additional labour was employed. I have watched the outfit in action, and have been impressed by the speed with which it can be manoeuvred from tree to tree and the picker at the top of his ladder placed just where he wants to be to secure the greatest number of cones in the least possible time.

Doubtless modifications or improvements will suggest themselves in course of use, but the prototype is already a first class piece of equipment and so far as I know an advance on any other method of cone collection.

—A. H. H. ROSS.

THE WASTELAND NURSERY AT TEINDLAND

BY D. J. URQUHART

THE PROBLEM of producing sufficient Sitka spruce to meet the expanding planting programmes has led to the preparation of " Wasteland Nurseries " on a fairly extensive scale. At Teindland Forest, Morayshire, a small plot was laid down in 1944 with small extensions added in 1945 and 1946, but in 1947 the area was increased to one acre in extent and new methods of treatment were introduced. The results indicate that the creation of this type of nursery is not only helping to solve the immediate problem of producing large Sitka spruce seedlings fit for lining-out, or even planting on ploughed ground at one year, but is also reducing the cost of production to a fraction of the price of raising seedlings of a similar size in established nurseries.

In 1944, 1945 and 1946 a blood-straw compost with bone meal and basic slag was the treatment used, but in 1947, in addition to these methods, manuring with fresh hop-waste plus a basic dressing of N.P.K. fertilizer (balanced Nitrogen, Phosphorus, and Potassium), and with N.P.K. fertilizer alone was carried out. In addition the plot which was laid down in 1944 was again dressed in 1947 with the same manure as in the original treatment. The final assessment which was delayed until the beginning of November, 1947, owing to late growth of plants gave the following figures :—

RESULTS OF MANURING EXPERIMENTS AT TEINDLAND NURSERY

Treatment	First Cultivation 1947 First crop 1 year seedlings			First Cultivation 1946 Second crop 1 year seedlings (one dressing only)		
Category	Plants over 1½″	Average height	Maximum height	Plants over 1½″	Average height	Maximum height
Blood-Straw Compost + Bone Meal + Basic Slag	60%	1¾″	7″	80%	2″	7″
Hop Waste + N.P.K. Fertilizer	85%	2¾″	10″			
N.P.K. Fertilizer alone	80%	2½″	7″			

Treatment	First Cultivation 1945 Third crop 1 year seedlings (one dressing only)			First Cultivation 1944 Fourth crop 1 year seedlings (original dressing renewed 1947)		
Category	Plants over 1½″	Average height	Maximum height	Plants over 1½″	Average height	Maximum height
Blood-Straw Compost + Bone Meal + Basic Slag	85%	2½″	5½″	95%	3″	7″

It will be observed that the 1944 plot which had a second dressing of blood-straw compost, etc., in 1947, has given the best results, but the most promising plot is the one laid down in 1947, and treated with raw hop-waste plus a basic dressing of N.P.K. fertilizers. It has been found, as can be seen in the above table, that there has been an improvement up to the third year's crop in the plants grown with a single dressing of the blood-straw compost, etc., and if a similar improvement takes place in the plots treated with hop-waste plus N.P.K. fertilizer, this method will be the best of the three tried so far. The results obtained with a dressing of N.P.K. fertilizer only, are also very good, although not as successful as when these manures have been combined with hop-waste.

In addition to reducing the seed bed rotation from two years to one year, the saving in weeding is a very important factor in lowering the production costs of the seedlings, and in selecting the site for a nursery this should be one of the main considerations. If a site which is free from annual weeds is chosen the plants should not require much weeding for a few years. At this unit little or no weeding was necessary for the first two years, weeding was only slight in 1946 and even in 1947 weeding costs were very low. In 1946 the nursery area was 744 sq. yds., and the total weeding cost was only £3 7s. 0d. The area under cultivation in 1947 was 4,845 sq. yds. and weeding has been done for £37 4s. 0d. This indicates that weeding costs will probably increase each year and when this operation becomes an expensive item, it may be found necessary for reasons of economy to break in new ground.

It would be a waste of time growing big one-year seedlings however cheap the cost of production, if the plants could not be successfully lined out, or planted, but they make good 1 + 1 transplants, which do well in the forest, and even do quite well when planted direct on to ploughed land. Five acres of one year Sitka spruce seedlings were planted on ploughed ground at this unit in F.Y.46, and despite the fact that they were exposed to the strong, frosty wind which blasted even the heather throughout the forest, and they had later to withstand a long summer drought, the death rate was only 15 per cent. It is doubtful if seedlings from an established nursery would have stood up so well to this severe test, and the system of getting plants accustomed during their nursery stage to the type of soil in which they are to be grown as a forest crop may not only help to lessen planting losses, but also reduce the chances of the plants going into check. In this case the nursery and planting area soils were more or less similar, and plants already show signs of being away quickly.

WASTELAND NURSERIES AT CLIPSTONE I

BY W. ARNOTT

THE ESTABLISHMENT of wasteland nurseries to alleviate overcrowding in permanent ones has now become a widespread practice and the following observations on their formation at Clipstone I may prove of some value. Their ease of preparation is dependent largely on the sandy nature of the soil, but success and cheapness are also due to good cultivation with plough and harrow.

The advantages of such nurseries are : Seed can be sown directly after preparation ; weeding is almost negligible ; lining out can follow sowing ; the ground when abandoned makes good fire traces; and the resultant crops compare very favourably both in size and quality with stuff grown in the permanent nursery.

Choice of site. A wide ride or strip of waste ground sheltered from the prevailing wind ; as level as possible and without frost hollows ; vegetation mainly heather or some bracken with as little couch grass or *Deschampsia* as possible. Should be near a permanent nursery to give ease and cheapness of transport of labour and materials, and also close to plantations which require brashing or thinning, so that labour may be transferred easily during hold-ups due to frosts, etc., and so minimise supervision. The aim for rides to be cultivated should be compactness rather than length, which is unwieldy ; but much depends on the area required : for example, rides used could surround a compartment and this would minimise fencing which is the most expensive item. A good width of ride is 30 feet which allows 9 feet through the centre for transport, leaving sufficient width each side for two widths of seed beds at about a foot from the nearest trees ; if later on lining out by plough is done it can be worked up one side and down the other ; or in view of the rather poorer results nearest the rideside trees, the 9 foot track could be left at the side of the fence.

Preparation. Fencing is of a temporary nature and is against hares and deer. Lift gates are placed at each end. Vegetation is cut as short as possible with a tractor and mower, and taken off or burnt ; the ground is then shallow ploughed and the cultivator removes roots, etc. Any couch grass is hand forked. It is then again ploughed and cultivated until thoroughly clean and a final cultivation is done by the Rotary Hoe. Best results seem to be obtained by not burying any humus layer and top soil ; the former certainly assists in prevention of soil blow during high drying winds, which appear to occur generally at time of sowing. No manure other than artificial is applied before sowing. Actual sowing and covering is done mechanically with a Jiffy Drill. Beds, for convenience, are made of a size to take 1 lb. of seed.

Subsequent Treatment. Thorough cleaning during preparation means practically no weeding except to remove gorse, bracken, and couch grass which should be dealt with early. When seedlings are lifted there is no difficulty in cleaning the ground during the same operation, and with little preparation the ground is ready for lining out by hand or plough.

DROUGHT AND IRRIGATION OF NURSERIES

BY A. PATERSON

INJURY FROM drought occurs in nurseries when the soil moisture is depleted to such an extent that the moisture cannot be absorbed by the roots of the seedlings at a rate sufficient to offset the moisture lost by transpiration ; this results in wilting and if prolonged will cause the death of the seedlings. High temperatures, low humidity, wind and intense heat will increase the transpiration rate and will intensify the injury caused by low moisture content. When adequate natural rainfall does not occur, restoration of soil moisture by irrigation or otherwise becomes necessary to prevent serious loss through drought.

Irrigation of forest tree nurseries has not yet been practised on a large scale in this country, and the information at present available is based mainly on results obtained in America, where overhead irrigation is practised extensively. An irrigation system of the overhead rotary sprinkler type has recently been installed in the Widehaugh Nursery of the North East England Conservancy, and further information on the effects of large scale and frequent irrigation should be available in due course.

The exact volume of water required by seedling stocks has not been worked out, but in our climate it is likely that 10—15 inches of water per year are required ; the amount required will vary with density of sowing, species and length of growing season. The amount to be applied artificially varies with the rainfall during the season ; i.e., from the time of sowing to the end of the season's growth : in dry seasons as much as 10 to 20 inches of water will be required. For maximum efficiency on a nursery of 30 acres, the available flow of water should not be less than 300 gallons per minute. The quality of the water supply is very important, since hard water containing over 200 parts per million of dissolved solids, largely in the form of calcium carbonate and bicarbonate, can materially affect the pH value of the soil ; the building up of the pH may not affect hardwoods such as sycamore, and ash, but it will seriously affect the less tolerant conifers, especially the spruces.

Irrigation is normally confined to periods of exceptional drought, but it can be used to advantage in producing more satisfactory growth and in rendering the soil in a fit condition for cultivation, provided the water is applied at the required time ; where watering is carried out to prevent damage from drought it should be continued until rain occurs. Where irrigation is used for increasing growth care must be taken not to continue watering too late in the season, otherwise " hardening off " will prove difficult and risk of damage by early frosts will be intensified.

The quantity of water to be applied at any one time depends on several factors such as : retentive moisture capacity of subsoil, texture of soil, stage of development of seedling crop, and season. The quantity of water lost by underdrainage is small in nurseries with retentive subsoil, and the good effects of one fairly heavy irrigation may last for 2—4 weeks without additional irrigation being necessary ; 2—3 inches of water per irrigation are considered a safe quantity to apply on soils of this type.

Light soils with a porous gravelly subsoil require more frequent irrigation than the heavier types ; the amount of water applied to the light soils should be from 1—2 inches per irrigation. The quantity of water to be applied is also governed by the time of the year, and the stage of development of the seedlings ; smaller quantities and more frequent applications are

necessary during the germination stage and immediately afterwards, since the rooting systems of the seedlings have only limited spread and depth of penetration, and consequently the amount of water required is not as great as later in the season when the seedlings have developed.

The total average rainfall in the British Isles in the years 1863—1935 amounted to 41.4 inches ; this would be amply adequate for crop requirements if its distribution was more or less even throughout the year, but in the months when moisture is required for plant growth, namely, May, June, July and sometimes August the rainfall is low. Further, this figure is the average for the whole country ; some eastern districts receive as little as 25 inches per annum.

In England, April is on the average the driest month, and October the wettest. In Scotland and Wales the annual rainfall slightly exceeds 50 inches, and in England the average is 33 inches ; rainfall in the West is much greater than in the East owing to land configuration.

Methods of Irrigation

There are two methods of irrigation, namely, the furrow method, and the overhead system.

Furrow method. By this method the water is directed along channels or ditches to the point where it is required ; the water is turned from the channel or ditch into the seed bed areas. Application of this method is limited by the contour of the land, and is not used extensively in this country.

Overhead Irrigation. Water under pressure is conveyed in pipes over the ground to the spray line or rotary sprinkler where the water is sprayed into the air and reaches the seedlings and soil in the form of a fine spray. This system can be used on either undulating or level ground.

In the practical working of a spray irrigation system having portable pipes or lines, the most expensive item is the moving of the lines ; in some cases the spray lines are permanent, being supported by posts or slung from overhead wires connected with taller posts at wider spacing.

The permanent spray line has the advantage that no labour or cost is expended in transporting the lines, but the initial capital outlay is very heavy, and further the supports for the lines may interfere with the free working of mechanical cultivation operations.

For nursery work the portable pipe line equipment is more suitable than the permanent spray line type.

In conclusion, it should not be assumed that the watering of seed beds, whether by hand or by an irrigation system, will of itself solve the problem of producing large seedlings of good quality. Recent carefully controlled experiments carried out by Dr. Crowther have shown that under some conditions watering alone may have little or no effect on the growth of seedlings. But outstanding and even dramatic results have followed watering accompanied by nitrogenous top dressings. Much more experimental work, however, is required before any standardised practice can be recommended.

WATER SUPPLIES IN FOREST NURSERIES

BY R. J. JENNINGS

MOST FORESTERS in charge of forest nurseries have at sometime or another experienced the disastrous effects of spring drought on both seedbeds and transplant lines. Is it generally realised by those fortunate enough to possess it what an enormous asset to a nursery a plentiful supply of water is ? The most skilled and careful work in the matter of ground cultivation, manuring, preparation of beds and sowing can be of no consequence if there be drought in April and May.

Sufficient moisture in the soil or the lack of it can mean virtually success or failure to the year's work. We have in the past been accustomed to varying periods of drought with blanks in our seedbeds and the decimation of valuable nursery stock, and have accepted these as inevitable ; but should we be content to let this state of affairs continue when the remedy is largely in our hands ? With a very large planting programme ahead and a consequent increase in the demand for planting stock, is it not time that serious consideration be given to one of the most important factors in nursery practice, namely, the provision wherever possible of a generous supply of water ?

It is of course realised that considerable numbers of nurseries are not favourably situated for the laying on of a piped supply of water, but wherever possible this is surely justified. Few nurseries are situated farther than say two miles of either a river or a large stream or supply capable of providing if collected several thousand gallons of water an hour. Since water can be and generally is available for F.W. Holdings and forest fires, let us see that we have it in our nurseries, for there it can also mean life or death to our trees.

The initial outlay might be considerable but would in the opinion of the writer be well worth while as successful germination could then be generally assured and losses by drought reduced to a minimum.

THE PREPARATION AND APPLICATION OF ORGANIC COMPOSTS

BY W. G. GRAY

THE PREPARATION and uses of organic composts in connection with the raising and growth of forest tree species have been the subject of experiments carried out by the Research Branch of the Forestry Commission in collaboration with Dr. M. C. Rayner, of Bedford College, University of London.

In the maintenance of a suitable standard of soil fertility the incorporation of organic matter becomes an essential factor. The beneficial effect of compost on seedling growth when applied to heathland nurseries has already been established. Hitherto farmyard manure has been the principal form of supplying organic matter ; to-day, however, supplies are more difficult to obtain, and the product is apt to vary considerably—further, it is a source of weed seed. Composted organic matter can replace or at least supplement the usual form. Indeed composts are suggested as the most suitable means of maintaining the organic structure of the soil in heathland and woodland nurseries. Composts can be weed-free products which is an important economic advantage.

Preparation of Composts. Satisfactory composts have been prepared from various base materials, including hopwaste, bracken, straw and green herbaceous ride trimmings, with the addition, in certain composts, of a nitrogenous organic manure such as dried blood or poultry manure to assist bacterial activity. The base products should be collected as cheaply as possible. The use of Auto-scythes or similar machines is recommended. Chaffing resistant materials such as bracken and straw, although entailing additional work, is probably worth while. A power-driven chaff cutter employing a type A Lister 3 horse power portable engine has an out-turn per man, per hour, of 6 hundredweight. Chaffing dry-base materials, i.e., bracken and straw, which can be stored, could be a wet weather occupation.

Adequate aeration during the composting process to maintain aerobic conditions is essential. This is obtained by stacking in long, relatively narrow heaps, 5 feet wide and 3½—4 feet high. It is not advisable to attempt to compost quantities smaller than 30 hundredweight. The heaps should not be unduly firmed ; such consolidating as may be necessary can be done with a garden fork or shovel during the preparation of the heaps. Packing by treading should be avoided. During the breaking down process high temperatures are expected, especially during the first two weeks, diminishing later as the oxygen in the heap is consumed. This is adjusted by turning the heap when the temperature falls. Such turnings are repeated at intervals until no further rise in temperature takes place, when composting is considered complete. For most composting materials, heaps require to be turned three times ; the first turning should be 5—10 days after preparation, thereafter at approximately 16 day intervals. Close observation during the first few days is necessary, when composting relatively dry base material, to prevent drying out, as during this period the maximum temperature can be expected. The entire composting process takes roughly 2½—3 months.

To facilitate stacking, the sides of the heaps can be supported by posts and wire netting. For turning, a space of 3 feet is left at one end of the heap ; for aeration, the heaps could be arranged at intervals of 2½ feet. The length of the heap is immaterial. Water is required in relatively small amounts,

being most necessary in the initial stages. It is essential that the base material should be sufficiently moist when the heaps are made up. The moisture content of a heap should be very similar to that of a squeezed out sponge during the whole composting process.

Composting is carried out under cover to prevent undue wetting by rain, and consequent leaching. For this, in sheltered positions, overhead protection is probably all that is necessary ; it is, however, an advantage in order to check excessive draught, to provide side protection on three sides of the shed in the form of rough slabbing, widely spaced. A roof of galvanised sheets supported on posts, high enough to give working space, is all that is required.

A rectangular compost shed, 20 feet wide, has been found satisfactory. This would accommodate heaps 17 feet long ; permanent divisions of wire netting to support the heaps, with alleys, could be erected. The space required for 3 tons of hopwaste is 253 cubic feet, or a heap 14½ feet long by 5 feet wide by 3½ feet high. For chaffed bracken, 3 tons require 403 cubic feet, or a heap 23 feet long by 5 feet wide by 3½ feet high.

By fixing guttering to the compost shed and providing storage tanks, the water supply can be greatly supplemented, if not maintained. For turning compost heaps, long handled 5-pronged manure forks are convenient.

Nitrogen required in composting. The percentage of nitrogen required for adequate composting does not exceed 1 per cent. of the dry weight of the base material to be composted. The actual amount required is determined by the nitrogen content of the medium to be used. Thus, the nitrogen content of dried blood is taken as 12 per cent., air-dried poultry manure 3.4 per cent., moist poultry manure 1.7 per cent., sewage sludge from outfall works employing drying beds 1.4 per cent., and ammonium sulphate 20 per cent. Fresh spent hops, when used as a composting agent, are usually applied by volume, forming either 20 per cent. or 25 per cent. of the mass.

Dried blood is perhaps the best source of nitrogen to use ; it can be conveniently stored and is easily handled. Air-dried poultry manure is obtained direct from the drop boards, and should be kept dry ; the nitrogen is readily given off when moist. Sewage sludge is best obtained from modern sewage farms employing drying pits, when it is easily handled. It is important to ensure that sewage sludge is not contaminated with factory waste products. Its composition is, however, very variable ; it is no use buying sludge with less than 1.2 per cent. nitrogen. It is recommended that use be made of fresh hopwaste as a composting agent. Inorganic sources of nitrogen have not generally given such satisfactory results, and are frequently troublesome when used for breaking down dry base materials. In such instances, the dry matter should be incorporated with at least 20 per cent. succulent material to help to retain moisture. The usual form of inorganic nitrogen employed is ammonium sulphate.

Hopwaste. Recent experiments have shown that raw, uncomposted hopwaste gives excellent results, and that composting is not normally necessary. If it should be desired to compost this material, it requires no additional nitrogen for composting. The heaps should be stacked as soon as possible after the hopwaste is received from the brewery ; water is not required at any time. No firming of the heaps is necessary. Temperatures may reach 60°C = (140°F) at the end of the first 10 days. The loss in weight due to composting amounts to approximately 17 per cent., or 18 lb. per cwt. ; 1 cwt. of spent hops in a moist state ex-brewery is equivalent to 3 cubic feet, or one standard wheel-

barrow load. The weight, however, is apt to vary. Where difficult to obtain in quantity, it is best to reserve what hopwaste is available for use as a composting agent to mix with bracken or straw.

Bracken. To conserve the natural nutrients, bracken requires to be cut in July and either composted immediately, or dried like hay and stored under cover for future use. The nutrients are quickly washed out if exposed unduly to rain.

Three cubic feet of air dry bracken weighs 30 lbs. Bracken requires 1 per cent. nitrogen in the process of composting ; therefore, 3 cubic feet, either green or dry, requires either 2½ lb. dried blood, 8 lb. 13 oz. air-dried poultry manure, 17 lb. 10 oz. moist poultry manure, 21½ lb. sewage filtrate or 1½ lb. ammonium sulphate. Alternatively, mix in 20—25 per cent. fresh hopwaste by volume. It is better to chaff the bracken as this makes for easier stacking and turning, and also makes the material much more absorbent of water. The material must be thoroughly moistened during stacking ; water is occasionally necessary during the composting period to prevent drying out, especially in the early stages. It should be applied when turning the heaps.

Temperatures rise rapidly ; readings up to 70°C. (=158°F.) can be expected during the first 5—10 days. At each turning the sides of the heap should be placed in the centre to ensure that the whole mass is broken down. Bracken gains in weight during composting, due to increased moisture, approximating to roughly 93 per cent. or 104 lb. per cwt., subject to variation according to season.

Ride Trimmings. A satisfactory compost has been made at Kennington from herbaceous ride trimmings cut before seeding (60 per cent.), chaffed straw (20 per cent.) and fresh hopwaste (20 per cent.). It is preferable where possible to use the ride trimmings fresh, not hayed. It is, of course, very important to cut before the weeds have had the chance to seed. There is some risk also of introducing weeds if the straw comes from very weedy fields.

Other sources. Molinia breaks down well in composting. Other local materials might well be tried. Pine needles compost well with hopwaste. Mixtures are usually more easily managed in the composting process than pure dry base materials. The following have composted satisfactorily during the dry summer of 1947.

By volume

(*a*) Chaffed straw 75 per cent. ; fresh hopwaste 25 per cent.
(*b*) Chaffed green bracken 75 per cent. ; fresh hopwaste 25 per cent.
(*c*) Chaffed ride trimmings, mainly grass and herbs, 60 per cent. ; chaffed green bracken 20 per cent. ; fresh hopwaste 20 per cent.
(*d*) Chaffed straw 50 per cent. ; chaffed green bracken 25 per cent. ; fresh hopwaste 25 per cent.
(*e*) Chaffed green bracken 50 per cent. ; chaffed straw 25 per cent. ; fresh hopwaste 25 per cent.

Application. The rate will no doubt have to be varied according to local conditions. Compost has frequently been applied at 20 tons per acre, or 9¼ lb. per square yard, as a first dressing. To maintain fertility it is suggested that further applications will be required every third crop, when half the initial rate should suffice in most cases.

The compost is either dug in during transplanting, or worked into the surface layers of the soil in the case of seed beds at the time of preparation, usually by a small machine, i.e., Rototiller. Composts should not be worked into the soil deeply. Where compost is in short supply it should be reserved for seed beds.

Cost of preparing composts. To present costing figures that can be generally applied is impossible. The following figures, however, represent costs of the compost mixtures given above. Chaffing was mechanised and, on this occasion, the out-turn per man was 4 cwt. per hour, employing a gang of three persons. Bracken was close at hand, but cost includes cutting and hauling to site. Straw cost 15s. per ton unchaffed. Ride trimmings were approximately 100 per cent. grass and herbs obtained from woodland rides. Hopwaste cost 13s. 4d. per ton on site. Water was collected from the roof of the composting shed.

The following are the total costs of 1 ton of compost as laid down. The squad consisted of one man, two boys and two women, whose wage-rates were respectively, £4 10s. 0d., £2 17s. 0d., and £3 8s. 0d., per 48 hour week.

	Constituents		*Watering Treatment*	*Cost per ton of product* £ s. d.
(*a*)	Straw	75%	Watered when laid down ;	2 2 6
	Hops	25%	twice subsequently.	
			Total — 73 gallons.	
(*b*)	Bracken ...	75%	Watered when laid down ;	1 9 7
	Hops ...	25%	no further watering.	
			Total — 23 gallons.	
(*c*)	Ride trimmings ...	60%	Watered when laid down ;	1 15 4
	Bracken	20%	twice subsequently.	
	Hops	20%	Total — 42 gallons.	
(*d*)	Straw ...	50%	Watered when laid down ;	1 16 4
	Bracken ...	25%	twice subsequently.	
	Hops ...	25%	Total — 39 gallons.	
(*e*)	Bracken ...	50%	Watered when laid down ;	1 15 2
	Straw ...	25%	twice subsequently.	
	Hops ...	25%	Total — 34 gallons.	
(*f*)	Hops only		No watering required.	19 5

A METHOD OF SOWING ACORNS

BY W. V. JACKSON

IN THE EARLY years of the late war, when labour was particularly scarce, a new and somewhat unorthodox method of sowing acorns was tried. The results were so satisfactory that the method is now accepted in East Midlands and certain nurseries in England as standard practice.

The bed to be sown should preferably be rectangular in shape with its length approximately double that of its width, while a reasonable size is about one acre.

Seed is laid out in open receptacles (not sacks) for easy access ; tarpaulin sheets have been used and are quite convenient. Eight such receptacles are required, which are placed at regular intervals along the two paths on the longer sides of the bed ; four on either side, i.e., in the centre of each sower's length or " stint." A typical sowing gang consists of eight people to sow the acorns, one man to work the plough, one boy to lead the horse, and a foreman or ganger for supervision.

Method—Ploughing starts in the normal way by ploughing furrows Nos. 1 and 2 side by side, but facing opposite ways ; i.e., towards the outside of the bed, the first furrow is left empty but the second is sown. As soon as this second furrow has been started, No. 1 sower starts sowing his length which is a quarter of the length of the furrow ; as the plough passes the quarter-way mark, No. 2 sower commences on his length ; No. 3 sower starts his length when the plough passes the half way mark and No. 4 starts his length when the plough passes the three-quarter mark. The plough then starts the third furrow and No. 5 sower starts his length ; as the plough reaches the quarter-way mark, sower No. 6 starts sowing ; at the half way mark No. 7 starts sowing ; and at the three-quarter mark No. 8 sower also joins in. By the time the plough has completed the circuit and starts on furrow No. 4, sower No. 1 has completed his " stint " and is again ready for sowing ; and the same applies to the rest of the sowers as the plough reaches their length, covering in the seed they have already sown and at the same time making them another " drill." Ploughing and sowing should thus go on quite smoothly. As will be seen in the foregoing, the soil from No. 3 furrow covers the seed in No. 2, and so on.

N.B.—It is important that the horse should not walk in the furrow otherwise the seed is likely to be either scattered out of place and/or buried too deeply.

Depth—The first two furrows should be made as shallow as possible, the second pair only a very little deeper, reaching the normal depth of 2½ inches on the 5th and 6th furrows.

Spacing—Furrows 9 inches wide, giving rows 9 inches apart, have been found quite satisfactory.

Density—One pound of seed has been sown per square yard or 12 lineal feet of furrow.

Rate of sowing—4,000 to 4,300 lb. of seed on the equivalent number of square yards per day.

This is a method I can thoroughly recommend since the results are equal to band or broadcast sowing and considerably cheaper.

SOWING OF CHERRY SEED

BY C. McNAB

ON THE 27TH JULY, 1946, I received seven pounds of cherry seed (gean) as picked from the forest to sow in Widehaugh Nursery. This was weighed out into two equal parts as it was intended to sow 3½ pounds of the fruit as picked, and the other 3½ pounds to be macerated and washed clean through a sieve before sowing ; this second process gave 14 ounces of clean seed. Both lots of seed were sown on 29th July, 1946, the fruit being covered with beech humus to a depth of 2 inches with a very light covering of riddled nursery soil to hold the humus from blowing away. The clean seed was covered with ¼-inch whinstone chippings to a depth of one inch. When a count was made on the 5th July, 1947, it was found that the 3½ pounds of fruit realised 76 seedlings, whereas the clean seed gave 240 seedlings.

A second sowing was carried out on the same lines on 22nd August, 1946, when 11½ pounds of fruit were sown and again covered with beech humus, and 2 pounds 14 ounces of cleaned seed covered with ¼-inch whinstone chippings. When a count was made on 5th June, 1947, the 11½ pounds of fruit gave 1,830 seedlings whereas the cleaned seed gave 2,580 seedlings. All seed was sown at a density of 5 square yards to one pound of cleaned seed, worked on a basis of 4 ounces of seed to one pound of fruit. It will be noticed that the later sowing gave the better results and the cleaned seed gave the higher germination.

When cherry seed is sown it is necessary to protect the seed from mice and this is done by inserting wooden battens 8 inches wide in the ground along the bedside to a depth of 5 inches, leaving 3 inches protruding above the surface of the bed, and nailed to posts driven in the ground to keep them rigid. Mice wire netting (⅜-inch mesh) is then run along the surface of the bed and nailed down to each side of the battens, using plaster laths 4 feet long by one inch wide and one-quarter inch thick, thus fixing the netting between the battens and the lath (as this type of netting is only supplied two feet wide, two parallel strips are necessary for a bed of normal width.) The netting is then lifted from the bed by running a single strand of No. 10-gauge fencing wire lengthwise along the bed, stapled to pegs driven in the soil nine inches above the surface, and joining the two side nettings together, giving the structure a tent-like appearance. The soil from the alleyways is then packed against the battens on the outside so that there is six inches of soil between the batten and the alleyway. The bed should be 9 inches above ground level to secure drainage during the winter months.

FROST LIFT AT KENNINGTON NURSERY

BY W. G. GRAY

THE WINTER OF 1946-47 was the coldest since observations commenced at Kennington Nursery (in 1926). and was characterised by a prolonged period of frost, which virtually suspended nursery operations from 23rd January until 17th March. The cold spell commenced on 18th January and continued up to 8th March ; there was, moreover, a period of 59 consecutive days from 18th January up to 17th March, when the nightly grass minimum temperature did not rise above 32°F.

The most severe frosts were recorded on 24th and 25th February, when 37° and 36.5° of frost were recorded. The depth to which open nursery ground was frozen was recorded on 27th February, and was as follows at the Oxford nurseries :

Kennington Old—7½", Kennington extension—8½", Bagley (a woodland nursery with fair amount of humus incorporated)—11¼" and Wytham (a woodland nursery with little humus present)—11¾". The nursery at Wytham is situated on the highest ground and is the most exposed.

During the period under review snow fell on 16 occasions ; single heavy falls however were not prevalent, the heaviest being 6.8 inches on 5th March. The air temperature on occasions rose sufficiently during the day time to cause partial thawing of the snow, causing the weighing down of transplants, particularly conifers ; seedlings were invariably covered by snow and generally were not affected.

The period ended with a general rise in the day temperature on 8th March and the thaw became rapid on 14th March when the ground appeared waterlogged due to the frozen condition of the lower levels of the soil. Consequently water could not be absorbed and rapidly drained off nursery sections to lower levels. On this date roads in the vicinity became flooded and the Thames at Oxford overflowed. The wind throughout the cold spell was east to east-north-east ; the velocity generally was moderate, with a period of strong east wind from 8th to 20th February.

After the thaw an assessment was made of the transplants lined out earlier in the season, to ascertain the percentage affected by frost lift. The results are shown below.

PERCENTAGE FROST LIFT AMONGST NURSERY STOCKS AT KENNINGTON

Species	Age when lined out	Month when lined out	Size when lined out	Frost lift as a percentage		
				Partially lifted	Completely lifted	Total lifted
Norway Spruce ...	2+0	October	5" — 9"	0.4	0.3	.7
,, ,, ...	,,	,,	2½" — 5"	0.3	0.2	.5
Lawson cypress ...	1+0	,,	4½" — 6"	2.7	1.7	4.4
,, ,, ...	,,	,,	2" — 4½"	6.2	3.5	9.7
Thuja plicata ...	1+0	,,	2" — 4½"	8.7	13.7	22.4
,, ,, ...	2+0	,,	Average 10"	No frost lift		—
,, ,, ...	,,	,,	6" — 10"	2.9	0.8	3.7
,, ,, ...	,,	,,	2" — 6"	7.6	4.0	11.6
Thuja occidentalis	2+0	,,	4" — 6"	8.6	1.9	10.5
,, ,, ...	,,	,,	1½" — 4"	6.3	2.9	9.2
Pinus contorta ...	2+0	,,	6" — 9"	2.3	1.4	3.7
,, ,, ...	,,	,,	2" — 6"	12.1	4.8	16.9
Prunus sargentii ...	1+0	,,	6" —15"	No frost lift		—
,, ,, ...	,,	,,	3" — 6"	9.0	9.0	18.0
Sitka spruce ...	1+0	,,	1½" — 3½"	2.1	7.0	9.1
Picea rubra ...	2+0	,,	7" —10"	1.6	0.5	2.1

Losses on the whole were light, but it must be remembered that three months had elapsed between lining out and the start of the spell of severe frosts, and in that period the plants may well have established a firm roothold. Stocks having an average size of six inches or over suffered little loss, whatever their species or age when lined out ; the highest percentage of frost lift recorded amongst such stocks being 3.7. Stocks averaging ten inches or over showed no frost lift. The smaller stocks suffered most severely, the highest percentage recorded being 22.4 amongst one-year old *Thuja plicata* ranging from two to four-and-a-half inches high.

OBSERVATIONS ON FROST LIFT IN THE BLACK ISLE NURSERIES

BY J. A. DICKSON

DURING THE SEVERE weather in January, February and March, 1947, the Black Isle of Ross-shire escaped the heavy snows that fell over the rest of Britain, but frost lasted continuously from 19th January to 22nd March. This froze the ground to a depth of eighteen inches, despite a covering of snow from two to three inches deep, which fell on the 24th of February. Damage to nursery stock by frost lift was, however, slight, and possibly less than in an average winter. This may be attributed partly to the slight snow cover, and partly to the preventive measures taken, which took two main forms.

Sand Mould Covering. The mixture applied consisted of three parts sand to one part decomposed leaf mould, riddled on to the seed beds with a quarter-inch riddle. It is important to use sand free from lime.

Branch Shelters. Old branches of Norway spruce and Douglas fir, from which the needles had fallen, were set over the bed tent-wise, with their butts stuck into the soil on either side of the beds and their thin ends resting on a central wire supported on posts.

Where both forms of shelter were used together, losses from frost lift averaged as little as 2 per cent. ; where the beds were uncovered but sanded the losses rose to 8 per cent. ; where no protection was applied the losses were as high as 12 per cent.

The side shelter of growing trees was seen to have a marked effect at Ardmeannach Nursery, Millbuie, which has a row of old hardwoods and conifers along its northern side. One year Scots pine seedlings growing, without branch shelters, close to these trees, showed no frost lift, the percentage gradually increasing until at the farthest point, 310 feet away, 10 per cent of the seedlings were lifted. The height of the trees seemed to bear some relation to the measure of protection given, as no seedlings were lifted for a distance from the trees equal to the height of the trees.

The density of sowing also affected the number of plants lifted by frost. During F.Y.47 no germination or purity figures were given with the Scots pine seed, and consequently beds varied considerably in density. Results showed that the denser the beds, the less the number of plants lifted.

As regards bed preparation, it was noted that beds which were worked deep and, when sown, were four to six inches above the level of the alleys, showed far less frost lift than beds that were almost on a level with the alleys.

IMPROVING THE HAUCK TORCH

BY C. McNAB

PRIOR TO BEING supplied with a Primus Burner, I had to use the Hauck torch for a number of years to burn small germinated weeds on seed beds six to ten days after sowing. There was always difficulty in keeping the filler plug with the pump attached air-tight. Each time the torch was replenished with fuel, about four times daily, it was necessary to remove this filler plug, and to get it tight again was sometimes impossible, resulting in the loss of pressure. To get over this difficulty I took the torch to a local garage and had a screw filler plug fitted to the fuel container on top near to the pump, and had the pump screwed down and made air tight. The position is now that when the torch requires fuel only the filler plug is removed and the pump is not interfered with. This has improved the efficiency of the tool and a much higher pressure is maintained.

BRANDON PARK

BY R. B. GILSON

FOR OUR PURPOSE the story of Brandon Park begins round about the end of the 18th century and the beginning of the 19th., when the enclosures took place. The Lord of the Manor of Brandon at that time was Edward Bliss, who acquired what is now called Brandon Park and all the land in Brandon Parish that lies to the east and south of it, with the exception of Ling Heath which was vested in the hands of Trustees for the benefit of the poor of Brandon. Before then it was all open heath, devoid of trees and used, according to Arthur Young, as sheep walks. Some flint was mined, probably early in the 18th century, on the high ground immediately north of the Bury Road entrance to the Newmarket Drive ; this only covered a few acres and the remains of these old workings are visible to this day. In 1816, extensive planting was done by Bliss, and from what is now left of this planting and from what is known of the fellings that have taken place during the last 30 years, it is possible, with the aid of a map dated 1838, to trace its extent. The species planted were Scots pine and European larch, mixed in about equal proportions as far as I can discover, with odd Norway spruce and *Abies grandis* along the Bury Road side. The round clumps, as shown on the 1838 tracing were planted with beech, but some were planted with Scots pine and European larch, sometimes with beech and sometimes without. Quite a number remain, and during the latter half of the 19th century before fellings had begun, the Park must have looked very attractive ; and with keepers strutting about in brown velveteen jackets, the scene must have been worthy of the brushes of Kate Greenaway and Caldecote.

During the fellings which have taken place in the Park since 1939, I have regularly, and throughout the areas involved, counted the rings of these trees planted, as I believe in 1816, and although it is extremely difficult in some instances to count exactly, owing to the extremely narrow rings of the last 30 or 40 years, I have found the variations of counts to be so slight that I am certain in my own mind that all the planting, if not done in one season, was not spread over more than two or three seasons. As there is definite evidence that in the autumn of 1841 some at least of the plantations were 25 years old I think we are justified in assuming that the plantations date from one year, 1816. It would be interesting to know why Bliss indulged in this short lived spasm of planting, for with the exception of some possible planting in the 1840's and isolated trees, there is no evidence of any other planting being done in the Park before 1903-8. Was it, I wonder, because he felt he ought to provide some relief work to help the local people in distress ? It is well known that a bad slump followed the end, at Waterloo, of the long drawn-out Napoleonic War, and Brandon, which had enjoyed a unique monopoly in supplying flints, a vital munition of war which was no longer required, must have become what we would now call a " distressed area." Anyhow, to judge by what is left of " P.1816," the planting seems to have been done well.

Between 1820 and 1838, the mansion, the two entrance lodges, the kennel cottage and the stables were built, and with the exception of the stables which have been pulled about and altered to make a garage and other accommodation, they remain practically unaltered to this day. The mansion is a typical Regency house with its low roof hidden by a parapet, its featureless chimneys, its large simple windows, its portico supported by widely spaced columns, its cast iron balcony and its stucco, and it included a feature intro-

duced only in 1820—a french window. Externally it is not unpleasing, and it fits in well with its surroundings. The walled-in garden was also made at the same time.

In 1841, some thinning was apparently done, for in October of that year there appeared in a Bury newspaper a notice advertising the sale of 20,000 Scots pine and European larch poles, 25 years old. About this time or a little later, some planting was done in compartment 300, round about the Newmarket Drive and in parts of Compartments 301 and 307 adjoining. The area now felled for seeding in Compartments 294, 295, 297, 298 and 299 and in one or two other small areas, were established at the same time. All these may have established themselves naturally—it is possible—but on account of their even age and the noticeable absence of other age-groups and the known sporting character of the Park, I am inclined to the view that they were planted haphazardly and widely spaced for cover. Dorling of Broomhouse, who spent his boyhood, now 60 years ago, in the London Road Lodge, assured me once that he does not remember those trees in his early days standing any thicker than they did before they were recently felled. For the rest of the century no further plantings took place, but sporadic natural regeneration gradually extended the planted areas. Towards the end of the century some spasmodic fellings began, ostensibly to improve the flushing of game.

Then in 1895, if local legend is correct, during the spring, a gale played havoc with " P.1816," and made breaches of all dimensions throughout its extent. All the windfalls, besides a lot more, were bought by a local sawmill, and it has been asserted ever since by everyone who was old enough to notice such facts that the timber was exceptionally good in quality, and as regards the larch, so much so, that it is still believed by some people in Brandon that it was a distinct species, " Red Larch." We may laugh at the idea of a distinct species, but we cannot ignore altogether the stories about its quality : they are too consistent and persistent. They were widely current when I lived in Brandon 1921-3, and they are still current. But they are hard to believe. One could understand the " P.1816 " European larch coming down pumped, but that explanation will not do for the incipient heart rot so prevalent in the young larches that have been cut as thinnings. Moreover, in 1922, Lord Iveagh felled the Jack Boot Plantation. It was mainly European larch 35 years old. It was planted on virgin soil as was the European larch " P.1816 " in the Park, yet hardly one was found without some signs of incipient heart rot. Some old European larch were felled in the Park recently ; all were sound and deep in colour. The only explanation that will fit the facts is some special strain, whose origin, unfortunately, will never now be discovered.

Two other features of the Park, as it is now known to-day, require a mention here. Everyone who has known the Park for the last 50-70 years has confirmed that the heather has spread enormously within their memory, and that until the fellings began there were hardly any birches. It seems probable that there was in its early period some cultivation, perhaps for game, and this exhausted the soil which in turn encouraged the calluna. I remember Tunstall Heath at Rendlesham growing heather very soon after cultivation had ceased, and enquiries revealed that the soil must have been exhausted by continuous white crops. The appearance of the birch is difficult to explain ; there are very few birches in the district.

In 1903 the Bliss family sold the Brandon Park Estate to Mr. Almeric Paget, afterwards Baron Queenborough. He began big changes. A five-year planting programme was put out on contract with a North Country firm, and the present nursery laid out. Immediate efforts were made to exterminate the rabbits, which previously had been encouraged ; and for the next ten years

this extermination was rigorously maintained. It was this elimination of the rabbits that produced all the naturally regenerated Scots pines which we value so much to-day. At some time during the operation of the five-year plan there must have been an exceptionally good seed year, and all the available ground within reach of the old stands soon produced huge masses of seedlings. These favourable conditions apparently never occurred again, and this explains why all the naturally regenerated areas are so even and of one age.

The areas planted in the Park by Mr. Paget are few and small ; the bulk was done in the Mount, Two Chimneys, Mayday, and The Elms which was then part of the Estate. The planting, as was customary in those days, was well done : the ground was trenched 18 inches deep, by hand, and big plants used, for where game coverts were wanted, expense did not matter. Mr. Paget planted the avenues which are such a delightful feature—where they have been allowed to develop—in the Park : (1) The Copper Beech entrance drive, (2) the Cherry Tree Avenue lining the eastern end of the Newmarket Drive, (3) The Beech Avenue framing the West view from the mansion, (4) The *Cedrus Atlantica* Avenue framing the view of Brandon Church tower from the mansion, (5) the Deodar Avenue lining along its full length the Broad Drive, (6) The Sycamore Avenue, to form a vista ride running south from the mansion, (7) The Birch Avenue lining the south view from the Kennel Cottage and (8) *Tsuga heterophylla* Avenue to make a vista from the drawing-room of " The Cottage." It seems, too, that some attempt was made to line The Newmarket Drive from the Mausoleum to the London Lodge with beeches. It is a great pity that these avenues were never preserved by subsequent owners, for only fragments remain of the two cedar, the sycamore and the tsuga avenues, while the others are not wholly complete. Mr. Paget formed the Pleasure Gardens, built and enlarged, in 1906, the gardens and bothy and greenhouses, and metalled the Newmarket Drive along its whole length. The laundry, too, was built and the gashouse was converted into an electric power-house. The various ornamentals which are to be found scattered throughout the Bury Road side belts were planted in Mr. Paget's time, no doubt to fill up and thicken the natural regeneration that had sprung up there.

Mr. Paget's ownership only lasted ten years. In 1913, the estate was bought by Sir John Bird, the contractor who built the Assuan Dam. He bought it solely for its sporting possibilities, and rabbits were allowed to re-infest the Park. No forestry of any description was done. He did, however, build Wood Cottage.

In 1917, Sir John Bird sold the estate to a timber merchant, J. B. Kind, because, so tradition has it, he did not relish the Park being devastated for its timber. Kind felled completely the Magpie Clump (C.298) The Black Plantation (C.286-7) and the timber in C.284, C.291, C.305, C.304, and C.309, but elsewhere the matured timber was only heavily thinned. There does not seem to have been much cutting of small stuff for pitwood and the like, and the naturally regenerated Scots pine of Mr. Paget's regime, while not old enough to be exploited, was old enough to be safe from rabbits and hares; for in spite of good prices and poaching, the rabbits were still abundant.

Soon after the end of the war, Kind sold the estate with the exception of the Park to Mr. Rought, and in 1923 the Park itself was bought by Mr. Lewis Wigan. Mr. Wigan's interest, like that of Sir John Bird, was centred solely on the game, and everything was sacrificed for it. Belgian hares were let loose in large numbers in an attempt, not very successful, to improve the rabbit population ; deer were encouraged by the provision of racks for feeding, and some of the natural regeneration was either heavily thinned or mutilated in order to provide more cover for the increased stock of game.

Broom and gorse were introduced to make more cover, and fear of fires resulted in indiscriminate cutting of rides which caused, apparently, more beetle damage than the war-time felling. The rotted heaps of poles remain in places. Altogether, the Park was a rare modern example of the old legal definition of a park, a tract of ground kept for the preservation of game.

Mr. Wigan died in 1935, and in the following year his widow sold the Park to the Forestry Commission. It seemed fit and proper that the Commission should acquire in the heart of Breckland, where the most extensive of their operations lie, what is probably the earliest attempt at afforestation in the district. In spite of the changes and chances of the past hundred years the Park is truly a valuable addition, but I wish it were possible for Edward Bliss to come to life and tell us something to satisfy our curiosity concerning many intriguing features and problems. The more I study the map of 1838, the more fascinated I become with Edward Bliss. Whatever his motives might be, he was undoubtedly a man of wisdom, faith and courage, to conceive and carry out in all the unique and difficult circumstances of the day, even with the help of a professional landscape gardener, a scheme which to-day excites our admiration and wonder. A Capability Brown or a Repton could not have done better. Edward Bliss died on 17th March, 1845, at the age of 70. On the day following the centenary of his death, when I was coming out of church and saw his grave right opposite the door, I could not help but think that if Edward Bliss were to rise from the dead and to revisit the Park, he would see that the times we live in are very similar to those through which he lived before he began the Park, and he would be delighted to know that he builded better than he ever knew.

HARTLAND FOREST AFTER TEN YEARS

BY W. WILKINSON

THE AREA COMPRISING Hartland Forest is situated in North Devon, its western edge about five miles inland and its south-west angle about three miles from the Cornish border. Its depth, in an easterly direction, is about ten miles. The terrain consists of wide valleys with gently sloping sides, the contour height varying between 500 and 700 feet. The soil ranges from light brown to black with a depth of six to nine inches. In the depressions and flushes peat to a depth of two feet is found. The subsoil over the whole area is a bed of impermeable yellow clay. The original vegetation was *Molinia* and rushes with a heather/gorse mixture on the drier parts. Owing to its bordering on the Atlantic, exposure between south-west and north-west is very severe, south-west gales being of great frequency. Rainfall is heavy and even in its distribution, there being no consistently dry periods. But fire danger conditions arise very quickly between January and June, owing to the heavy mat of *Molinia* being rapidly dried by the velocity of the winds.

Prior to planting, the acquisitions were either moor, rough pasture or derelict agricultural land, the better land being reserved and apportioned to the several farms on the area acquired. During the war years a considerable acreage was cultivated by the War Agricultural Committee. Included in the acquisitions were three small plantations of Scots pine whose appearance left much to be desired. As is customary in North Devon each moor or field is bounded by a bank (5—7 ft. high) to give shelter to stock, the trough at the foot of the bank acting as a drain.

Operations commenced in the autumn of F.Y.37. Owing to the combination of a heavy rainfall and a water retaining subsoil, planting of trees in the natural surface was impracticable ; therefore ploughing was resorted to. Furrows were ploughed at 5 feet intervals by a double-furrow Oliver Plough drawn by a Caterpillar Tractor, these furrows being 1 foot 6 inches wide and 6—10 inches deep. Where conditions allowed, along road-sides, boundaries and compartment boundaries, fire traces to a width of 20 feet were full ploughed. Ploughing was fairly uniform over the area excepting in the depressions where tussocks prevented the furrow staying put. Even after ploughing a considerable amount of hand labour had to be done ; the unploughed portions had to be turfed, and the furrows had to be linked up with draining furrows which carried the excess water into the numerous brooks on the area.

Planting was done with the ordinary garden spade by an L notch. The ideal aimed at was to get the roots of the plant between the surface of the inverted furrow and the natural surface underneath. The main species used in P.38 was Sitka spruce. Some Norway spruce and three half-acre plots of *Abies grandis*, tsuga, and Lawson cypress also were planted. Initial results were promising, Sitka spruce being our main hope. By F.Y.40, Japanese larch and Corsican pine had been introduced with satisfactory results. Beech had also been planted on some of the interior banks to give shelter. Larch on selected sites have since put on good growth. Scots pine were not used until P.43 ; although browning of the needles takes place in the late winter, this does not seem to have any retarding effect on their subsequent growth. *Pinus contorta*, first planted in F.Y.45, have grown rapidly but their stability is questionable.

In F.Y.44, ploughing was done by the new single-furrow R.L.R. Plough, ploughing to a depth of 1 foot 4 inches. This depth has since been modified as it was found that planting costs are extreme where the furrow has to be reduced by hand to a reasonable thinness, otherwise the greater proportion of the plant stem is buried. An advantage of the R.L.R. plough is that ploughing can be successfully carried on throughout the summer. Previously the lighter Oliver had been at a big disadvantage when the ground dried out in May, its weight being insufficient to keep the plough in its work.

In the spring of F.Y.42 a cycle of severe spring frosts commenced. This cycle was unbroken until F.Y.47. At elevations below 550 feet serious damage was done, Sitka spruce suffering most. It was noticed that owing to its later flushing Norway spruce was less affected than Sitka. This fact was responsible for Norway being used in heavy beating up in F.Y.43. However, in a severe frost at the end of May, 1945, Norway suffered just as much as Sitka, so our ideas had to be revised. By this time we had a legacy of checked Sitka on the drier heather/gorse areas. Pines (S.P. and P.C.) have since been interplanted among the spruce with some apparent beneficial effect. By the end of F.Y.47 just over 1,000 acres had been planted. On some of the older areas cleaning and thinning should commence in the next five years. Reviewing the situation at the end of ten years, would that I could, in the words of the well-known hymn, report a state " where every prospect pleases." However, considering all the factors, we can claim to have put up a creditable show.

Concerning our future plans and prospects the two most difficult problems we have come up against as yet are the checking of spruce on the heather/gorse areas and the severe damage caused by late spring frosts. A helpful factor in the solution of both problems would be the full ploughing of all land carrying heather/gorse vegetation and land below 550 feet. My assumption is based on the following facts : fire traces (which are full ploughed) on checked areas have produced a much better type of vegetation such as grasses, brambles, rushes, etc., a much more hopeful indication for spruce. The same effects are noticeable on adjoining moorland which prior to cultivation, for food, carried a heather/gorse vegetation, its previous state being a series of narrow ridges with draining furrows between. After tractor ploughing the whole area has an even surface and the vegetation is now grass and rushes. On the low lying areas, after a rough working down, a light ploughing at planting distance would enable spruce to be planted at their correct depth, avoiding the checking period so common to spruce, consequently they would get above the frost level so much quicker. The main objection to the above proposals would be the extra cost of ploughing and rough working. But full ploughing would reduce hand labour to a minimum, while the saving in the cost of intensive beating-up and prolonged costly weedings would greatly surpass the extra ploughing costs.

ORLESTONE FOREST, KENT

BY D. R. BEAUMONT

THE FOREST OF ORLESTONE is situated in Kent, about 4½ miles from Ashford and about 1½ miles from Tram Street and Warehorn. The area comprises about 700 acres and is largely heavy clay very similar to Chiddingfold in Surrey and Sussex. About 400 acres is almost flat and on none of the area is there any high ground, such slopes as there are being caused by small streams over the course of ages. The area is, with the exception of a ten-acre field, all coppice land, the chief coppice being oak, hornbeam and birch, with some chestnut on the better ground nearer Warehorn. The flat areas were drained between forty and fifty years ago and a good system of ditches was dug, but very little seems to have been done for some years now, although I believe when regular coppice cutting was done the area cleared was also drained. In winter the ground on the flat areas is swampy and in summer gets very dry.

The first work on the area was begun in November, 1942, when I took charge with three Women's Land Army girls as my gang. We had an area of nearly 70 acres to fence and clear of rabbits, and were expected to plant about 50 acres. There were about 105 chains of fencing to be done, about half of it being five-wire stock-fence and at least 900 stakes and posts to be made and a tool shed to be built. I was fortunate in having particularly good girls who in quite a short time learned how to cut and split stake lengths while I did the pointing, and in fencing I was able to go ahead with one girl, fitting up the straining wire, while the others came behind and hung the netting. After about three months two more girls came and I was also lucky in having the help of a local gamekeeper for clearing rabbits. Planting was finished in May, and for number of plants planted per day the girls were ahead of many men I have had since. Planting is not the only work where the girls I had beat the men, especially some of the younger ones.

The species planted in P.43 included Norway spruce, Lawson cypress, Scots pine, Japanese larch, Corsican pine, tsuga, *Abies grandis*, *A. nobilis*, and a few Norway maple and sycamore. The tsuga failed badly, chiefly owing to the fact that we could not get them planted until some time after lifting, and the Corsican pine failed owing to late planting and drought. Japanese larch suffered rabbit damage and did not recover well, but have since been beaten up and are now thriving. The Lawson cypress had quite a number of failures but those left are showing up quite well. All the P.43 planting, apart from the Japanese larch, Silver firs, and Norway spruce, was beaten up with Scots pine and these are doing all right.

In P.44 we planted Douglas fir and Norway spruce on cleared ground, and also Douglas fir, Lawson cypress, thuya, and beech under coppice. The Douglas, Lawson, and beech are doing well, especially the Douglas. Some of the coppice poles were cut out this summer during weeding to let in more light and the plants should benefit this year. The thuya are not very good, but the Norway spruce are getting away. The Douglas in the open were frosten in June, 1945, but are recovering. Part of the area is rather wet and the Scots pine that have been used for beating up there are not very good so far.

P.45 planting is chiefly Douglas, with some under coppice, and about half an acre of Wellingtonia and an acre of *Cupressus macrocarpa*. These last failed badly, although a few are left here and there. They were beaten up

once with the same species, which failed owing to being too small and were then beaten up with Douglas. The Wellingtonia are doing quite well and also the Douglas, especially under coppice.

Since 1945, Norway spruce has been the principal species used. Weeding at Orlestone is a long job owing to the growth of the coppice, and to be effective has to be done thoroughly. Half measures when weeding coppice are useless as the work only has to be done again.

A VISIT TO A GERMAN FOREST

BY W. J. WILSON

THE GERMAN FOREST, and the forester's modes of executing his duties, are most educating and interesting not only to the student of forestry, but also to the proficient forester. During the year 1945, I was fortunate enough to spend some considerable time in the *Staatsforst Oberelmer*. It was here that I met the *Revierforster* for that district. I found this German very proud of showing his plantations, working plans and method of administration to any interested visitor.

The origin of afforestation is hidden away in early German history, for it was then, through the people's experience of drought and famine, that they realised the necessity of trees and forest. With their constant observation of the weather and the effects of the trees drawing to earth the rain clouds, the need for afforestation to conserve water, regulate the run off from the hills, and maintain a higher water table became obvious. In 1648, owing to the fear of shortage of timber, the State took over a large measure of control of all forests, irrespective of ownership.

The forester, who in the early days had been merely a huntsman, has now became a fully trained man. This revolutionary change in their systems of silviculture was brought about slowly by such people as Gottfried von Moser, who compiled the first rules, laws and principles in forestry. Then came Karl Gayer who advocated that the forest should conform to the biological laws. Such theories as natural regeneration and mixed forests with soil improvers were introduced. As far back as 1882, A. B. Frank in his study on root formation came across the fungal element known as *mykorrhiza* (mycorrhiza).

The transition period was no doubt long, but by 1939, although the Germans were importing 40 per cent. of their softwood, they had built up their forests to 30 million acres, which occupied one-quarter of the country. More than one-and-a-half million workers were employed in all branches of forestry. During the war the Germans used the numerous products hidden away in the trunk of the trees for chemicals and alcohol ; while the Allies used vast amounts of their own timber for wood pulp for paper. The Germans also used charcoal and wood gas to propel vehicles. It was estimated that Germany and German-occupied countries were driving 180,000 vehicles with a saving of 647,000 tons of other fuel per annum.

The countryside in and around the Oberelmer forest is not unlike that of one of our own forests in the West of England. There is a rolling mass of hills ranging from 1,000 to 1,500 feet high. Most of these hills are thickly clothed in forests consisting mainly of Norway spruce. There are some wonderful stands of beech growing approximately 800—900 feet above sea level, with a south-easterly aspect. The beech I saw here and in other parts of Germany were remarkably free from forking. The ground flora is very scanty in the young beech plantations, but in older stands dog's mercury and wavy hair grass predominate. The conventional method of the German forester is to sow the beech seeds directly into the forest in lines. The seedlings are allowed to germinate and the survival-of-the-fittest battle is continued for four or five years. The spaces between the rows are weeded yearly, but it is only after the fifth year that the forester steps in and thins the seedlings out. If one

area has an abundance of trees, while another area is depleted, the trees pulled from the abundant area are transferred to areas where the trees are less plentiful.

In the valleys of these hills, oak (*Quercus pedunculata*) seems to be the main tree. The most noticeable thing on entering these oak woods is the tiers of shrubs and other ground flora. Hazel and holly form the first tier, then come the *Rosa* species and brambles. Below these come dog's mercury, primrose, raspberry, foxglove and bracken, etc. Oak, Norway spruce, Corsican pine, beech and birch are the main timber trees in the area. Trees such as horse chestnut, Spanish chestnut, hornbeam, various kinds of *Populus* and *Abies* exist, but were there mainly for an ornamental purpose. I noticed that larch was by no means plentiful, although I was shown this forester's system of sowing. Again the seeds were sown directly into the forest. The area that was being planted had previously been Norway spruce ; the elevation was approximately 1,000 feet above sea level, and had a north-westerly aspect. An area of ground one-third of a metre (1 foot) square was screefed and a sprinkling of larch seeds sown. The distance between one area of screefing and the next, together with the distance between the lines, was two metres. To me this method appeared extremely wasteful, but no explanation was given excepting that very little planting was done by mattock or spade. I was shown a stand of oak underplanted with beech, but owing to the inadequacy of the forester's knowledge and foresight in underplanting, the area was shown rather unwillingly. The oak had been well thinned and was between 30 and 40 years old. The soil contained a large proportion of lime, consequently the beech that had been used as an underplant had practically dominated the oak.

A useful method of counter-attacking injurious insects was also shown. In a well developed forest not only were bird boxes provided, but to attract and retain the birds in the area, such berry-bearing trees as rowan, cherry (*Prunus avium*), etc., were planted quite freely.

Animal life, in the Oberelmer forest as well as in most other German forests, was very abundant. The destruction caused by the rabbit bore no comparison to that caused by the deer. If planting was done by spade or mattock, a rabbit as well as a deer fence was necessary. Seeds which were sown abundantly and directly into the forest were not enclosed by a fence. By far the most destructive animal this forester had to contend with was the wild boar. When walking through the oak woods I was amazed at the large cavity these animals made at the base of the oak trees. It is in the autumn, when in search of acorns, they appear to do the most boring ; consequently, when the winter winds come, many fully matured oak trees are blown to earth. The only remedy against the wild boar is shooting. The ordinary 4-inch mesh 15-gauge fence affords little protection, for when I was hunting these animals I found that they had enough strength to break such a fence. There are, of course, the usual animals such as fox, otter, squirrels (the grey squirrel had not found its way into the area) and badger, etc. These animals, although interesting in their habits, were no real detriment.

The environment of the German forester is very similar to that of our own forester. A small holding is provided by the State with sufficient land to enable him to keep a cow, pig and poultry. He is a person who commands high respect from the people in the nearby villages and he is called upon to make many decisions in local controversies. With his dark green breeches, jacket and a hat plumed with boar's hair, he soon becomes a familiar sight to the foreign visitor.

REAFFORESTATION IN GERMANY

BY J. CHRYSTALL

THE REGION IN WHICH the methods of reafforestation described herein are carried out is in the province of Hanover, Germany, in the forest belt north of the city of Hanover and stretching to Luneburg Heath. The lay of the land here is for most part flat with the exception of a few rolling rises which could hardly aspire to the name of hills. This flat plain varies in height above sea level from 300 ft. to 500 ft.

Average rainfall for the year is approximately 30 inches, and weather conditions during the summer months are warm and dry but with sufficient rainfall to eliminate drought conditions. Winter weather can be very severe with long periods of hard frost.

Soils are mainly of the light types varying from a heavy sandy loam to a very light sandy soil almost verging on pure sand. These light soil conditions lead to a good deal of trouble in the spring months when winds blowing across the plain lift the fine particles of sand to create minor sand-storms. The land under tree cultivation is usually of the lighter sandy types and performs the dual act of utilising soil too poor for agricultural purposes and also serving as an obstacle to the spring soil-carrying winds while the surrounding arable land is still unvegetated. The main types of vegetation are heather (*Calluna vulgaris*) and bilberry (*Vaccinium*).

EXISTING FORESTS

The existing forest belt runs more or less continuously from Hanover northwards to Luneburg Heath, and is a conglomerate of State and privately owned woodlands. The main species used in stocking these forests is overwhelmingly Scots pine, with small patches of Norway spruce, and small quantities of hardwoods, mainly oak and beech. Scots pine ranges in age from seedlings to mature timber of up to 120 years, although the timber in the area under review did not exceed 90 years.

In the larger blocks of State-owned woodland, the forest is broken up into compartments by the laying out of rides on the grid system, and this method is probably due to the flat terrain and the consequent lack of advantages in doing otherwise. These existing forests had been established by natural regeneration, direct sowing and by normal planting methods and it was evident that the two former methods had been used pretty extensively, at least in this area, with good results.

FELLINGS AND REGENERATION

At the end of the war, the urgent need of timber for the reparation of war damage and for consumption in the mining industry, both in Germany and in Western Europe, led to heavy fellings in German forests. Germany had, during the domination of Europe, liberally helped herself to the timber resources of the occupied States and used only small quantities of her own, and was therefore in a good position to supply this much-needed material. Fellings in Germany were the responsibility of the North German Timber Control who at all times agreed to reasonable requests to the retaining of seed bearing trees to assist in the restocking of denuded areas by natural regeneration.

The procedures adopted by German foresters in the selecting of seeding trees, and in the preparation of the ground for the formation of a new crop by natural regeneration or direct sowing, follow the three systems described below :

Selection System—By this system selected seeding trees of good stem and crown formation are left at the rate of 12—15 per acre. These trees are as evenly distributed throughout the area as possible so that each tree has an equal area of ground to cover.

Strip System—As implied this is the retaining of strips of trees as seed-bearers. These strips are of varying density but the general principle is to leave only sufficient for the purpose for which they are retained. This system is used less often than that above although more frequently than the Group System.

Group System—This system was not much in evidence and appeared to have been created more from natural causes than to have been artificially applied. Gaps caused by windblow or other reasons appeared to be the chief agents in forming this method.

PREPARATION OF GROUND

The German custom of utilising every part of the tree, i.e., stem, branches, and roots, helps to improve the conditions already in existence for natural regeneration. It is not unusual for three different merchants to be interested in the same block of fellings. First the timber buyer who is interested only in the main stem, secondly the firewood merchant who deals with lop and top, and thirdly the root dealer. For selling and handling purposes the firewood merchant has the branchwood cut and made into wire bound bundles, one metre long of a standard thickness and of a weight easy to handle when removing. Stumps are extracted from the soil either by blasting or by power driven winch.

These methods of disposal of what might be considered waste, give to the formation of a new crop by natural seeding a twofold assistance. Firstly, any seed-bearing cones attached to the branches are by the handling in gathering, cutting to length and making into bundles, so well shaken that any loose seeds are freed. Secondly, the removal of stumps, either by blasting or winching, turns up fresh soil and improves the germination bed for the coming seeding.

Prior to felling it also appeared customary for farmers to be allowed to remove the top layer of vegetation, especially in lightly stocked areas where bilberry and heather were strong, for use as farm litter. This practice also makes for a non-competitive seed-bed. Normal dragging operations over the light sandy soil also help by mixing the top soil layers.

The ground having been thus prepared, the success of the operation depends on a good crop of seed-bearing cones on the seeding trees, and good climatic conditions for germination and establishment afterwards. Very little can be done to help at this stage, although doubtless the removal of competition from the seedbearers would stimulate seed production, as witness the frequency with which isolated trees produce good crops of cones. Climatically a certain amount of protection is given by the overcrop. This shelter would help in breaking the strong spring winds and in conserving the moisture in the soil.

Removal of Overcrop—When the desired results have been obtained, the overcrop is removed ; and while the above preparation of ground is carried out for both strip and selection systems the benefits of the strip system are evident ; damage to older regeneration is reduced to a minimum as the

trees are felled and extracted along the line of the strip. Removal of the isolated selected trees on a well stocked area, while doing more damage than in the strip system, would soon become unnoticeable.

DIRECT SEEDING

Extensive areas of the present German forests have been established by the above methods when good seed trees and favourable soil conditions were present, but on areas destroyed by fire, where seed trees were not available, other methods had to be adopted. In many cases such areas have been re-afforested by direct sowing.

Ground is prepared for direct sowing by the removal of burnt stems, sneddings, and roots, and left ready for such cultivation of soil as is needed. Cultivation consists of a light plough operating to a depth of about two inches, merely scratching the soil but removing the top layer of vegetation. Seeds are then sown either by hand or mechanically in the spring. Forests thus established are easily recognisable by the thick density of the trees in the lines.

The formation of this type of plantation is more expensive than those previously described, because it entails the collection, extraction, and sowing of the seed. Cultivation is also not in this case a by-product of other operations, as in the former. It is advantageous, however, in that the artificial seeding ensures an even aged and fully stocked plantation in the first year, which is unlikely in the more cheaply formed naturally sown areas.

PROTECTION

No protective measures appear to be taken to avoid loss and damage by fire and vermin. Rabbit-proof fencing is non-existent, and fire traces equally scarce. There is an almost complete absence of rabbits although the brown hare is much in evidence. Roe deer are plentiful, but are not considered pests and are carefully protected, and shot only when in season ; they form a source of revenue as the forest is divided into beats and let. Strategic points such as fields surrounded on three sides by forest, a favourite feeding place of the roe, are usually overlooked by a tower 20—30 feet high with enclosed top for the comfort and convenience of the sportsmen ! These towers would, of course, be useful during fire danger periods as observation posts. Foxes are fairly numerous ; red deer and wild pig are only occasionally seen. Strangely enough, with this high population of roe deer the amount of damage evident is slight. This may be explained by the heavy density of young plantations and the subsequent cutting out of damaged trees in cleanings and thinnings.

As stated above fire traces are practically non-existent. The well-used forest rides would serve as such, as they are free of vegetation of any description. The perimeter of the forest is also fairly well protected in that the surrounding land is mainly arable and under cultivation. Smoking or lighting of fires within the forest during danger periods is strictly forbidden. In the event of a forest fire others besides the forest workers are expected to attend ; the ringing of the village bell is a summons to all able-bodied men to gather and assist in the fire-fighting.

THE ESTABLISHMENT OF BEECH CROPS

BY B. R. G. HAMMOND

AT COLLINGBOURNE in Wiltshire we have some 1,400 acres lying on the eastern escarpment, at the northern end of Salisbury Plain, the general aspect being south. The elevation varies from 750 ft.—400 ft. and the rainfall is roughly 30 in. per year. The land is mostly old woodland which carried a crop of poor oak, and was cleared of all timber during the recent war.

Nursery Treatment

As to the sowing of beech, 1 lb. to 4 square yards is satisfactory, but I am in favour of a rather less density, as it is not unusual to find many whippy seedlings at this density, and when sown at 1 lb. to 5 square yards a larger percentage of stocky seedlings will be produced.

Beech is essentially a tree for chalk and requires a good fibrous root formation to obtain moisture in this normally dry soil. Colour is also an important point. At stocktaking I have found it advisable to mark badly coloured patches ; single trees cannot be so marked if large quantities are being dealt with. A healthy beech is of a deep blue-green colour, the internodes are long, the leaf fine in texture and even-veined, the bud deep brown and well shaped, and generally the best stocks have only one terminal bud ; the stem tapers evenly. In bad stocks the internodes are short, the leaf is coarse and wide-veined, there are usually two or more terminal buds, the colour is yellowish green, and there is marked taper to the stem. I have noted that most of these characteristics persist throughout each succeeding year.

Before planting, root-pruning may be necessary. Beech is a free-rooting tree, and on inspection of failures after planting I have noticed that trees that have had their roots crushed into a notch are far more liable to be lifted by frost, than a well pruned tree. Seedling beech are sometimes recommended for forest planting, but I have never had satisfactory results from them, and consider it essential to use transplants.

Site Types for Planting Beech

Open Downland. When once rabbits have been excluded from open downlands, grass competition and exposure to frost and sun-scorch will be the major adverse factors for the first two years. Where possible the planting of pure beech should be avoided, and a mixture with Scots pine appears to be the most suitable method of establishing beech on such an area. It is important to establish the conifer a year or two ahead of the beech. I have tried beech and Corsican pine in alternate rows planted at the same time, but failures through frost and sun-scorch have been heavy, and I cannot see that any benefit is derived by the beech from the conifer crop in the first two critical years, when it most needs it.

It is extremely hazardous to attempt to grow pure beech on open downland, until a crop is established to give protection. No doubt if exceptionally favourable seasons occur over a long period it can be so grown, but I have found shade essential for an even and vigorous crop, and in the course of fifteen years' study of beech I have never seen a satisfactory pure crop growing on an open downland site.

If such a crop is to be attempted, a 2 + 1 transplant (if very well rooted, and not " leggy ") should succeed as well as any, as it may derive some shelter from the grass—this is beneficial in hot weather, but very detrimental in frost. Any larger transplant suffers from wind-throw as well as the other set-backs, and a small 1 + 1 transplant has not the stamina to thrive in hot, dry periods.

Clear Felled Areas. Such areas usually constitute a suitable place for beech growth, if soil and other conditions are favourable to the species, but it is important that planting be carried out as soon after felling as possible, so that the humus content of the soil is not considerably lessened. Generally it is far more difficult to establish beech on old conifer areas, as the natural coppice is not present, and it may well be that similar treatment to that proposed for downlands should be carried out. On clear felled hardwood areas however, vigorous coppice growth usually occurs in the first season after felling, and I have found that by careful selection of the best coppice shoots, it is possible to obtain a valuable cover in two years. In such areas, soil is usually rich and a smaller transplant can be used to advantage. I have 1 + 1 beech, planted P.46, putting on vigorous growth in such an area.

There is one important point to be remembered here—it is remarkable how quickly nature covers up man's devastation. It is the duty of a forester to know how she will go about this, and to prepare for the weed growth that may arise. For example, I had an area carrying dense hazel coppice under an oak crop—the floor was comparatively clean. Just three months after clearing and planting the area, it was completely covered with a dense carpet of bracken up to 8 feet in height.

Felled areas carrying light coppice. Here I firmly believe we have the ideal matrix for beech establishment. The suitability will be governed to a certain extent by the type of coppice, but where this is birch if it be thinned to 50—100 stems to the acre—the ideal being clean poles of 20 to 40 feet in height, evenly distributed over the ground, then frost and sun scorch risk is reduced to an extremely low figure. I have in my charge approximately 300 acres growing under these conditions at a height of some 600 feet, and from 1943 to 1945 I had no beating up to do. In 1946 I had only 10 per cent. failures on 60 acres. Last year on a site considerably lower (400 feet), a serious attack of caterpillars and a subsequent drought has caused heavy loss, but there have been no losses through sun-scorch or drought in the 1946 plantings, which shows the great value of the light and even shade provided by birch cover.

Under such a cover I have found a large transplant, 2 + 2 or 2 + 3, very satisfactory. It is false economy to plant anything smaller, as weeding costs in such an area are high ; coppice shoots persist for several years, and small plants naturally require more intensive and frequent weeding.

Felled areas carrying heavy coppice. In such areas, which are usually the result of long-delayed treatment after felling, or are neglected coppice, there are several planting systems open to us, the amount of money available for preparation being the limiting factor. Were this not so, conversion to light coppice would be the most satisfactory method, but to-day as much as £14 per acre may be required for such work. Where costs have to be kept down, the cutting of groups or strips may be adopted.

A suitable system is to lay out groups of 6 ft. square—100 to the acre, or strips 21 feet wide, leaving a 21 foot uncleared strip repeated throughout the treatment. Of the two systems I favour the strip method as management in after years is much easier, and initial lay-out can be easily grasped by the ordinary workman, whereas the lay-out of groups requires careful supervision and can be very difficult in dense coppice areas. Groups of irregular shape

can also be considered, but with these there is an unsatisfactory appearance and stocking to the area, and generally a uniform sized group is easier to stocktake, and ensures a uniformity of growth, as there is a tendency for small groups to grow faster than large ones as greater shelter is provided in early life. In all types of groups and strips, sturdy well-rooted transplants should be used, and root formation must be good.

General Treatment

Beating-up Beech Plantations. Beech is a difficult species to beat-up. In many cases die-back of the main shoot occurs, and secondary leaders may appear and also die-back ; a tree is placed beside such a one, and in the second year this " beat-up " itself dies-back, whilst the original sends forth a lusty shoot and goes ahead—and sad to relate in the third year the " beat-up " does the same, with the result that we have a number of unwanted trees in the plantation. Therefore do not beat-up in the first year any trees other than those definitely dead ; by the second year any doubtful trees will either show vigorous growing tendencies or a further going back.

Season of Planting. The actual time of planting beech has been made the subject of an experiment on my forest, and in 1944 four months were chosen, October, November, February and March. A sample acre was divided into rows, of which 1 — 5 — 9, etc., were planted in October, 2 — 6 — 10 in November, 3 — 7 — 11 in February, and 4 — 8 — 12 in March. Unfortunately, owing to two grades of plants becoming mixed it is not possible to give the results for October planting, but it can be seen clearly that the November planting is decidedly more vigorous than the February or March plantings.

Apart from this experiment, however, I am of the opinion that root growth, or rather adhesion to the soil, commences as soon as the plant enters the ground, and it continues throughout the life of the plant. Consequently the sooner it can be put in, after leafage has finished, the sooner it will start rooting, and it will be in a much better position to nourish new leaves when the bud bursts, than it would be if planted only just before flushing.

I feel therefore that beech (and other species for that matter) should be given the greatest chance to withstand the demands of flushing by planting as early as possible. Although in certain cases late plantings do become established, this depends upon the season, and in dry springs and summers late planted areas cannot have the resistance of earlier planted ones.

The weeding stage. A bad first weeding of a young beech crop may do incalculable harm. This may sound an over-statement, but the forester must bear in mind that he has in his charge a crop of young trees upon which a great deal of care and money has been spent. The species is definitely delicate in this young stage, and should ignorant workmen be allowed to cut away coppice or herbage without guidance, then frost and sun may take a fearful toll, and all the efforts of good planting and careful preparation of the area be wasted.

On open downland, only grass and small ground weeds usually occur, with possibly patches of heather, gorse and bracken. The golden rule on such areas is to watch the season, and not to weed too early, or suddenly expose the young crop to a scorching mid-summer sun. Beech can stand a great deal of shade when young, and so long as the trees are freed from grass by autumn time, that is all that is necessary.

On clear felled areas, all kinds of weed growth are likely to appear. Examine the area carefully before commencing operations, and make sure the men know how you wish the work to be done. Natural birch can be retained but not all of it, and it is advisable to show the ganger concerned a plantation

of beech under pole cover, so that he can realise the need to retain the best young coppice stems. Avoid, however, the formation of " lanes " of birch coppice, which may cause gaps in the plantation by utilising a great deal of the moisture needed by the young plants, and also by whipping the tender buds.

In areas where birch fails to appear, such species as hazel, privet, field maple, whitebeam, sallow, and even oak, ash or other more valuable crops usually appear as coppice. In a clear-felled area, retain an even cover of preferably the quickest growing species, but not hazel or privet. This can then be dealt with each year in weeding, by switching up to ensure it does not whip the beech leaders. Such cover proves most valuable in the first two years when the crop is still in the lower weed cover, and danger from frost is most serious.

On felled areas carrying light coppice there is one main danger that must be avoided, that is allowing a second stage of cover to come in under the main pole cover. Avoid this at all costs ; the chief cause of it is cutting the coppice shoots too high. In three years, banks of coppice can line the rows of trees, and light and air is curtailed, and most serious of all, moisture is drawn from the young plants when they most need it.

The weeding of beech in groups or strips is usually a straightforward operation—no coppice or high weed growth should be retained in either treatment ; the coppice surrounding the groups or strips acts as the frost or sunscorch protection. If this is made clear there is little danger of the most inexperienced workman doing harm, providing he knows the trees from the weeds, but it should be seen to that the sides of both the groups and the strips are well switched up to ensure that they do not encroach on the cleared spaces in each.

The Cleaning Stage. It is unwise to tamper with the actual crop at this stage—many advocate the removal of wolves and badly shaped trees, but I think the correct time for this is in the thinning stage. When cleaning, it is advisable to retain every available tree of the crop to encourage canopy formation and suppression of weed growth.

Careful pruning of double leaders and heavy side branches should be undertaken at this stage, and in this connection I do not agree with those who hold that beech does not like the knife. Nor am I a believer in foreshortening double leaders by cutting one off with a slasher in passing. Double leaders should be pruned carefully flush with the stem. A well-healed scar offers little risk of becoming infected, whereas a rough jagged cut, even if on a foreshortened double leader, offers a suitable point of entry for infection.

A further most important and often overlooked operation in cleaning a plantation is the removal of honey suckle from the trees—a tedious and expensive operation. I have found that if a hook is used, not only can the main stems of honeysuckle be cut on the trees, but the small suckers surrounding them can also be cut right back, so when canopy formation becomes complete, almost all the honeysuckle is killed. This is rarely the case if small suckers can get on to the tree soon after the main stem has been cut through.

Lastly, in cleaning, attention should especially be given to the backward patches which occur in almost every plantation—try to find the cause for the lack of regularity, such as past neglect in weeding. In cleaning such areas, I have often found removal of everything except the trees brings about response, and this, coupled with the protection of the trees surrounding the area, helps to ensure uniformity.

TRIALS OF POPLAR SPECIES AND VARIETIES

BY T. R. PEACE

IN THE PAST poplar cultivation in this country has only been on a small scale, and has been largely restricted to the Black Italian hybrid poplar, *Populus serotina*, with the more recent addition of *P. robusta*. On the Continent several other varieties have been grown with success, and recently a spate of hybrids has come from breeders in Europe and America. Some of these might well do better in this country than *P. serotina* and *P. robusta*, so the Research Branch is forming a collection and using the more promising varieties in field trials. Matters which have to be investigated for each variety are rate of growth, straightness of stem, freedom from large branches, and disease resistance, with particular regard to bacterial canker, which is the most serious disease attacking poplars in this country.

The war sadly interupted work on the growth and canker resistance of poplars in Great Britain, and only two trials have proceeded far enough to give any results. The larger one is on a heavy clay at Yardley Forest, Northants, on which establishment takes a very long time, so that only the earlier planted plots have yielded any results. The smaller trial was planted later, but on a fertile valley soil at Bagley Wood, near Oxford, on which growth was rapid from the outset ; only a limited number of varieties were included. Other small trials were planted during the last three years, and should begin to yield results before long. This winter it is hoped to start three large scale trials, and to plant two stool beds, one to provide small quantities of cuttings of most of the varieties in the collection for distribution to other workers on poplar, and the other to provide larger quantities of cuttings for Forestry Commission nurseries, and possibly for the nursery trade for the eventual use of private landowners. To start with, *P. serotina*, *P. robusta*, *P. gelrica*, and *P. serotina erecta* will be distributed. Certified high quality stocks are being imported from Holland for this purpose. Arrangements are also being made for a poplaretum, in which three trees of each variety will be planted. This will form a permanent stock of varieties not considered promising enough to be included in the trials, and of canker-susceptible varieties of scientific interest, which for sanitary reasons will not be grown in the stool bed.

The poplars in the collection are listed alphabetically, in most cases according to the name under which they were received. In a few cases a sufficiently good re-identification has been made to allow of another name being used ; in such cases the name under which it was received is always quoted. Varieties which have not been long enough in the trials for any remarks to be made on their growth are marked " N."

P. acuminata. Presumably *P. acuminata* Rydb. Received from the Canadian Forest Service, Ottawa, 1939. N.

P.A.G. 2. Hybrid *P. alba* × *P. grandidenta*. Received from Ottawa, 1939. Difficult, though not impossible to propagate from cuttings. N.

P.A.G.12. Hybrid *P. alba* × *P. grandidentata*. Received from Ottawa, 1939. Difficult, though not impossible to propagate from cuttings. N.

P. alba L. Collected by Dr. Burtt Davy, location unknown, also a later collection (about 1943) from Bedgebury Park, Kent.

P.A.M. (No. 154) Hybrid of unknown parentage. Received from Professor Jacometti, Italy, 1939, and from Professor Piccarolo, Instituto di Sperimentazione per la Pioppicultura, Casale Monferrato, Italy, 1947. So far appears promising.

Andover. Hybrid *P. nigra betulifolia* × *P. trichocarpa.* Received from Dr. Schreiner, New Haven, Conn. U.S.A., 1937. N.

Androscoggin. Hybrid *P. maximowiczii* × *P. trichocarpa.* Received from New Haven, U.S.A. 1937. N.

P. angulata erecta. So far this appears to be absolutely identical with *P. robusta*, and to have grown just as well. It was received from Dr. Burtt Davy in 1934, and I believe he got it from Glasnevin, Dublin. So it quite probably came from the collection of Professor Henry.

P. bachelierii. This is supposed to be a selection from *P. robusta.* Received from Dr. Houtzagers, Arnhem, Holland, 1947. N.

P. berolinensis. Received from Lt.-Col. Pratt, Ryston Hall, Downham, Norfolk, 1934. It is not known whether our stock is male or female. It is showing considerable promise in the heavy clay area.

Bianco Pioppo. Presumably a hybrid with *P. alba* as one parent. Received from Monferrato, Italy, 1947. N.

P.B.L. Hybrid of unknown parentage. Received Casale Monferrato, Italy, 1939 and 1947. N.

P. brabantica. A natural hybrid between *P. serotina* and *P. marilandica.* Received from Dr. Houtzagers, Arnhem, Holland, 1947. This variety is very susceptible to bacterial canker. N.

P. Burtt Davy. This variety, which came from the late Dr. Burtt Davy's garden in 1944, has not yet been identified. N.

P. canadensis commune. It is not known what this poplar is. Received from Casale Monferrato, Italy, 1947. N.

P. candicans. Ait. Collected from a house called the " Scholar Gypsy," near Oxford. Very susceptible to bacterial canker.

P. canescens. Smith. Probably collected near Oxford.

P. carieri. This is probably the same as the tree which goes under the name *P. carriereana*, and which is supposed to be *P. regenerata erecta.* Received from Lt.-Col. Pratt, Ryston Hall, Downham, Norfolk, 1934. It has grown extremely well in trials, but unfortunately is very susceptible to bacterial canker.

P. charkowiensis. This is probably a hybrid between *P. nigra* or *P. nigra betulifolia* on the one hand and *P. nigra italica* or *P. nigra plantierensis* on the other. Received from Hamburg, Germany in 1934 or 1936. Its behaviour in trials has been irregular.

P. eugenii. Simon Louis. Our original stock came either from the Oxford Preservation Trust property known as Johnson's Piece, near Oxford, or from Lt.-Col. Pratt, Ryston Hall, Downham, Norfolk, 1933. Received also from Dr. Houtzagers, Arnhem, Holland, 1947. Normally very susceptible to bacterial canker, but Col. Pratt has one tree, which has remained uncankered, and which will be brought into our collection this winter.

P. freemontii. There is considerable doubt as to whether this really is *P. freemontii.* It appears more like *P. marilandica.* Received from Lt.-Col. Pratt, Ryston Hall, Downham, Norfolk, 1934. It has done quite well in one trial, but forms a rather spreading crown.

P. Frye. Hybrid *P. nigra* × *P. laurifolia.* Received from Dr. Schreiner, New Haven, Conn., U.S.A., 1937. N.

P. gelrica. A natural hybrid between *P. serotina* and *P. marilandica.* Received from Dr. Houtzagers, Arnhem, Holland, 1937. Doing very well indeed in one trial.

P. generosa. Hybrid *P. angulata* × *trichocarpa.* Received from Hilliers Nursery, Winchester, 1934. Susceptible to bacterial canker.

P. Geneva. Hybrid *P. maximowiczii* × *berolinensis.* Received from Dr. Schreiner, New Haven, Conn., U.S.A. 1937. N.

P. laevigiata. This is a male tree, and may not therefore be the same as *P. laevigiata* of Dode. For some time we have regarded this as a form of *P. serotina*, which in some ways it resembles. But there are differences of leaf character. It is a fast growing erect tree, and appears to be resistant to bacterial canker. It was received from Lt.-Col. Pratt, Ryston Hall, Downham, Norfolk, in 1934. He got it from the French Nurseryman, Versin, in 1916. It comes into leaf much earlier than *P. serotina.*

P. laurifolia. Received from Lt.-Col. Pratt, Ryston Hall, Downham, Norfolk, in 1933. Very susceptible to bacterial canker.

P. Marais Poitevin. Probably *P. serotina erecta.* Collected in Marais Poitevin, near Niort, France in 1947. N.

P. Maine. Hybrid *P. candicans* × *berolinensis.* Received from Dr. Schreiner, New Haven, Conn., U.S.A., 1937. N.

P. marilandica. Received from Lt.-Col. Pratt, Ryston Hall, Downham, Norfolk, 1934.

P. North-West. Unfortunately two lots have been confused under this name. One was received from the Canadian Forest Service, Ottawa, in 1939, was said to be a hybrid *P. deltoides* × *tacamahaca,* and was also known as *P. Jackii.* The other was received from the Horticultural Research Station, Cheyenne, Wyoming, U.S.A. in 1940, and was said to be a cross of *P. nigra* with a balsam poplar. N.

P.O.P.14. Hybrid *P. charkowiensis* × *P. deltoides monilifera.* Received from Dr. Schreiner, New Haven, Conn., U.S.A. 1939. N.

P.O.P.19. Hybrid *P. charkowiensis* × *P. caudina* (a variety of *P. nigra*). Received from New Haven, U.S.A. 1939. N.

P O.P.60. Hybrid *P. alba* × *canescens.* Received from New Haven, U.S.A. 1939. Does not strike readily from cuttings. N.

P.O.P.62. Hybrid *P. angulata* × *robusta.* Received from New Haven, U.S.A. 1939. N.

P.O.P.63. *P. deltoides monilifera* × *P. caudina* (a variety of *P. nigra*). Received from New Haven, U.S.A. 1939. N.

P.O.P.64. *P. charkowiensis* × *P. nigra plantierensis.* Received from New Haven, U.S.A. 1939. N.

P O.P.65. Hybrid *P. charkowiensis* × *P. robusta.* Received from New Haven, U.S.A. 1939. N.

P.O.P.66. Hybrid *P. sargentii* × *nigra italica.* Received from New Haven, U.S.A. 1939. We have been unable to raise good stocks of this variety ; it seems very feeble in this country. N.

P. Oxford. Hybrid *P. maximowiczii* × *berolinensis.* Received from New Haven, U.S.A. 1937. N.

P. petrowskyana. This is very difficult to distinguish from *P. berolinensis.* Received from Ryston Hall, Norfolk, 1934.

P. rasumowskyana. This also is very difficult to distinguish from *P. berolinensis.* Received from Ryston Hall, Norfolk, 1934.

P. regenerata. Received from Ryston Hall, Norfolk, 1934. Susceptible to bacterial canker.

P. robusta. Received from Ryston Hall, Norfolk, 1934, also from Hilliers, Nurserymen, Winchester. The two stocks are mixed. This has done well in all trials.

P. Rochester. Hybrid *P. maximowiczii* × *nigra plantierensis.* Received from Dr. Schreiner, New Haven, Conn., U.S.A. 1937. N.

P. Roxbury. Hybrid *P. nigra* × *trichocarpa.* Received from New Haven, U.S.A., 1939. N.

P. rubra poie. Received from Lt.-Col. Pratt, Ryston Hall, Downham, Norfolk, 1934. He received it from Dode in 1915, and has it listed as a hybrid *P. nigra* × *angulata.* It closely resembles *P. marilandica* in leaf and in habit of growth and is a female tree.

P. Rumford. Hybrid *P. nigra* × *laurifolia*. Received from Dr. Schreiner, New Haven, Conn., U.S.A., 1937. N.

P. serotina. Collected from a old nursery in Bagley Wood, near Oxford, 1935. It has done badly in all trials and may be a poor form.

P. Sp. Minn. (Species Minnesota). Received from the Horticultural Field Station, Cheyenne, Wyoming, 1940. Not yet identified. N.

P. Sp. Minn 2881. Received from Cheyenne, Wyoming, 1940. Not yet identified, but different from the above. N.

P. Strathglass. Hybrid *P. nigra* × *laurifolia*. Received from Dr. Schreiner, New Haven, Conn., U.S.A. 1937. N.

P. suaveolens. Received from Dr. Denham, Oxford, 1935. Not at all promising.

P. tacamahaca. Received from Canadian Forest Service, via Dr. E. W. Jones, Oxford, 1944. N.

P. trichocarpa. Received from the Canadian Forest Service, Ottawa, 1939. Said to be a particularly straight growing form. Not yet known if it is susceptible to bacterial canker, but this species usually is. N.

P. trichocarpa. Received from Hillier, Nurseryman, Winchester, 1934.

P.15A. Hybrid of unknown parentage. Received from Professor Jacometti, Italy, 1939. Has grown fairly well, but not as fast as *P. robusta* in one trial.

P.30A. Hybrid of unknown parentage. Received from Professor Jacometti, Italy, 1939. This variety is about the best of those received from Italy in 1939, and looks very promising indeed.

P.65A. Hybrid of unknown parentage. Received from Professor Jacometti, Italy, 1939. Has not so far done well under trial.

P.72A. Hybrid of unknown parentage. Received from Professor Jacometti, Italy, 1939. Has so far done badly in trials.

P.78B. Hybrid of unknown parentage. Received from Professor Jacometti, Italy, 1939. Not properly tried yet. N.

P.98/40. Hybrid of unknown parentage. Received from Professor Piccarolo, Instituto di Sperimentazione per la Pioppicultura, Casale Monferrato, Italy, 1947. N.

P.214A. Hybrid of unknown parentage. Received from Professor Jacometti, Italy, 1939, and also from Professor Piccarolo, Casale, Monferrato, Italy, 1947. N.

P.262. Hybrid of unknown parentage. Received from Casale Monferrato, Italy, 1947. N.

P.455. Hybrid of unknown parentage. Received from Casale Monferrato, Italy, 1947. N.

P.488. Hybrid of unknown parentage. Received from Casale Monferrato, Italy, 1947. N.

Thanks are due to all the persons listed above, who have supplied cuttings, and also to Mr. P. G. Beak for assistance with systematy. The collection is in general intended only to include varieties of possible importance for timber production, or of particular interest in connection with work on bacterial canker. For that reason *P. nigra* and some of its varieties have been discarded from the collection. It is hoped this winter to add quite a number of interesting varieties, including some of Dr. von Wettstein's hybrids and some German selections of *P. robusta*.

As the trials become established and work on canker resistance proceeds, I hope to be able to give more details as to the behaviour of the different varieties.

LAWSON CYPRESS AS A PIONEER SPECIES

BY DAVID GRANT

IN THE SOUTH-WEST the name of Wilsey Down is synonymous with severe conditions for tree growth. This 400 acre block, a northern outlier of the Bodmin Moor of Cornwall, is exposed to the full fury of the gales from the Atlantic, seven miles westward. The soil is of the poorest type, thick turf or fibrous peat of varying depth overlying granite rubble and grey clay, with a " shillet (slate) pavement " at a depth of 10 to 15 inches. This soil supports a rank vegetation of ling, dwarf gorse and blue moor grass (*Molinia caerulea*).

Lack of soil aeration appears to limit micro-biological activity, and the tree roots, being confined to the upper soil layer, are in direct competition with those of the surface vegetation. Double-furrow ploughing with the Oliver plough over portions of the area in the past has not cultivated the soil deeply enough to remedy this defect.

Since 1927, Sitka spruce with some Lodgepole pine (*Pinus contorta*) has been the main species planted. Apart from isolated blocks where better soil conditions exist, most of the area is in check or struggling to come out of check. In the midst of a depressing walk through Sitka spruce planted between 1933 and 1938, averaging only three feet in height in 1948, it is surprising to find about an acre of 1938 planting of Lawson cypress growing vigorously at 900 feet elevation on the most exposed part of the moor. Two-plus-one transplants, planted at 5 × 5 ft. spacing on the double furrow slice, with basic slag added at time of planting, have never been in check and have only needed a light beating up and some weeding in 1939. The trees now average 5 ft. 6 in. in height, the current year's growth averaging eleven inches ; there is a slight lack of foliage on the south-west side of the trees due to the exposure.

In comparison, the surrounding Sitka spruce of the same age or older, average only three feet in height, the current year's growth being only three inches. Some Lodgepole pine too, although seven feet in height, show a decrease in growth to six inches in 1947 and look distinctly weedy. Both these species received slag when planted. The Lawson cypress are too wide apart to have had much affect on the vegetation in the early stages ; nevertheless, they have proved to be more successful than the Sitka spruce in making the most of the improved soil conditions in the shallow furrow slices. In adjacent compartments Lawson cypress beat-ups in the Sitka spruce are showing much better growth than that species.

The promising growth of the Lawson cypress indicates that it may be a most useful species in mixture with Sitka spruce in ameliorating soil conditions on similar areas elsewhere in the west. It is interesting to quote Dallimore and Jackson who inform us in their *Handbook of the Coniferae* that Lawson cypress occurs naturally in South West Oregon in a very moist climate under the influence of ocean winds, one of its associates being Sitka spruce.

NOTES ON ABIES NOBILIS

BY HARRY WATSON

THIS SILVER FIR from the Pacific Coast has shown itself to be a very heavy cropper in our west coast forests. From an amenity point of view, groups of this species light up the sombre tones of our other mass producer—Sitka spruce.

It is easily reared in the nurseries and is best planted out as a 2 × 2 transplant. It cones very heavily but unfortunately the germination percentage of the seed is usually low. It has therefore to be sown so thickly that practically all the seedbed surface is covered. It is a sturdy seedling and weeding is therefore not costly. Lining out at 2 in. apart seems to produce quite good plants. If groups are to be planted, I would suggest 6 foot spacing with fairly early brashing, and the pruning of both dead and living branches when necessary.

In the light of having seen two " emergencies " in my forest life, with prices good and quality not an essential, I would use this fast grower to plant up difficult extraction sites at 15 feet apart (about 200 to the acre) and prune by stages up to 20 feet. Plants and costs would be greatly reduced and no uneconomic thinnings would accrue. In fifty years—which I consider an ideal rotation—these trees should produce one hundred cubic feet each. What about quality ? I would suggest that 2 inches be the minimum thickness for the conversion of this timber. This obviates the tendency to split, which although a " nobilis fan," I admit. This size of material makes very suitable packing cases for machinery export.

Another profitable use for this species would be to plant up gaps in those poor oak scrub areas where the felling and extraction of the scrub is uneconomic.

To round off, I append notes on an *Abies nobilis* tree felled at Benmore in November, 1941, and sold standing.

Age 68 years (original cost say sixpence).	
Height to 6 in. diameter ...	95 feet
Total Height	110 feet
¼ girth over bark at mid length ...	24½ inches
Cubic Contents	396 cubic feet
Less 10 per cent. for bark	39 cubic feet
	357 cubic feet

In conversion, besides 90 sleepers, all sorts of mining timbers were produced.

Revenue

	£	s.	d.
6 bags small twigs for wreaths at 4s. 4d.	1	6	0
1¾ tons branches at £18 per ton ...	31	10	0
357 cubic feet timber at 9d. per cubic foot standing	13	7	9
	£46	3	9

Expenditure

Labour in pruning and bundling branches ...	£3	13	6
Profit on tree	£42	10	3

Six tons of branches per year were sent for three years to Iceland for decorative purposes. The small pieces are in demand in the cities for wreath making, etc.—another source of revenue ; in all we sold over 9,000 cubic feet of *Abies nobilis* timber at 9d. per cubic foot and that quantity was only limited by us because we hated to part with all those noble silver firs.

JAPANESE LARCH

BY L. A. KING

AT GRIZEDALE FOREST there is a five-acre plantation of Japanese larch which was purchased with the estate in 1937, when it was in a dangerously unthinned condition. The site is moderately exposed to the west but sheltered in other aspects, and the ground surface is rough with much rock outcrop. This plot has since been systematically thinned, and a recent sample plot (1948), gave the following figures :—

Age of stand : 43 years.
Present stocking : 280 trees per acre.
Breast-height quarter-girth range : $5\frac{1}{4}$ to $10\frac{3}{4}$ inches.
Average b.h.q.g. : 8 inches.
Average total height : 66 feet.
Average timber height to 6 inches diameter : 41 feet.
Volume of average tree : 13 ft. 11 in. q.g.o.b. measure
Volume per acre : 3,897 cu. ft. q.g.o.b.
Volume per acre previously removed in thinnings : 4,000 cu. ft. q.g.o.b.

Details of thinnings

Number	1st	2nd	3rd	4th
Date	1939	1941	1943	1945
Trees removed per acre	450	300	200	200
Volume removed per acre c.f.q.g.o.b.	900	1,100	1,000	1,000

The area has responded well to thinning. Some butt rot was noticed in felled trees, and it is interesting to see considerable natural regeneration.

GROWING POPLARS AMONGST CONIFERS

BY C. F. VETCH

DURING THE WAR there came to my notice a wood of some four acres in extent, on a slight slope and with a damp soil, carrying a mixed crop of European larch, Norway spruce, and beech, together with about thirty poplars. The age of the crop was between forty and forty-five years. All the poplars had attained a good size, but those on the outskirts of the wood had developed many side branches. By contrast, those within the wood had gone up clean and straight, having a height of from forty to forty-five feet to their first branch. The largest tree measured nineteen inches in quarter girth at breast height, over bark. A London timber merchant bought these trees at maximum prices, but would only offer a low figure for those growing on the outskirts.

Why not grow poplar with conifers ? If Norway spruce were chosen, an early return might be obtained from Christmas trees, and with this and other species, pit props would be forthcoming from later thinnings. At the same time the conifers would keep the poplars free from side shoots, and prevent branching too low down.

DOUGLAS FIR IN COPPICE AREAS

BY GEORGE LEES

A PORTION OF Hope Wood on the Old Red Sandstone, which carried a crop of standing oak, birch, sycamore and ash along with hazel coppice, was clear felled and then planted up with Douglas fir. After planting, natural birch, ash, and sycamore began to appear ; thus a broad-leaf plantation was being offered us, which would have saved planting and much weeding. The weeding of the Douglas first went on for a few years, at a heavy cost, which also included the loss of a few years of growth of good coppice and natural growth cut back in the weeding. Eventually it was decided to give up the struggle to produce a Douglas fir plantation and accept the result.

After a few years of non-interference, the broad-leaved species thrived, with the result that a thinning was done four years ago, and the area will soon be ready for another. The Douglas firs are now very few, most of them being suppressed by the rapid growth of the natural hardwoods. Any Douglas firs which were good enough were left as shelter for birds.

This shows that we would often do better by accepting what nature gives, rather than by attempting to introduce conifers, and also gives a warning against planting up an area of this type so soon after felling.

THE USE OF ORNAMENTALS IN THE FOREST

BY T. R. PEACE

IT MAY BE ARGUED that it is the business of the forester to plant trees for the production of timber, and that he should leave the planting of ornamental trees and shrubs to the gardener. Personally I feel that this is taking too narrow a view, and that, while planting for timber production should, of course, be our primary object, the maintenance and creation of beauty in the areas we have to deal with is a matter worth care and consideration. We are often accused of covering the face of England with dull conifers, and the reasonable use of ornamental trees and shrubs is one answer to this criticism. We must be prepared, however, if we do endeavour to beautify our forests, to be met with bitter criticism from some quarters and with considerable practical difficulties. There is a large and powerful school of thought which takes the view that England is best as it is and that any alteration is bound to be for the worse. These folk view all exotic trees and shrubs with aversion, and insist that their use is destructive to the English landscape. In saying this they conveniently forget that many of the species they regard as native were colonists after the ice age or early introductions by man. In addition, there is, chiefly among ecologists, a considerable weight of scientific opinion which objects to the naturalization of exotic species because these introduce an unnatural element into the British flora, which it is their wish to study in its untouched state.

To the first group I would give the answer that if an exotic grows well—and we should confine our planting to varieties that do grow well—it will soon look as if it was a native. Numerous instances of this can be quoted ; in many parts of the country, Snowberry (*Symphoricarpus racemosus*), often planted for game cover, has established itself ; *Buddleia*, an enthusiastic colonizer of bombed sites, has also become naturalized in several places on the chalk, and looks perfectly at home ; *Rhododendron ponticum* grows rampantly on suitable soils in many areas, in fact it grows so well as to be a nuisance. If we brought a foreigner to this country with no knowledge of the English flora, he would assume that all these plants were native, and he would certainly not regard them as out of place. When I was in America, I thought that both *Forsythia* and Broom were wild until I was told that they had been introduced. The ecologists can certainly claim that selected areas should be left in an untouched state for their studies, but since a planted forest is unnatural anyway, the addition of ornamentals to it can make little difference.

CHOICE OF SITE

Naturally the best site will vary according to the type of ornamental under consideration. Trees of forest stature can be planted anywhere along the margins of plantations. If the crop is on a slope so that the crowns of the trees can be seen from a distance, or if the forest is so situated that it is often seen from some higher viewpoint, an ornamental tree species can be mixed with the main crop, provided, of course, that a variety is used that will hold its own with the trees with which it is mixed.

Smaller trees and shrubs are best planted in groups along wide rides, in clearings and in odd corners of ground too small for plantation use. It is important that only wide rides should be used ; ornamentals in narrow rides will soon be shaded out by the forest crop. Often small patches of ground in the neighbourhood of nurseries can be used. It is a mistake to plant continuous belts or lines of ornamentals along the margins of plantations or along

rides, not only because such plantings look unnatural, but because they are bound to interfere with the extraction of thinnings and to be damaged during this operation. In the same way, if clearings are planted it should be ascertained first that they will not later be required for stacking grounds.

It may prove desirable to provide in some of our forests picnic and camping sites, the margins of which form obvious places for small trees and shrubs. Most of the berrying shrubs are valuable as food for birds, and many of the trees and shrubs considered below form useful nesting sites. For this latter purpose it is important that they should be planted in reasonably large groups so that fairly dense thickets are produced.

SOURCE OF SEED AND PROPAGATION MATERIAL

One of the difficulties facing the forester or forest officer interested in raising ornamentals is where he is to get seed, cuttings, layers, etc. By far the most successful plan is to make friends with neighbouring gardeners, especially those concerned with large gardens where shrubs are likely to have been considerably used. If large quantities of seed are obtained, pass some on to another forester who is interested. Perhaps the best source of all is a large garden that has run wild for several years, but not for so long that all the worthwhile shrubs have disappeared. In such a place one can tell which plants are holding their own, and those are the ones most likely to be useful in the forest ; also, in the absence of cultivation, layers, suckers and natural seedlings are likely to be more freely produced. Once an initial stock has been raised, two or three plants of desirable varieties can be planted in a corner of the nursery to provide seed, cuttings or layers for future use.

RAISING ORNAMENTALS

It is beyond the scope of this paper to discuss details of propagation for the numerous trees and shrubs which can be used in the forest. Seed, cuttings, layers and suckers are all legitimate methods of propagation for the various species. Many of the berried shrubs require stratification of the seed for a whole season before sowing. Probably the best reference book is *The Propagation of Trees and Shrubs* by G. C. Taylor and F. P. Knight, published by Dulau and Co. Grafting is not permissible as a means of raising trees and shrubs for forest use. There is too great a risk of the stock growing away and replacing the grafted variety.

Ornamentals are usually raised only in comparatively small quantities, and are worth a little extra care and attention in the nursery. There is a strong tendency for foresters to regard them as oddments, to shove them in a corner of the nursery and to leave their lining-out and planting till all the big lots of forest trees have been dealt with. This is a mistake. They should be given a good site in the nursery, though one so placed that its permanent retention for ornamentals will not interfere with the large scale cultivation of the nursery as a whole. Lining-out and planting should be done under the most favourable conditions available.

Ornamentals require a little more care in the forest than the ordinary run of trees, and this is more easily given if they are large enough to be easily seen ; they are particularly subject to attack by browsing animals, especially deer, and here again large plants have an advantage ; finally they are, unfortunately, very subject to damage or even theft by man, and there is more chance of a large plant surviving injury, and less chance of it leaving the forest in the boot of a car or on the carrier of a bicycle, than a small one. For all these reasons large plants are to be preferred, but it is essential that they should

never be left for more than two years in the nursery without transplanting, and they must be reasonably widely spaced so that they are stout as well as tall.

PLANTING AND MAINTENANCE

Planting must be done very carefully, and pit-planting is normally the best method ; for trees, but not shrubs, staking is desirable. On dry sites, or where the vegetation cover is thick, it will prove advantageous if a small area is screefed before planting in order to reduce root competition. Any open weather in the late autumn, winter or early spring, is suitable for most deciduous trees or shrubs, and late planting should be strictly avoided. Evergreens are best planted in late October, if the soil is moist enough, or in late March or early April. All varieties will repay great care in lifting, and every effort should be made to keep the roots moist during transit. It is gross waste of the time and expense involved in raising ornamentals if they are not carefully planted and properly tended thereafter.

Unfortunately most ornamentals, with the exception, I think, of Rhododendrons, are just as much subject to rabbit damage as forest trees. As far as possible, therefore, ornamental plantings should be within the rabbit fences, and when they are not, temporary ring fences should be provided till they are well established.

It has already been suggested that only those species should be used that can maintain themselves reasonably easily under forest conditions. But like any other forest crop they will need weeding, and later, cleaning, and it will pay to give them just a little more care than is normally given to the ordinary forest crops. The fact that they do need a little more looking after than forest trees does suggest that they should be concentrated in certain parts of the forest, not scattered widely over the whole of it. They could be used in groups along a few of the wider rides, in a few clearings, along any public roads (though these will be bad places for theft and damage), and in the neighbourhood of the nursery. If they are not too widely scattered the forester can keep an eye on them more easily, and one sensible man can be detailed to weed and clean the lot. There is a great deal to be said for entrusting the care of such plants both in the nursery and in the forest to one man who is known to be interested in gardening.

VARIETIES TO PLANT

The trees and shrubs available for our use can conveniently be considered under three heads ; trees of timber value, native trees and shrubs of little timber value, and exotic trees and shrubs of little timber value, the last being by far the largest group. In this article no attempt has been made to give an exhaustive list of all the varieties which could be used in the forest. There is room for experiment and, even more, for observation in this matter. If a decorative tree or shrub is flourishing under fairly tough conditions in your neighbourhood, it may well be worth a trial in your forest.

Of course the first consideration should be the trees, if any, which are already present on the ground. In crops which are to remain standing, care should be taken to see that marginal specimens of varieties such as wild cherry, service or rowan are not being suppressed. If the crop is being felled, efforts should be made to preserve marginal trees of desirable species, limiting one's selection to such trees as are stout enough to stand firm when the shelter round them is removed. Preservation should not be limited to the obviously ornamental trees, such as those mentioned above, but should be extended to a limited number of finely developed, well preserved specimens of the ordinary forest species, particularly hardwoods. These can be left along rides to give shade and shelter and to break the monotony of the young plantations.

Forest Trees. Many of the ordinary forest trees can be used to increase amenity if planted in limited quantity against a background of a contrasting species. In this matter one needs to consider not only the colour of the foliage at different seasons, but also the colour of the bark and twigs. Japanese larch is outstanding in this respect, the bright colour of its twigs adding greatly to the winter colour of the woods. European larch has not got this beauty, but for a short period in the spring the bright green of the expanding needles forms a refreshing variation on the rather dull green of most of the evergreen conifers. Birch is the other outstanding example of beautiful bark, and while it is probably not worth planting for amenity purposes, occasional groups of really white-barked birch are worth preserving for their beauty apart from their forest value.

Several conifers are worth using in small numbers on plantation margins for colour contrast. *Pinus contorta*, and to a greater extent where it is hardy, *P. insignis*, show up very bright green against the commoner pines. The ordinary Lawson cypress is not very striking in its colour, but several of the blue forms grow quite as quickly as the type. Normally these are expensive to procure, but they are quite common, and it might well be worth collecting seed from them, in the hope that some of the resulting seedlings might turn out to be blue. Among the conifers the two sequoias and tsuga are hard to beat for beauty of form, though *S. sempervirens* always looks brown and shabby after a hard winter.

Of the larger hardwoods, beech is outstanding as an amenity tree. The use of copper beech is probably best confined to the neighbourhood of buildings or nurseries, as its unusual colour does give it a somewhat cultivated air. Among timber producing trees, beech, American red oak (*Quercus rubra*), Norway maple, wild cherry (*Prunus avium*), and service (*Pyrus torminalis*) all colour well in the autumn. In addition, of course, cherry has a brief period of beauty when in flower in the spring, and the foliage of red oak, apart from being large and handsome, is a fresh bright green until it turns red in the autumn.

Native Trees and Shrubs of Little Timber Value. Only one native conifer need be considered here, though the juniper is quite attractive. Well developed yew trees, that are placed some way back from the fence line and thus away from danger of poisoning cattle, are often worth leaving. In some forests on the chalk, yews have colonized bare slopes. Leaving them in such situations may prove the best course from the practical angle, as well as from the amenity point of view.

Most of the native hardwoods mentioned below are worth preserving or even encouraging where they occur, but are probably not worth raising in the nursery and planting. Two exceptions to this are bird cherry (*Prunus padus*), attractive both in flower and fruit, and sea buckthorn (*Hippophae rhamnoides*). Both have rather a limited natural distribution in this country and are worthy of more widespread use. The latter is normally found on sand dunes near the coast, but will grow on any reasonably moist soil. Plants of both sexes must be used, however, if the bright orange berries, which with its silvery foliage form its main attraction, are to be produced.

Of the other species, for beauty of flower, good well placed specimens of hawthorn, crab and the comparatively rare wild pear should be retained. Of course, both gorse and broom are very attractive in flower, but both constitute a dreadful fire danger, especially after a hard winter, and the latter is perhaps too familiar as a plantation weed. Broom, however, can reasonably be left where it occurs in clearings, or on the margins of young plantations. For berries we have holly, privet, spindle (*Euonymus*), hawthorn again, rowan

(*Pyrus aucuparia*) and the two native *Viburnums*, *V. lantana* (wayfaring tree) and *V. opulus* (guelder rose). The last two are attractive for flower and autumn foliage as well ; *V. opulus* is worth raising from seed in the nursery, though its early growth is painfully slow. Both white poplar (*Populus alba*), which does particularly well on exposed places near the sea, and whitebeam (*Pyrus aria*) are attractive because of their white foliage, while good specimens of the native maple (*Acer campestre*) should be retained for the fine yellow autumn colour.

Exotic Trees and Shrubs of Little Timber Value. There is here such a wealth available that it is very difficult to make a selection. Even if we limit ourselves, as we should, to the easier kinds, the choice is still very wide.

There are not many conifers which we need consider here. On really wet ground or on any moist fertile soil the swamp cypress (*Taxodium distichum*) is worth planting. Fresh green in the spring, it turns a bright brown in the autumn and is one of the few trees that will stand long periods in stagnant water. Unfortunately *Taxodium* seed is difficult to procure, otherwise it could be tried as a forest species on very wet sites. Among columnar conifers, *Libocedrus decurrens* is one of the best and most handsome.

There is not a very large choice among those larger trees not generally used for forest purposes ; some like elm, plane and walnut, are surprisingly difficult to establish under forest conditions. Probably the most useful are the horse chestnut, the tulip tree (*Liriodendron*), and false acacia (*Robinia*) which does particularly well on dry sites.

There are more small trees to choose from, though it is advisable to avoid some of the best garden varieties, mainly because their showy flowers make them so liable to damage by the public. Apart from our native species, a number of the more vigorous hawthorns, cherries and crabs are quite suitable for forest use provided they are on their own roots. Of these, the American hawthorns *Crataegus carrieri*, *C. mollis* and *C. punctata*, and, among the cherries, *Prunus sargentii*, with single pink flowers and good autumn colouring, and *P. serotina*, a more vigorous type of bird cherry than our native one, are all worth raising. The more decorative crabs are likely to be too popular with small boys but the Siberian crab (*Pyrus baccata*) and *Pyrus* John Downie could be tried in positions under fairly frequent observation ; *Pyrus spectabilis*, which carries masses of apple-like flowers, is not attractive in fruit. Three of the *Sorbus* group of *Pyrus* have already been mentioned, namely, service, rowan and whitebeam ; the Swedish whitebeam (*Pyrus intermedia*) which is probably native, is also a good forest ornamental. The North American sweet gum (*Liquidambar styraciflua*) colours magnificently very late in the autumn ; there is a small plantation of this species in Gravetye Forest in Sussex. On moist sites the coloured-barked willows are hard to beat, especially if they can be planted against an evergreen background. They colour much better if they are cut back periodically and for this reason they are particularly suitable for making a screen, where the cutting-back process actually serves to enhance their beauty. For a site where there is room for it to develop its characteristic form, the weeping willow (*Salix babylonica*) is a fine tree. All these willows are easily raised from cuttings. Finally, the laburnum should be mentioned. This tree will stand rather more shade than most of the other ornamentals, though to flower well it must get a reasonable amount of sunshine. It is very easily raised from seed, and since individual trees vary considerably both in size of flower and in freedom of flowering, it will pay to select a good tree for seed.

Among the shrubs there is a wealth of material we can use, though it is essential that we confine our choice to those vigorous enough eventually

to overcome the wild vegetation, or at any rate to be able to hold their own with it. For early flower, one of the best shrubs is *Forsythia* ; *F. intermedia spectabilis* is the finest variety, but all kinds are suitable. *Forsythia* increases rapidly because the tips of shoots which touch the ground take root. *Berberis* (*Mahonia*) *aquifolium*, which has been so widely planted for game cover, will bear attractive yellow flowers very early in the year if planted in a position where it gets some sunlight. On chalky soils the *Buddleias*, *B. variabilis* and *B. alternifolia*, will quickly establish themselves ; though they are not long lived, they will sow themselves abundantly on any bare ground. They will flower more freely if they are cut hard back annually. This could be done when the rides are trimmed in the winter. For sandy soils near the sea the various varieties of *Tamarix* are good shrubs. They are easily raised from winter cuttings, in fact on reasonably moist soil, pieces of walking stick size can be rooted in their permanent positions. On very dry sites the Spanish broom (*Spartium junceum*) is very showy, though it grows straggly with age ; it will tolerate chalk. *Colutea* (bladder senna) is another good dry site tree, easily raised from seed. On reasonably moist soils any of the single lilacs will do well. They will grow on very dry sites, but do not flower well unless kept free from competition by surrounding vegetation for water. Since this is hardly possible under forest conditions, they are best confined to better sites. Lilacs are often grafted, but for our purpose they must be on their own roots. Provided they have not been grafted, the numerous suckers that the lilac sends up will be of the same variety as the main bush and can be cut off with their roots as the quickest means of propagation. The so-called syringa or mock orange (*Philadelphus*) merits trial both for its flowers and scent. It requires full sunlight.

Many of the St. John's worts (*Hypericum*) will establish themselves and increase under forest conditions ; they will flower under light shade. The most useful is probably the Rose of Sharon (*H. calycinum*) which has large yellow flowers, and will form a dense ground cover under quite heavy shade. It is virtually wild in many places, for instance, in the neighbourhood of Santon Downham in Thetford Forest. Most of the taller *Hypericums* have rather smaller flowers which, however, are often in large clusters. They can be propagated very easily by seed or in some cases by division. Finally for flower, we have the rhododendrons and azaleas. The common species (*Rhododendron ponticum*) has become something of a pest because it spreads into plantations and is difficult to eradicate, but there are many more desirable varieties far too numerous to mention here. Established bushes of rhododendron often have many lower branches which have layered themselves. If the variety is a good one, these layers can be removed and used for planting, after they have been brought on in the nursery, preferably in a shady part. Some foresters may have access to one of the many large gardens which have fallen into neglect during the war ; such places may be very fruitful sources of rhododendron layers. As forest shrubs, rhododendrons have the great advantage of preferring a certain amount of shade. The azaleas are of much less value to us, but the more vigorous varieties are capable of holding their own on sunny sites, and they are fairly easily raised from the suckers that arise round established plants.

There are a number of shrubs which are of value mainly for their berries, and among these the *Cotoneasters* are outstanding. *C. frigida*, which forms a small tree, *C. simonii* and *C. henryana* are all good varieties, but any of the more vigorous sorts will suit our purpose. The *Pyracanthas* are also valuable for their berries, and though in gardens they are usually found on walls, such a position is not really at all necessary, as they make fine spreading bushes in the open. Snowberry (*Symphoricarpus racemosus*), with

its curious white berries, has been widely planted as game cover, and will more than hold its own on most sites. The taller varieties of *Berberis* are quite useful, and will come so freely from seed that the tendency is to raise too many. As they are painful to handle only the number of plants required should be lined out. Unfortunately, although they are so well armed, the young shoots are eaten by rabbits. Various wild types of rose are suitable for forest use, most of them having more beauty in their fruits than their flowers, but the varieties are too numerous to mention. They are easily propagated by removing suckers from existing clumps. The red-berried elder (*Sambucus racemosa*) has naturalized itself in parts of Scotland. It is probably no use trying to grow it in low rainfall areas, but where it can be grown, its fruits are very attractive. Among the less known berried-shrubs, *Stransvesia davidiana* and *Photinia villosa* are worth growing. Both are easily raised from seed and both colour well in the autumn.

For winter colour the red-barked dogwood (*Cornus alba*) is outstanding ; it does best in a fairly moist site. *Amelanchier canadensis*, which colours finely in the autumn, and which has attractive white flowers for a very short period in the spring, is able to naturalize itself on sandy soils.

WILD FLOWERS

It is worth remembering that although planting is best confined to trees and shrubs, the forests can be made and kept more beautiful if some effort is made to preserve and encourage the many attractive wild flowers that occur. Some forests have special sources of beauty such as wild daffodils, and some have cultivated daffodils, snowdrops or aconites planted by a previous owner. We must not allow our feelings toward these flowers to interfere with the prime purpose of our forests, but we can see that the ride sides where they grow are not trimmed till the leaves of the bulbs have withered, and we can take care that timber or poles are not piled on top of the best clumps.

CONCLUSION

Finally, I would like to make a suggestion on the proper way to approach this question of preserving and adding to the amenity of our forests. Much can be done by preserving existing trees of particular beauty or value, by intelligent layout of plantations to provide contrast, lines of view, small clearings, irregular edges to plantations, mixed marginal plantings, and so on, by preserving the existing wild flowers, and by cherishing such shrubs, ornamental trees and flowers as previous owners may have planted in more spacious days. Our own direct contribution should be limited to the number of plants that we can really look after once they have been planted, and it should, as already suggested, be confined to certain parts of the forest, so that the trees may receive that extra care without which they will not thrive. In fact it is really by far the best thing to do a little and do it well.

AMENITY BELTS AND RIDES

BY C. P. CARR

"A THING OF BEAUTY is a joy for ever," is as true now as when Keats wrote it. So let us break away from the old stereotyped method of planting up as much ground as possible and try to combine commercialism with idealism.

We all know that on occasions some roadsides are tidied up and a little window dressing is done to some advantage. I think this should be encouraged. When motorists are again allowed to use their cars, let our roadsides be more colourful and varied ; this will be much appreciated by the layman.

Japanese larch has proved very adaptable and could be utilised more for this purpose. Where conditions allow, the willows lend themselves admirably to colour schemes. The golden, purple, red and weeping willows give a glorious effect, whilst on dryer banks the hazel family give excellent results. Most of these trees can be raised from cuttings with little difficulty. Wild cherry, silver birch, hawthorn, horse chestnut and copper beech planted out in clumps, each of one kind, look very effective and are much better than a general mixture.

Most rides are marked out by a single row of trees for the boundary, but it is much better to employ two rows for this purpose. The first row can later be cut out, if necessary, giving added width to the ride to facilitate extraction. If Norway spruce is used, the trees removed can be profitably sold as Christmas trees.

TREATMENT OF OAK COPPICE AREAS

BY W. PEARSON

CONTROVERSIAL OPINIONS have arisen on several occasions as to the future treatment of some 300-400 acres of coppice oak at Wyre Forest, Worcestershire.

However, a policy has now been laid down and approved for these areas, but before giving a description of the treatment adopted, and now under way, no doubt the following remarks regarding the type of coppice areas under treatment will be of interest to readers. Records indicate that matured oak stands, 80-100 years old, were clear felled in 1928. The entire area was allowed to coppice, reaching the thicket stage once more after 20 years growth. Seedling birch came in and intermingled with the oak coppice, the birch becoming prominent in places. Owing to the prominence of birch, this at one time seemed to rule out the theory that a suitable, and worthy crop could be raised on the area without preparation of ground and replanting. The technique decided on, however, was that where birch was prominent in places it should be treated as for oak ; the objects being to obtain a crop on the ground and to avoid breaking up forest soil conditions now approaching perfection once more.

The oak coppice had an average height of 15-20 feet, with a b.h. diameter of 3 to 5 inches ; the stems per acre before treatment were approximately 2,500, and were reduced to between 1,500 to 1,700 per acre.

Description and method of Treatment

Firstly, all useless undergrowth is cut out, usually by women forest workers or youths at a piece-work rate of 27s. 6d. per acre. This resembles a light cleaning in an ordinary conifer plantation, and enables one more easily to spot the useless stems competing with those that should be retained. The area ganger now marks stems suitable for retention, using ordinary household distemper, which lasts long enough for the work to be undertaken before fading out, whereas paint has a more permanent effect. The method of selecting stems is as follows :—

A fairly straight line is ranged through say half of a compartment, cleaned ready for treatment. This line is set out by the aid of " Sight Rods," painted white. The line established, the marker selects suitable stems along the line and marks same to remain. Upon reaching the end of the line the rods are moved over 5 feet, 8 feet, etc., according to the spacing, which depends on type and class of stems in the area being worked. The moving over of rods is carried out until the compartment is completed. I would point out that the marker does not stick too rigidly to stems along sight-line ; he may favour any more suitable stem to right or left of the line, provided it is within reasonable distance. The axemen following up have no difficulty in knowing which stems are to be retained and which are to be cut out, and they deal expeditiously with all unmarked material in the row, and all unmarked material between the rows.

Costs for this work of marking and cutting out varies from £4 10s. 0d. to £6 10s. 0d. per acre. In some areas marking can now be dispensed with

after axemen have spent a week or so in marked areas, and have become familiar with the density required.

Most produce cut out is utilizable, being converted into round oak fencing stakes, barb-wire piles, hedge stakes, firewood, etc., sold through Conservancy Office, or locally to the trade.

Considering present day costs of prep-ground, planting, etc., coupled with plant shortages, this method should be given thought where coppice areas can be treated to produce useful future stands of timber for short or long rotations, without the necessity for re-planting.

COPPICE CONVERSION IN THE HIGHMEADOW WOODS

BY F. WATSON

IN THESE woodlands of the Wye Valley, conversions of coppice to High Forest have been carried out, wherever conditions have been suitable, for many years past. Many of our most promising hardwood stands were originally coppice areas. The presence of old standards, chiefly oak and beech, in these coppice areas, has complicated the carrying out of this treatment.

A stand of seventy-year-old oak and beech, occupying an area of eighteen acres, was selected for conversion in 1922. The crop at that time consisted of oak and beech coppice, the beech being slightly in the higher proportion, with approximately 6 or 8 old oak standards per acre, dispersed over the whole area. The first operation was a thinning to reduce the number of clean stems to 4 or 5 per stool ; at the same time all the suppressed and crooked stems were removed. The beech received the heavier thinning as these were getting well above the oaks ; no large breaks were made in the canopy and none of the oak standards was taken out. The produce obtained from this thinning was readily saleable as pitwood and lagging, the latter being a class of small pitwood which is always in good demand by the small collieries in the neighbourhood. This lagging is prepared with a minimum top diameter of 1½ inches.

A second thinning was made six years later, in 1928, when the stems were further reduced to 3 or 4 per stool. All beech which were found to be topping the oak were removed. Most of the oak stems now had a fair amount of head room, with the beech crowns about level with the oak. No further treatment was given until 10 years later, in 1938, when it was decidde to remove the old standards. The coppice stems were now well spaced, giving more room for extracting these old standards, and the crowns of the coppice were well up out of the way. It was necessary to lop practically all the old trees and very little damage resulted from the felling or the extraction of these.

A further thinning was made in 1943. This thinning reduced the number of good clean stems to 3 or less per stool, all having fairly uniform height and girth. It will be necessary to thin this area again during the next two or three years. Both species are making rapid growth, and quite a number of the oak stems are being crowded out by adjoining fastly developing crowns. The number of oak stems per acre is now greatly in excess of the beech ; the total of both species being around 430 per acre.

The average height is now 55 feet, and the diameter at breast height 7 to 10 inches. A noticeable feature is the almost total absence of side branches below 25 feet. Throughout this conversion period, the canopy was never opened up sufficiently to permit vigorous weed growth to occur, and only patches of weak bramble have survived throughout these operations. A fairly regular soil covering of humus extends over most of the area.

NOTES ON COPPICES AT TIDENHAM CHASE

BY H. JONES

IN THE SOUTH-WESTERN end of Turnips Wood, that is compartment 16 of Tidenham Chase, can be found some very good sycamore coppice approximately 40 feet in height, and 4 to 8 inches diameter in the butt. The soil is loam on sandstone, elevation about 400 feet above sea level. The area was originally planted with ash and larch in P. 28. The majority of the intended crop has disappeared, being unable to compete with the rapid growth of the sycamore, although that was doubtless cut during weeding operations.

In Parsons Allotment, beside the Green Road, on very shallow soil over limestone, 600 feet above sea level, sycamore was planted to form ride rows in P. 29 ; by P. 46 the maximum height of these plants would be 20 ft., and they were growing at the average rate of about one foot per year. Now during the winter of 1946-47, some of these plants were damaged, and in the following summer the damaged plants sent up vigorous coppice shoots to a height of four feet, while the undamaged plants continued to grow at the old normal rate of one foot per year. I think in time the coppice shoots will be far better than the undamaged plants.

An area in Caswell Wood, Compt. 19 and 20, was felled in 1942 or 1943. At the present time sycamore, ash, cherry wych elm, aspen, lime and other species of hardwood coppice together with natural seedlings, can be found ; the average height of the coppice is 15 to 20 feet and it shows every prospect of continuing this rapid growth. I think it would have been impossible for seedlings or transplants to have competed with them.

In a hollow on the south-eastern side of East Wood, Compt. 13a, there is a Sitka spruce plantation of P. 30, amongst these spruce can be found some very nice ash, sycamore and cherry coppice. Undoubtedly the hardwoods have been cut back on several occasions, but even now the plantation has reached an average height of 15 feet. The risk of the hardwoods suppressing the spruce still exists.

Beside the ride in Compt. 10 in East Wood, some small poplar were accidentally cut off in the winter of 1946-47. During last summer the poplar sent up coppice shoots to a height of over eight feet, while some similar poplar nearby put on only about 2 feet.

In Compt. 13b, small beech planted in 1942 on the south-western end have partly failed ; poplar coppice has taken its place, and in some cases it has reached a height of 20 feet and shows every prospect of continuing this rapid growth to form a good crop. Adjoining this plot a very similar case occurs, only this time elm has taken the place of poplar ; though not growing so rapidly it has reached a height of about 6 feet, and is doing much better than transplants or seedlings could have done.

NATURALLY REGENERATED OAK

BY A. E. WALKER

DURING THE period that I have been in the Forest of Dean I have been much impressed by the quantity and quality of naturally regenerated oak on various areas. Where nature has reafforested areas with such bountiful crops, it is essential that we should take every advantage of this gift and look after it in every possible way to provide good timber for the future. In the first instance, no expense has been incurred on seed collection and the resultant nursery work, and therefore we should be prepared to expend much more effort on naturally regenerated oak than has been done in the past. Much more attention should be given to these crops in the early stage. We should not leave the crop to grow on under haphazard conditions with the idea of obtaining " the survival of the fittest " ; we shall not obtain good results by this method. Most areas of planted oak are generally very slow in growth for four or five years, some even longer than this, which involves considerable expenditure on weeding ; but the crop usually bears no comparison to the growth of the naturally regenerated oak. Therefore I consider that we should be prepared to expend up to 50 per cent. of our average planting cost on the treatment of the latter.

Recently I saw an area of naturally regenerated oak about twelve years old, 10-12 feet in height, and with a density in places of 10 trees per square foot. Areas of this description require immediate attention ; the produce could easily be disposed of as bean rods and the revenue obtained would cover half the cost of labour. If allowed to continue at its present density, it would produce a crop of whips, which, when thinned, would never stand up to grow into good timber ; furthermore, the density of a crop of this description must impoverish the soil and retard the rate of growth. It would also produce many dead, dying and suppressed trees of no market value except firewood. Adjoining this natural regeneration there is an area which has recently been planted with oak and groups of beech, this area might well have been cleared when the adjacent natural regeneration was three years old, and the surplus plants lifted from the natural regeneration and used for planting ; thus thinning it out where required. In this way a uniform crop over the area would have been obtained and the nursery costs saved.

There are several age classes of naturally regenerated oak in the Dean from about the year 1901, some of which have been under-planted with beech, but owing to damage by sheep, have not been very successful. I suggest that on some of these areas we under-plant with tsuga in place of beech, for I feel convinced, provided sheep trespass is kept down to a minimum, that the results would fully justify the expense incurred. There are also some areas which have been planted with larch, now about 10-12 years old, which are carrying practically a full crop of oak natural regeneration growing exceedingly well. The larch, if allowed to remain, will obviously suppress and kill the oak. The larch should now be taken out, for with careful attention the oak will provide a far more valuable crop in the future than the larch.

NATURAL REGENERATION

BY G. ROBERTS

AFTER THE EXTENSIVE fellings that have taken place in our woods during the war years, I expect many foresters have quite a lot of natural regeneration on their areas. At a time when the supply of plants is not too good, and there are large areas needing replanting, we should endeavour to give any natural regeneration the attention it requires ; in the past it seems that the most popular idea in regard to treatment was to trust to the survival of the fittest, with the result that what did survive was of a very poor average quality.

Probably the most common mistake made with natural regeneration is to leave it too densely populated in its early stages ; I have recently seen P. 28 oak with twenty stems to the square yard.

The treatment I suggest is to lift a number of plants where they are overcrowded, and to plant them where the crop is too thin. This operation will give more room for weeding which should be done at least twice each year, never allowing the crop to be overgrown. Where birch seedlings are mingled with the crop, the best way of dealing with them is hand-pulling. If this is done, and the crop thinned lightly and often, I am sure we can produce some fine timber for the next generation.

THE TREATMENT OF UNDERSTOCKED HIGH FOREST AREAS

BY D. F. STILEMAN

IN THESE DAYS one frequently comes across woods from which the best trees have been removed, leaving a very patchy crop standing. In mixed conifer and hardwood stands, all the conifers may have been taken out, leaving a very open crop of hardwoods.

The problem of how to treat such areas presents considerable difficulties, for the sudden access of light usually causes a vigorous growth of coppice, brambles, briar, bracken, etc., which are liable to suppress any small natural regeneration and make it very difficult to eliminate rabbits.

Where the standing crop is of inferior quality and is never likely to improve, the whole area should, of course, be clear felled, fenced and re-planted. In some cases, however, to save the expense of clearing, if there is a considerable amount of coppice undergrowth it may be advisable to allow the coppice to grow on for a few years until it is large enough to be saleable and then make a clear fell of standing trees and coppice.

Assuming, however, that the standing crop is, say, oak of about eighty years old, which has been left in rather an open condition, but is capable of growing on to form a useful stand, the following methods of treatment, apart from clearing all undergrowth, netting and underplanting, might be adopted :

1. If there is a good proportion of useful coppice on the ground, such as ash, chestnut, sycamore, birch, suckers of elm and aspen, etc., the coppice can be left to grow on and the stool shoots gradually thinned out and stored to High Forest, thus forming a complete crop of oak and stored coppice.

2. If there are comparatively small openings in the canopy where coppice is absent, these can often be filled up by planting a single good-sized European or Japanese larch, say 3-4 feet high, or a black Italian poplar 6-8 feet, in the centre of the gap, provided, of course, that there is sufficient light for them to grow up into the canopy.

Where the gaps tend to be smaller, single plants of shade bearers, such as Douglas fir, thuja, tsuga, Lawson cypress, *Abies grandis*, beech, etc, may be planted.

In both the above instances a certain amount of pruning may be necessary later on, except perhaps in the case of European larch. Where scattered single trees are planted, and it is considered uneconomic to fence in the whole area, the single trees may be protected by a narrow sleeve of wire netting placed round each plant and held upright by three small stakes. A good method of preventing the wire from chaffing the tree is to insert a wad of grass inside the sleeve round the plant. Such wads will usually last for a considerable time without having to be renewed.

3. A successful method sometimes adopted, provided the rabbit population is well down, is to plant good sized and well rooted plants 3-4 ft. high, at 6 × 6 ft. or 8 × 8 ft. spacing in small groups in fairly open patches through a wood, without either clearing the undergrowth or fencing. A small ring is made with a spade in, say, a mass of brambles, and a plant is inserted with very little disturbance to the undergrowth, and hence there is not much chance of damage from the odd rabbit. Prolonged weeding should not be necessary.

4. Advantage can also be taken of any patches of natural regeneration. In such cases the undergrowth must be cleared and all coppice cut hard back until the regeneration is established.

THE PREPARATION OF GROUND

BY J. O. EVANS

LARGE-SCALE WAR-TIME fellings have given us thousands of acres to be re-afforested. On some areas the " browst " was burnt at felling time, but on most it was left in " trenches." These we still have as a heritage of the War. Now, when we come to start on the reafforestation of such areas, the trenches are 5 to 6 feet high, and covered with a network of bramble. These are difficult to cut because the curved tools required strike against the old tops which are buried beneath the canopy of brambles. The simplest and by far the cheapest method is to burn both *in situ*. Experience shows that this can only be done by a " spreading " fire ; whereas for a " stationary " fire the tops have to be sorted out, and put on the fire in an orderly manner, which entails man-handling. The latter costs as much as £20 per acre : the former approximately £5, including cost of preparing and burning safety strips. The greater the area to be reafforested in one block, the greater the saving per acre, blocks of 200 acres being common.

Preparation of ground of this type should be done in advance, i.e., P. 50 ground prepared in the summer of P. 49, on a long-term policy with a view to finding average low cost per acre. First of all a plan of campaign is drawn up. In South Wales, when the vegetation is suitable for burning (apart from minor local deviations, cross-currents and whirlwinds) the prevailing wind blows from the north-east.

Assuming that there is a block of 200 acres of wartime fellings to be cut and cleared for planting, procedure would be as follows :—

1. Cut and burn in heaps a strip 100 yards wide on the perimeter of the entire block. This would be done by unskilled labour, such as Prisoners of War, civilian prisoners, displaced persons or Borstal lads.

2. (*Strip B*). Leave strip 100 yards wide.
(*Strip C*). Cut strip 22 yards wide quite clean, and burn in heaps. This is a precaution against a fire spreading from *B*.

3. Cut bramble, broom and coppice around the trenches in strip *B*, pile on to them then burn the branches *in situ*. This is a combination of both spreading and static fires.

4. We are now ready to commence the final operation with a safety strip of 220 yards cut and burnt around the entire block. Light up the western edge N.W. to S.W., and let the back-fire burn against the wind as well as along the line. Naturally, the other flank of the fire would be put out as soon as there is a continuous burnt strip 36 inches wide. Having completed this :—

5. Burn north and south flanks, whichever is the higher elevation.
All three edges are now alight, and being a back-fire, burning steadily and quietly in towards the centre.

6. Light up the last edge so that for a grand finale each edge is burning inwards.

Equipment Required :
Heather burner (this is essential for controlled burning), knapsack sprayers, shovels, canvas buckets.

Labour :

A gang of young, agile, willing men hand-picked for actual controlling of operation, the older men being employed to stand and watch at corners, etc. Essential points to safeguard :—

1. Lighting to be kept strictly under control so that the fire could be totally extinguished at a moment's notice.

2. If conditions change to be unfavourable, cease operation forthwith. Extinguish all smouldering pieces.

3. Do not try to hasten the lighting.

4. If steep bank, have main fire to travel *down* the hill.

5. Have enough men and equipment allowing for emergencies and reserves.

6. Notify neighbouring foresters, local fire stations, local people with private telephone installed (to prevent undue alarm), of intention to burn.

An objection to burning is that many of these old woodlands are in the process of natural regeneration, hampered only by rabbits which harbour in the lop and top, but there is also a possibility of these areas being set on fire by person or persons who are not responsible for their actions. Such a fire is very serious danger to outgoing plantations or standing crops.

Experience in the Welsh coalfield areas (Margam and Rheola) has shown that foresters have to balance risks in boundary burning against almost certain loss if not done. The re-stocking of old woodlands will remain a difficult problem for many years, and I put forward these suggestions as a result of very limited experience.

MECHANISED AFFORESTATION

BY G. A. SHARP

SHORTAGE OF MANPOWER and high wages are causing us to consider more and more the possibilities of machines for the various forestry operations. In this article I am submitting suggestions for the adaptation of existing machines and some ideas for new development.

1. The first is an idea for a new machine, for use in planting old woodlands where it would seem that only hand methods were applicable because of the number and size of old stumps. Using a D.2 Caterpillar or similar machine, couple to it laterally a heavy round drawbar, ten feet long, to which are attached at five feet intervals three beams, free to swing upwards but not sideways. To each of these beams attach a four-legged implement similar in design to a " swastika " and governed by automatic spring-loaded trip gear. One leg only on each " swastika " would be in use at one time, and this upon striking an obstruction would be automatically tripped backwards, pulling the nearest forward foot into the digging position beyond the obstruction. To complete the planting operation, three men would follow immediately behind the machine, slipping plants into the upturned furrow. Experiment only would show the correct shape of foot required to hold the furrow open long enough for the plant to be put in.

The number of legs necessary on each " swastika " may, in fact, be only three. The reason for the three " swastikas " on one drawbar, is, of course, economy ; a simple calculation will show that with only one set of legs travelling at two to three miles per hour, insufficient plants would be put in at five feet intervals to make the scheme worth while.

2. Foresters with bulldozers may be interested in the notion of a simple attachment which would utilise the hydraulic power for the purpose of pushing in fencing stakes. The attachment would take the shape of an inverted ladle whose cup would be large enough to fit over the top of the largest stake whilst the crook on the end of the handle would fit underneath the blade of the bulldozer, being secured by a suitable fastening. The stake would be forced into the ground by simply lowering the blade.

3. A machine for peeling stakes might be devised, consisting of a short drum containing three worm-driven blades. This could be powered from the back wheel of any lorry whose best days were over.

4. A machine for the thinning of your plantations might be adapted from an autoscythe, whose actions closely resemble the motion of a " Bushman " saw. The blade in this case would be a wide-section cross-cut saw with sufficient " set " to prevent pinching before an upright pushing arm mounted above the framework took over. This machine would probably be capable of felling trees up to five inches in diameter.

DIRECT SOWING

BY W. FORSYTH

ANY MEANS OF reducing the cost of establishing a tree crop is worthy of the closest attention these days, particularly with the cost of labour so high. Direct sowing is a recognized method in parts of Sweden, Norway, Finland, East Poland and Germany. It has been tried without much success in America, and certain experiments have been carried out in Britain from time to time, but the results have not always been promising.

As a result of the Forestry Commission's latest developments in mechanical soil cultivation with tractor and plough on peat areas, and as a result of recent State Forest development in nursery practice towards heathland nurseries using hop waste or other humus plus artificial manures, it was considered of interest to ascertain whether or not a tree crop could be established economically by sowing seeds on the upturned furrow slice and aiding the seedlings with artificial manures.

With this object in view, in the spring of 1945 two experiments were laid down in the North Tyne valley, where Sitka spruce, Norway spruce and Scots pine seed were sown on two soil types : Type A, a poor peaty soil, on a very exposed site at 1,250 feet elevation ; Type B, a good mineral soil on a comparatively sheltered site at 750 feet elevation.

The following factors were considered :—

(a) Depth of sowing, varying from 0 to 1 inch.

(b) Time of sowing, from 11th April to 30th May at four fortnightly intervals.

(c) Seeds mixed with mustard and Italian rye grass in separate bands and spread uniformly.

(d) Seed sown with and without lime, with and without nitrogen, phosphate, potash, and varying combinations of those three artificial manures.

There were, of course, controls sown without any treatment whatsoever.

Counts were made during June, August and September of 1945 and February, 1946. The results were surprisingly good on both types, but in the subsequent year, 1946/47, the vegetation on the good mineral soil type tended to suppress the seedlings, and on the peaty type in a number of the individual experiments the seedlings appeared to suffer from frosting and frost lift. Nevertheless, there was sufficient evidence to indicate the need for a more detailed examination of the problem. Consequently in 1946 the following experiments were laid down on various soil types, each one replicated three times, throughout the North Tyne and Rede Valley areas :—

1. To examine the effect of the time of sowing seed from December to May at monthly intervals.

2. To examine the effect of sowing seed from February to May at two-weekly intervals.

3. To ascertain the optimum density of sowing required to obtain a full crop from a given laboratory germination percentage.

4. To ascertain the effect of sowing seed with various types of artificial manures.

5. To examine the effect of sowing seed with broom.

6. To examine the effect of sowing seed on soil inoculated with mycorrhiza.

Each of these experiments had six treatments, laid out in a 6 × 6 Latin square, and assessments are being made twice a year. In some cases sowing was done on the upturned furrow slice, and in other cases on turfs cut in the normal manner for planting at 5 feet apart.

The immediate results of the 1946/47 sowings were so promising that in the following year a number of private estates were sufficiently interested to take up and extend the work. Of these estates, three are particularly worthy of mention :

(a) Earl Fitzwilliam's Wentworth Estates Coy. at Bradfield, near Sheffield.

(b) East Doncaster Estates Coy. at Cantley, near Doncaster.

(c) Escrick Park Estate (Wheldrake Woods), approximately 5 miles south-east of York.

Through the co-operation of Col. J. W. B. Landon, Director and Agent of the Wentworth Estates Company, and Lt.-Col. W. H. Nutter, Agent for Doncaster Estates Company and assistant agent at Wentworth, two experiments were laid down by Lt.-Col. Nutter at Cantley, near Doncaster, and replicated at Bradfield on the Wentworth Estate. These experiments were laid down in the Latin square lay-out method with the object of determining :—(a) the optimum time of sowing, and (b) the optimum density of sowing, and six treatments of each of the following species were applied :—

European Larch	Oak
Corsican Pine	Ash
Sitka Spruce	Sycamore
Scots Pine	Beech

In the " time of sowing " experiment, the seed was sown at monthly intervals from January, 1947, until June, 1947, and the " density " experiment sowing was done on the 29th and 30th April, 1947. Assessments were made on the 21st July, 1947, and the 4th September, 1947. Brief extracts from these assessments are as follow :—

The " time of sowing " experiments entailed the sowing of 48 groups of seed of various species monthly with 50 viable seeds in each group. From the September assessment the following information was obtained from Bradfield for Scots pine :—

SCOTS PINE—TIME OF SOWING
(BRADFIELD. Elevation 1,000 ft.)

Date of Sowing	Number of groups failed (i.e., with 5 or less seedlings)	Number of groups with 6 or more seedlings	Percentage failures	Percentage germination of viable seed
23/12/46	35	13	73	7.2
17/1/47	14	34	29	20.0
24/3/47	5	43	10	34.5
25/3/47	13	35	27	22.8
16/4/47	30	18	62	12.8
14/5/47	41	7	85	4.8

The " density " sowing experiment at Bradfield entailed the sowing of 48 groups of seed of various species at six different densities of sowing, all on one date. From the August assessment the following information was obtained for Corsican pine, sown on 17th April, 1947 :—

CORSICAN PINE—DENSITY OF SOWING

(BRADFIELD. Elevation 1,000 ft.)

Density of sowing (viable seed per group)	Number of groups failed (i.e., with 5 or less seedlings)	Number of groups with 6 or more seedlings	Percentage failures	Percentage germination of viable seed	Lbs. of 100 per cent. viable seed required per acre in groups at 5 ft. × 5 ft.*
10	48	Nil	100	10.4	.544
20	26	22	54	29.7	1.08
30	7	41	14	50.5	1.63
40	10	38	21	34.3	2.17
50	7	41	14	36.3	2.72
60	9	39	18	36.4	3.26

* Assuming 32,000 seeds per lb.

Note :—The percentage germination of viable seed should not be unfavourably compared with nursery seed bed germination, as the seed was sown in groups regularly spaced and sometimes in snow, where conditions were such that sowing on the top of tufts of vegetation and tree stumps was unavoidable.

On Escrick Park estate, through the co-operation of the agent, Mr. Claude W. Thompson, who arranged for the necessary fencing and the sowing of the seed, two soil types were selected and two square chains of land fenced off, half of each being sown with Scots pine, and Corsican pine seed, in groups three feet apart.

It is much too early to endeavour to assess the results, but it is interesting to note that the growth of Scots pine and Sitka spruce seedlings on the Wheldrake, Bradfield and East Doncaster areas is almost as good, if not as good, as the results obtained from seed sown on the heathland nurseries. For example, on the three estates the following maximum height growths of the various species was assessed in February, 1948.

COMPARISON OF HEIGHT GROWTHS

Species	Average height (in ins.) of the 12 largest trees			Average height (in ins.) of the 12 smallest trees			Estimated average height (in ins.) of each species		
	Escrick	Bradfield	E. Doncaster	Escrick	Bradfield	E. Doncaster	Escrick	Bradfield	E. Doncaster
S.P. ...	3.0	4.1	5	1.0	1.75	1.5	2.0	2.25	3.25
C.P. ...	2.5	2.5	*	.5	1.2	*	1.5	2.0	1.5
E.L. ...	---	5.0	7	—	1.4	1.0	—	3.25	3.5
S.S. ...	—	3.9	*	—	0.87		—	2.25	1.0
Oak ...	—	7.8	*	—	2.25	*	—	4.5	3.5
Ash ...	This species was just starting to germinate on 12/2/48								
Sycamore	—	10.4	9.75	—	2.3	2.5	—	6.25	6.0
Beech ...		7.0	10.5		4.0	4.0	—	5.0	5.5

* There was such a poor yield from these species at East Doncaster it was only practicable to fix an average figure.

Expenditure throughout was limited to cost of seed, sowing, and fencing.

Any conclusions must, as yet, be drawn with caution, owing to the relatively short time, and the limited range of soil types over which the experiments have been carried out ; but it would appear worth while to investigate this method further, particularly the time of sowing factor. One matter which may be important, but which is really a sideline of the original idea, can be stated by the following hypothesis :

> From experience gained with heathland nurseries and the application of hop waste and artificial manures, it is obvious that seedlings can be produced of a size and type very much better than the seeding produced in the average forest nursery ; also the yield of seedlings per lb. of viable seed is very much higher. Further, the high cost of weeding seed beds is almost completely eliminated. If it is possible to do this on heathland nurseries where it is costly to transport hop waste, and purchase and apply artificial manures, it may be possible to find similar conditions in the natural forest where the soil conditions are such that they are equal to, if not better than, the conditions artificially reproduced in the heathland nursery, and where seed can be sown which will produce the desired results at a very much lower cost.

In certain cases, light sandy soils from which a conifer crop has been clear-felled may lie barren for a number of years with little or no colonization by weed growth, from the surrounding vegetation. The reasons for this are obscure, but it was on such land at Bradfield and Wheldrake that good results have been obtained. It may well be that if areas of such land were selected, and seed sown on it, the resulting seedlings could be produced at very little cost and robust enough for lining out in the first year.

A simple form of cultivation, such as tractor drawn disc harrows of the Australian " stump jump " plough type, penetrating to a depth of $\frac{1}{4}$ to $\frac{1}{2}$ inch, followed by broadcast sowing with a " fiddle," and consolidation by a narrow roller or such other means, may be all that is necessary.

At the same time, when the seedlings are lifted a number could be left in groups at regular intervals to grow on and establish a tree crop on the area, provided, of course, that it is not practical to utilize the same ground for a number of successive years to produce seedlings cheaply for lining out, and then allow groups to develop.

Sowing experiments on this basis are being laid down this year.

THE USE OF BROOM AS A NURSE IN PLANTATIONS

BY M. NIMMO

SINCE THE EARLY days of the Forestry Commission, there have been a good many trials of broom as a nurse species both by the Conservancies and by the Research Branch, and I do not wish to suggest that it should be more commonly used except on very difficult sites.

The technique of producing a good crop from a sowing of broom is fairly widely known, and it may very rightly be asked why the subject should be brought up again at this late stage. I would therefore like to make clear at this point my reasons for writing this note—they are threefold :—

(i) I do not think the remarkable results of certain of these broom experiments are sufficiently widely known.

(ii) Any beneficial effects resulting from a broom nurse crop have usually been attributed to the combination of the physical shelter afforded and the extra nitrogen made available by the root nodules. I think, however, that there is much more in it than this, and the results of certain experiments carried out under the direction of the Nursery Nutrition Committee throw a new light on the effect of broom.

(iii) Our colleagues working on fundamental research, at Oxford and elsewhere, have asked us to give them our problems and here, to my mind, is one of great importance and complexity.

To illustrate these points let us take the results of Experiment 36 P. 38 on very poor Bagshot sand soil at Sugar Hill, Wareham Forest, Dorset.

The broom was sown in strips 8 ft. apart in 1934, and four years later transplants of Sitka spruce, *Tsuga heterophylla*, *Thuja plicata* and *Abies nobilis* were planted at 4 feet spacing in single lines between each pair of broom rows, so as to form small pure blocks of each species, every plant receiving 2 oz. of basic slag.

A small number of each species were planted at the same time outside the broom as a control ; unfortunately only a few of these were slagged, too small a number for assessment purposes and for comparison. I have therefore used data from slagged Sitka in a nearby experiment.

Considering the site factors, all four species have grown remarkably well within the broom area, and the results of the latest assessment (late September, 1947) are as follow :

Species	Mean Height (Inches)			Mean Shoot (1947) (Inches)			Death per cent.		
	Broom + Slag	Slag	Control	Broom + Slag	Slag	Control	Broom + Slag	Slag	Control
Sitka spruce	73.8	28.5	13.5	13.1	0.75	0.7	0.6	4.0	60.0
Tsuga heterophylla	57.1	—	22.2	11.9	—	3.5	24.5	—	60.0
Thuja plicata	72.0	—	9.4	11.8	—	1.3	0.6	—	43.0
Abies nobilis	34.7	—	15.6	5.8	—	0.6	2.5	—	60.0

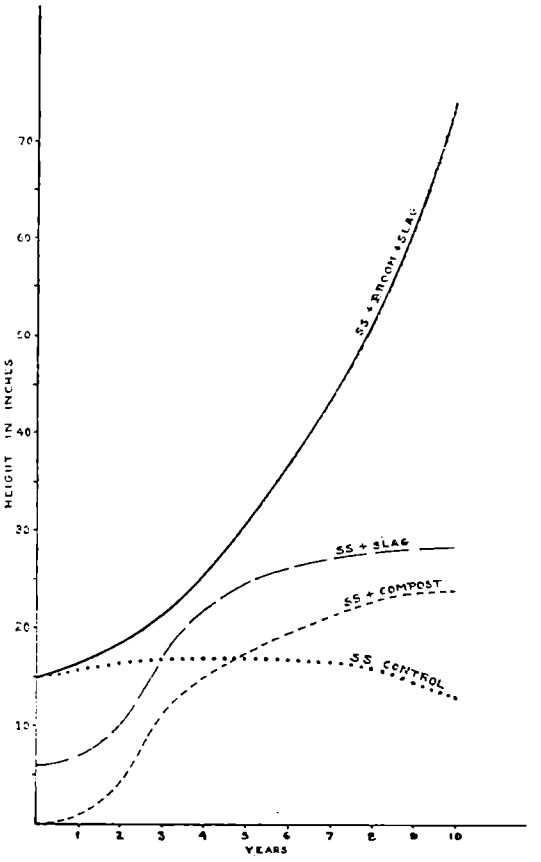
N.B. Two points should be noted when considering these figures :—

(i) The heavy death rate in the tsuga was due to a very severe frost in May, 1944.

(ii) The few surviving tsuga control plants are now benefiting from some vigorous *Pinus radiata* over 15 feet high and only 2 yards away—their annual growth is improving, due presumably to these pines.

Taking Sitka spruce as our example, the following diagram compares the growth, over a period of 10 years, of the following four treatments :—

(i) Sitka with broom and slag.
(ii) Sitka with slag alone.
(iii) Sitka control. No special treatment.
(iv) Direct sowing in the forest of Sitka spruce on patches prepared with hopwaste compost.



HEIGHT GROWTH OF SITKA SPRUCE UNDER VARIOUS TREATMENTS AT WAREHAM FOREST

It will be seen that neither phosphate nor compost keeps up the initial good growth, whereas broom has succeeded in keeping the Sitka going well for 10 years, and shoot growth is still increasing.

The broom also shows a most marked effect on the size and variety of the surface vegetation—*Calluna*, *Molinia*, *Erica* and *Agrostis* all double the height of their flowering shoots, and better species such as bramble and willow herb make their appearance.

Since 1945, extensive and complicated experiments have been carried out at Wareham under the direction of the Nursery Nutrition Committee. One of the points arising from these experiments is that, at Sugar Hill, the soil is very lacking in potash and does not contain sufficient in its upper layers for the satisfactory growth of Sitka spruce. Now the plants within the broom plot show no signs of any such deficiency. Does this not suggest that the biological and ecological changes brought about by the introduction of the broom crop make much nutriment available to the tree roots that is otherwise in an inert state or at too great a depth ?

Surely this should be the subject of researches by our bio-chemists—What is the real effect of broom—which seems able to supply not only added nitrogen but to satisfy the trees' demands in other directions as well ?

Until we can answer this question, are we really in a position to make definite recommendations for restoring or keeping up the fertility in forest nurseries ? May we not be bolstering up an inert soil with artificials instead of bringing about the biological changes necessary for the active life of soil fungi and bacteria ?

I think the results of our broom sowings suggest that the proper use of artificials in forestry may well be to encourage the growth of nurse crops, green crops or leys, whose root activities will so improve the soil in all three spheres—biological, chemical and physical—that ample fertility for tree growth may be maintained.

STRIP AND GROUP METHODS OF PLANTING OAK AT YARDLEY FOREST

BY H. C. DYER

STRIP METHOD

Strip Dimensions.—The strips of oak spaced 5 in. × 2½ in. were made half a chain wide.

Belt Dimensions.—Quarter chain belts of coppice were retained where available ; big blanks in belts were made complete by filling in with Scots pine, Norway spruce, beech or sycamore, and where no coppice was available, belts of Norway spruce were planted at 4½ ft. × 4½ ft. Belts and strips were laid out alternatively.

Weedings.—These were carried out yearly, when labour permitted, until well established above weed growth, and afterwards only overtopping coppice and briars required removal. The Scots pine, Norway spruce and beech or sycamore were very difficult to find where planted in gaps in coppice belts, and frequently required weeding more often that the one weeding done in the case of the oak. During the war years and up to date, yearly weedings and clearings have not been always possible, owing to shortage of labour ; as a result plants have suffered to some extent, particularly where suppressed by the dense growth of grass in the early stages. Plants have been so stifled that chances of recovery, or of making decent trees, are very remote.

Observations.—As a result of planting too close to the edges of the coppice belts, the rapidly growing coppice has overshadowed and checked the oak on the edges of the strips. It is advisable when planting to keep well away from the edges of the coppice and Norway spruce belts.

GROUP METHOD

Dimensions of Groups.—Groups of 9 oaks planted at 1 ft. × 1 ft. were spaced at 20 ft. × 20 ft. over the area. The ground between was already covered with mixed hardwood coppice.

Weeding.—This has been a difficult problem. Groups in early stages had to be marked with stakes to avoid their being lost, and racks made from group to group. Where possible, coppice has been sold to local purchasers to save the F. C. time and expense of cutting same, care being taken to select careful purchasers who would not damage the groups. Racks have had to be opened twice yearly when possible. The coppice has very soon overtopped oak groups in spite of being severely cut back. It has been altogether a very expensive operation, clearing and cutting racks, weeding and cleaning. Owing to shortage of labour in recent years, it has been impossible to carry out weeding and clearing yearly, and as a result trees have suffered to some extent, though in most groups there are still sufficient left to enable one to choose enough trees for the final crop.

STRIP AND GROUP METHODS COMPARISONS

Observations.—Generally speaking the advantages of the Strip Method easily outweigh any advantages of the Group Method. In the Strip Method, expense is saved in weeding cost and in early stages no clearing costs are involved as was the case in the Group Method. Trees are much easier to find in the rows in the Strip Method, as against searching for trees in the Group Method. In the Strip Method, the trees got away better and are looking and thriving better than in the Group Method.

A METHOD OF PLANTING OAK SEEDLINGS

BY J. H. CRAFT

At Gravetye our P. 40 programme included the planting of 17,000 oak seedlings in a rough coarse field over which the soil is mostly clay ; in this plantation only 500 plants were required for beating up, and the average height of the trees is now 6 ft. The seedlings were planted in holes made with an iron bar, 3 ft. 6 inches long, and three quarters of an inch in diameter, pointed at one end and with a crooked handle for ease of carrying. After inserting the seedling, the hole is closed and the plant firmed by jabbing the bar into the soil a little away from the hole, and then heeling around to finish off.

I maintain that by using the bar one can preserve the long roots which oak seedlings have, and it obviates all the cracking which so often happens when a spade is used.

Good one-year seedlings are better than two-year stock, as the latter are apt to fork and get corkscrew roots, which means pruning. Oak seedlings grown in light soil produce better and straighter roots than those raised in heavy soil. The heavy soil just *will* produce crooked roots.

In conclusion, a good man can plant up to 600 trees per day, and by this method steep banks, where it is difficult to use any other tool, can be planted.

AN EXPERIENCE IN THE HANDLING OF FROZEN TRANSPLANTS

BY D. MILNE

During earlier days when the writer toiled in the nursery—and toil was surely the word—his ganger's instructions were edicts not to be questioned, so that when that pedant stated that frost was fatal to the exposed roots of a plant, the portentous utterance was recorded as an unqualified fact.

But how the reality of life can temper one's unreasoned beliefs !

On January 27th of 1947, 9,000 Japanese larch arrived in an enclosed van at a railway station five miles from the receiving forest. Because neither the hired lorry which hauled the plants the remaining distance by road, nor the forest could supply a waggon sheet, the consignment travelled only partially protected through the first snowstorm of that phenomenal winter. Weather conditions permitted no alternative to placing the packages, unopened, in an enclosed shed to which no further access was possible until February 8th. when the severity of the weather lessened. It was then found that water had entered by the storm-damaged roof, and that one of the packages was frozen to the floor. In another shed, whose roof alone was weatherproof, dry straw was spread thickly on the ground. The plants were then unpacked and piled upon the straw in bee-hive fashion and with roots inwards ; the whole was covered liberally with straw, and except for an occasional anxious glance through one of the many apertures in the walls of the shed, was left alone with fate until March 25th. By this date the snow had entirely disappeared and time had been allowed for the ground to become warmed, for there appeared to be no circumstance in favour of hurry now. If the early-acquired belief were still to be retained as an unqualified fact, the plants would be dead already, but if reasoning were permissible, reasonable delay was an advantage.

When the plants were uncovered it was noticed that those bundles of roots which had been frozen into a hard mass were now free and damp, others appeared to be moistened only by the atmosphere, stems were limp and on the whole the appearance of the plants presaged disappointment.

The result was astonishing. The latter days of the following May showed not more than twenty deaths in nine thousand plants !

(*We do not recommend this treatment as an aid to successful planting.*—Ed.).

THINNINGS

BY E. E. DIXON

All foresters will be familiar with the excellent booklet *The Thinning of Plantations*, and not a few will know a little of Research Branch Sample Plot work at Bowmont and elsewhere. Many of our forests are now being thinned, and it is interesting and essential to know what they are capable of yielding, and to compare results in both State and private woodland.

In this district (North-West England Conservancy—North) we have endeavoured to increase interest in thinning figures, and the tables given below summarise those which have been obtained during the last four years, during which at least five hundred acres have been silviculturally thinned. Owing to high altitudes, exposure to wind, prevalence of wet snow, and occasional loosening of soil cover by heavy rainfall, it has been our practice to thin on a medium to heavy grade and thereby preserve stability.

The areas now being thinned are mostly on slopes of 10 degrees to 40 degrees, with occasional rock outcrops of scree, and intermediate patches originally covered with the bracken, heather and grasses typical of Lakeland hill scenery. Walking is seldom easy, and the ground surface influences the rate of marking thinnings to a considerable degree.

Species

European Larch : This tree has made unsatisfactory growth. Some stands have died completely, and the best are being thinned heavily with a view to ultimate underplanting.

Japanese Larch : This appears a very useful tree in that it gives rapid ground cover, and the earliest return of any. It grows at a moderately fast rate and is thinned on a medium-heavy grade.

Douglas Fir : This tree is very variable in form and growth. The worst may be described as only fair, the best as good, though it is doubtful if the latter compares with the best in the country. It is difficult to thin, but gives the most rapid response. In this district it is growing on steep shaley slopes and is thinned on a heavy grade.

Norway Spruce : Its regular growth makes this species the easiest conifer to mark for thinning. Much of the older Norway spruce in this district was planted on dry or heathery ground and has grown at only a moderate rate.

Sitka Spruce : This is probably our most accommodating species. It is growing at elevations of from 300 to 1,750 feet, and on sites varying from steep rocky banks to almost bottomless peat bogs. It is generally fairly easy to mark, but gives occasional difficulty. It is being thinned on a fairly heavy grade.

Periodicity of Thinning

European Larch : Will probably be on a five year cycle.

Japanese Larch : Three year cycle.

Douglas Fir : Three year cycle. It is unwise to leave longer.

Norway Spruce : Would probably be on a four to five year cycle.

Sitka Spruce : Three to four year cycle, aiming ultimately at every three years.

The labour question has to a certain extent influenced the rate of thinning, but arrears have been made up and Foresters are beginning brashing and first thinnings at a rather earlier stage than was practicable some years ago. It is our experience that Douglas fir in particular is ready for thinning almost before it is brashed, and the response to this earlier attention is very considerable.

Rate of Marking Thinnings

Thinnings are normally marked by means of a slasher. The following table shown the average rate of progress in *numbers of trees per hour* :

1st Thinning	2nd Thinning	3rd Thinning	4th Thinning
E.L. 200—250	—	—	—
J.L. 150—180	120—140	100—120	110
D.F. 100—160	100—160	80—120	—
N.S. 180—210	—	—	—
S.S. 100—150	120—150	110—140	—

These rates are for fully brashed plantations and will, of course, vary according to type of tree, and whether wolves and weed species are still present. First thinning does a considerable amount towards evening up type and size. With the second and subsequent thinnings, the time taken over individual inspection and looking up at crowns, tends to become more constant, and rate of marking depends more on uniformity of crop and ground surface or slope.

Cost of Marking

Marking of thinnings has for the most part been carried out by Foresters, with assistance at times from Foremen and Gangers. The following costs per cubic foot have been based on the work of a Grade II Forester, who to date has marked well over 300 acres unaided ; the rate of pay used in this calculation was 2s. 6d. per hour.

1st Thinning	2nd Thinning	3rd Thinning	4th Thinning
E.L. 0.36—0.45	—	—	—
J.L. 0.50—0.60	0.14—0.17	0.13—0.15	0.08
D.F. 0.25—0.40	0.11—0.18	0.10—0.15	—
N.S. 0.43—0.50	—	—	—
S.S. 0.40—0.60	0.15—0.20	0.08—0.10	—

These costs are a small fraction of the total cost of thinning and extraction, and it would appear that despite the other advantages of line thinning on flat ground, there is negligible saving on this count. Lower figures could be obtained by employing Foremen, Gangers and Grade I workers, and this is our aim.

Statistics on Thinning

It is not usual for height growth to be a deciding factor as to when a plantation should be thinned. In dense conifer stands, crown tops are difficult to see, and therefore a better indication is given by the apparent density of the stems at or about eye level. In the following tables the density of stocking has therefore been introduced, and some idea of cubic contents given.

1st Thinning

Species	Age	Stocking		Trees removed	Volume removed cu. ft.	Volume remaining cu. ft.	Remarks
		Before Thinning	After Thinning				
E.L. ...	20	1550	1000	550	180	650	See Note A
J.L. ...	14	1560	1100	460	230	1100	See Note B
J.L. ...	15	1400	900	500	150	550	do.
D.F. ...	16	1100	800	300	270	1200	See Note C
D.F. ...	17	1100	750	350	350	1350	do.
D.F. ...	17	1410	1100	310	160	950	do.
N.S. ...	28	1740	1200	540	200	1000	See Note D
N.S. ...	28	1700	1000	700	230	1000	do.
S.S. ...	18	1500	1100	400	130	900	—

2nd Thinning

Species :	Age :	Stocking		Trees removed	Volume removed cu. ft.	Volume remaining cu. ft.	Remarks
		Before Thinning	After Thinning				
J.L. ...	14	1090	870	220	140	1500	See Note E
J.L. ...	19	900	650	250	330	1450	--
J.L. ...	23	830	650	180	350	1350	See Note F
J.L. ...	23	730	550	180	340	1500	do.
D.F. ...	19	850	610	240	390	1900	See Note G
D.F. ...	21	850	520	330	490	1900	do.
S.S. ...	25	1300	900	400	480	1875	See Note H
S.S. ...	25	1200	830	370	400	2050	do.
S.S. ...	25	1100	800	300	380	2000	do.
S.S. ...	25	900	650	250	380	2400	do.

3rd Thinning :

J.L. ...	23	680	450	230	350	1700	See Note J
J.L. ...	23	770	450	320	550	1500	do.
J.L. ...	23	520	400	120	230	1750	do.
D.F. ...	20	640	450	190	450	1800	—
S.S. ...	26	1050	720	330	600	2700	See Note K
S.S. ...	27	1000	750	250	750	2600	do.

4th Thinning :

J.L. ...	23	400	300	100	320	1800	—

Notes on above :

A. Many trees removed were dead but readily saleable.

B. The younger of these two J.L. areas was originally planted 4½ ft. × 4½ ft.

C. Good quality D.F. The first two stands were originally planted 6 ft. × 6 ft. and the third stand at 5 ft. × 5 ft.

D. P. 20 N.S. originally planted at 4½ ft. × 4½ ft. on a dry bank.

E. A rapid growing crop planted originally at 4½ ft. × 4½ ft.

F. A moderately good crop growing between 500 ft. and 1,000 ft., the two examples showing the average differences in stocking and volume at the extremes of elevation.

G. A moderate quality crop only, originally containing much weed hardwood.

H. Some of the oldest F.C. Sitka spruce (P. 20), which checked for several years after initial planting. Now growing very well. The examples show the variation in stocking and volume according to soil quality and exposure.

J. Probably one of the better areas of J.L. planted by the Commission (P. 23) growing on a very steep hillside at elevations of 300 ft. to 1,000 ft., and varying with elevation and exposure.

K. P. 20 Sitka spruce on a favourable site. First and second thinnings were delayed.

VOLUMES PER ACRE

BY E. E. DIXON

DURING THE PAST few years many Foresters will have had opportunities of seeing and often felling areas of woodland on private estates. Although generally their management was different from our own and usually described as neglected or underthinned, some remarkable stands were discovered. Many of these are now felled, but it is hoped that records were kept of the more noteworthy for comparison with State woodlands of the future. The following are examples :

	Species	Age Yrs.	Stocking*	Average b.h.q.g. inches	Mid. q.g. inches	Total height, feet	Timber height, feet†	Volumes in cu. ft.	
								per tree	per acre
1.	D.F.	25	960	5	3¾	50	40	3—11	3,760
2.	S.P.	33	930	6	4½	48	40	5—8	5,270
3.	N.S.	38	940	6¼	5	60	52	9—10	8,460
4.	D.F.	56	120	19	12¾	110	90	101—107	12,190

* Trees over 3 ins. b.h.q.g., per acre.
† To 3 ins. top (poles), and 6-8 ins. (timber).
Volumes in Hoppus measure, over bark.

Notes :

1. *Heytesbury Estate, Wilts.*

   The former practice of this estate was to grow D.F. in regular blocks separated by narrow rides. The ground was flat and access easy. These stands were never brashed or thinned, and were clear felled at 20-25 years for pitwood. Windblows were common but not extensive.

2. *Stover Estate, Devon*

   Although very much underthinned, this stand had a clean and orderly appearance. It was the subject of much controversy over purchase and was purchased on felled measure. In the original valuation, all the trees were counted, about 8 per cent. measured and heights and mid-girths taken with the help of a ladder. The same area contained N.S. and D.F. of similar growth.

3. *Buccleugh Estate, Dumfries.*

   This stand was visited by the Empire Forestry Conference Delegates in 1947 and measured by Foresters subsequently at a Foresters' meeting. It has been thinned once only.

4. *Graythwaite Estate, Lancs.*

   A long narrow roadside strip fringed by old hardwood forest, and therefore not a particularly good example. The trees were planted by the present owner, who also planted other specimens nearby about 7 years previously (i.e., now aged 63). Some of these groups were recently felled and contained trees of over 200 cu. ft.

ESTIMATING YIELDS FROM FUTURE THINNINGS

BY H. V. S. DIER

THERE ARE OCCASIONS when the production at some future date from a forest still in course of establishment has to be estimated. Such was the case in 1946 when the Directors of the London and North Eastern Railway asked for estimates of the timber production from Loch Ard Forest in 1956, 1966 and 1976. Conversion of the yields into tons and wagon loads was simple ; the estimation of the yields was another matter. The following is an account of the problems which were met with in the course of the investigation and how they were circumvented or overcome.

To arrive at the yield from a forest, the area by age and Quality Class of each species must be known. At Loch Ard, the areas of species by P. years were recorded in the R.1 forms for the 7159 areas planted at the date of the assessment (from P. 29 to P. 46) but no Quality Classes had been allotted because of the youth of the plantations. At this point an estimate had to be made of the future planting programmes. It was assumed that the 9,600 acres still remaining to plant on this Forest would be cleared off in 14 years, and that the planting programmes would rise from 400 acres in P. 47 to 1,000 acres in P. 60. The future percentage stocking by species was estimated by correlating the proportion of each species in existing plantations with a knowledge of the vegetation types and their approximate area on the land still to be afforested. The estimated percentage areas of species were :—

Scots pine ...	10 per cent.
European larch	5 per cent.
Hybrid larch } Japanese larch }	10 per cent.
Douglas fir ...	2 per cent.
Norway spruce ...	20 per cent.
Sitka spruce... ...	48 per cent.
Lodgepole pine ...	3 per cent.
Other Conifers ...	1 per cent.
Hardwoods	1 per cent.
	100 per cent.

It was appreciated that the actual rate of planting might differ from that estimated because of labour shortage and other reasons, including the reservation of plantable land for agriculture, which might cause a reduction in the total area of plantations. Any differences there might be would not, however, affect the estimate of production for F.Y. 56 owing to the extreme youth of the plantations concerned ; for the same reason the F.Y. 66 estimate also would not be materially affected, and the F.Y. 76 estimate would be decreased by less than 10 per cent.

Once the future composition of the forest had been estimated, the next step was to allot each stand a Quality Class. This was not possible as some 7,000 acres of plantations not yet in existence were involved. As a

compromise, every stand of each species was classified Q.C. III. Further, to compensate for this obviously low assessment, it was assumed that all stands would be completely stocked.

Here the next difficulty was encountered ; there was no Yield Table for Japanese larch Q.C. III, and no thinning volumes in the Sitka spruce Q.C. III Preliminary Yield Table. Accordingly, a yield table for Japanese larch Q.C. III had to be fabricated. It was noticed that for the three ages which could be compared (20, 25 and 30 years) the European larch Q.C. I main-crop volume figures fell below those for Japanese larch Q.C. I, and similarly European larch Q.C. II fell below Japanese larch Q.C. II ; and, moreover, that there was a mathematical relationship between these figures. A simple proportion sum gave the following volumes for Japanese larch Q.C.III :—

Age in Years	*Volume in cu. ft.*
20	750
25	1,300
30	1,650

Thinning volumes for both Japanese larch and Sitka spruce were next required. Since Douglas Fir more closely approximates to Sitka spruce in stocking and yield than does Norway spruce, it was decided to base the Sitka spruce estimates on the Douglas Fir Yield Tables. The Japanese larch figures were based on the tables for European larch. It was found that with Q.C. III Douglas Fir, approximately 1/10th of the total volume would be removed as thinnings at 25 years, 1/10th at 30 years, 1/11th at 35 years, 1/13th at 40 years and 1/13th at 45 years. These proportions were slightly adjusted to compile the following table :—

SITKA SPRUCE Q.C. III

Age in Years	*Total Volume in cu. ft.*	*Divisor*	*Volume of Thinnings, cu. ft.*
20	1,530	8	190
25	2,710	9	300
30	3,810	10	380
35	4,800	11	435
40	5,620	12	470
45	6,370	13	490
50	7,060	14	500

The European larch Q.C. III Yield Tables showed that 1/14th of the total volume would be removed at 35 years, 1/15th at 40 years, 1/16th at 45 years and 1/17th at 50 years. It was therefore assumed that 1/11th would be removed at 20 years, 1/12th at 25 years, and 1/13th at 30 years. These proportions were also adjusted, bearing in mind that the removal of wolf trees would increase the yield from early thinnings in Japanese larch. The figures obtained for Japanese larch were :—

JAPANESE LARCH Q.C. III

Age in Years	*Total Volume cu. ft.*	*Divisor*	*Volume of Thinnings, cu. ft.*
20	750	10	75
25	1,300	10	130
30	1,650	11	150

It is realised that the methods employed in compiling these Tables are open to severe criticism. The Japanese larch thinnings volumes are especially unreliable since they are founded on an *ad hoc* yield table. However, since the total area of Japanese larch and Hybrid larch (it was considered that yields from both species would be identical) will amount to only 10 per cent. of the forest area and to much less than 10 per cent. of the estimated total volume, any errors in this connection will not be significant. On the other hand, the Sitka spruce percentage area is 48 per cent. ; hence the estimated volumes of thinnings must be as exact as possible. It is believed that the Sitka spruce figures are reasonably correct.

The ages at which each species would receive its first thinning had next to be determined. The first thinnings volumes are recorded in the Q.C. III Yield Tables at 45 years for Scots pine, 35 years for European larch, 25 years for Douglas fir, and at 35 years for Norway spruce. It is certain that these species yield produce at younger ages. The following ages for the first thinnings in Q.C. III stands were based upon current practice in West Scotland.

Species	*Ages When First Thinned.* *Years*
Scots pine ...	... 25
European larch...	... 20
Japanese larch ...	... 15
Douglas fir ...	... 15
Norway spruce ...	... 25
Sitka spruce ...	... 17

To estimate yields from thinnings at 5 year intervals earlier than those shown on the Yield Tables, the volumes given were graphed against age. These yields are shown in the following table :

Age, Years	Volume of Thinnings, Cu. Ft.					
	S.P.	E.L.	J.L.	D.F.	N.S.	S.S.
15 ...	—	—	25	75	—	—
20 ...	—	88	75	190	—	190
25 ...	60	108	130	305	120	300
30 ...	70	128	150	420	150	380
35 ...	80	145	170	440	180	435
40 ...	90	160	180	450	210	470
45 ...	100	175	190	485	240	490
50 ...	110	185	200	465	270	500

It was assumed that thinnings would be repeated at three-year intervals, i.e., that Scots pine would be thinned at 25, 28, 31, 34, 37, 40, 43 and 46 years of age, European larch at 20, 23, 26, 29, 32, 35, 38, 41, 44 and

47 years of age, and similarly with the other species. That the intervals would lengthen out to five years at the older ages was appreciated, but to avoid undue complications the three-year cycle was adhered to throughout.

To estimate the yields from each thinning, the volumes given in the Yield Tables for five-year intervals were divided by five. This gave the mean annual yield for each period. These figures were then weighted for age. Thus European larch Q.C. III gives 145 cu. ft. of thinnings at 35 years, i.e., a mean annual yield for the period (31 to 35 years age) of 29 cu. ft., weighted for age this may be shown thus :—

Age in Years	*Thinnings in Cu. Ft.*
31 ...	... 27
32 ...	... 28 Thinning
33 ...	... 29
34 ...	... 30
35 ...	... 31 Thinning

The yield from thinnings at the end of the three-year period (age 33 to 35) would therefore be 29 + 30 + 31 = 90 cu. ft. The estimated yields from all thinnings during the 47 years under survey (P. 29 to F.Y. 76) are given below :

Age, Years	Volume of Thinnings, Cu. Ft.					
	S.P.	E.L.	J.L.	D.F.	N.S.	S.S.
15	—	—	21	54	—	—
17	—	—	—	—	—	64
18	—	—	39	96	—	—
20	—	55	—	—	—	126
21	—	—	60	147	—	—
23	—	63	—	—	—	168
24	—	—	78	183	—	—
25	38	—	—	—	75	—
26	—	69	—	—	—	204
27	—	—	85	234	—	—
28	40	—	—	—	87	—
29	—	77	—	—	—	228
30	—	—	93	255	—	—
31	45	—	—	—	97	—
32	—	82	—	—	—	251
33	—	—	101	263	—	—
34	48	—	—	—	108	—
35	—	90	—	—	—	264
36	—	—	104	266	—	—
37	51	—	—	—	119	—
38	—	94	—	—	—	279
39	—	—	108	270	—	—
40	57	—	—	—	129	—
41	—	100	—	—	—	287
42	—	—	110	282	—	—
43	58	—	—	—	141	—
44	—	105	—	—	—	294
45	—	—	117	294	—	—
46	63	—	—	—	151	—
47	—	108	—	—	—	297

It was now possible to determine which stands would be due for thinning in F.Y. 56, 66, and 76, and to calculate the total production for these three years. However, since former planting programmes fluctuated in both total area and the proportion of species, it was anticipated that the production for the years immediately preceding and succeeding F.Y. 56, 66, and 76 would vary markedly from that for the years under examination. This was the case. It was therefore decided to average the figures for F.Y. 55,56, and 57, for F.Y. 65, 66, and 67 and for F.Y. 75, 76, and 77, and to give these averages as the estimated production, as shown below :

In F.Y. 55 730 acres thinned would yield 76,958 cu. ft.
In F.Y. 56 900 ,, ,, ,, ,, 94,991 cu. ft.
In F.Y. 57 700 ,, ,, ,, ,, 71,698 cu. ft.
and the mean yield for F.Y. 56 would be 81,000 cu. ft.

35 cubic feet to one ton was the factor used in converting volume into weight and 4 tons were taken as the average wagon load. This gave the following figures of production :

F.Y. 56 81,000 cu. ft., or 2,320 tons or 580 wagon loads.
F.Y. 66 361,600 cu. ft., or 10,330 tons or 2,580 wagon loads.
F.Y. 76 760,400 cu. ft., or 21,720 tons or 5,430 wagon loads.

It was also estimated that in 1976 41,000,000 cu. ft. (over 1,000,000 tons) would be standing timber in the Loch Ard Forest block. This estimate was based on the assumption that the 16,700 acres planted with ages ranging from 16 to 47 years would have an average volume of 2,500 cu. ft. per acre.

In conclusion, it must be emphasised that no claims are made as to the accuracy of the yield figures employed, other than those given in Bulletin No. 10 Yield Tables : nor is their general application intended. These are purely *ad hoc* figures. However, it is believed that the estimates based upon them are sufficiently correct. If the error is no greater than about 20 per cent., their use is justified. It is also hoped that the methods employed in reaching these estimates may be of some service if only by stimulating criticism.

Comments by F. C. Hummel, Mensuration Officer

With an estimate such as this, which is based on the manipulation of rather unreliable data, it is perhaps best to examine the final result and see whether it is probable, and then work backwards.

The average thinning yields given for F.Y. 55 to 57 work out at just over 100 cu. ft. per acre, and this is improbable. Except for pre-thinnings, which are confined to the removal of a few wolf trees, thinnings in most species amount to anything between 200—500 cu. ft. per acre, and are never less than 100 cu. ft. Unless this minimum can be removed, thinnings are not economical, nor are they necessary silviculturally. A conservative average figure for thinning yields in young crops would be about 200 cu. ft. per acre, or twice the figure arrived at by Mr. Dier. It thus appears that he either over-estimates the acreages that will be ready for thinning in 1956, or, if the acreages are correct, his total figure of 81,000 cu. ft. is too small. His estimate is based on two main assumptions : First, that at an average, all crops are Quality Class III, and secondly, that the thinning yields given in Bulletin 10 are more or less applicable to present-day practice. The first assumption may or may not be correct, but a comparatively small deviation either way might affect early thinning yields quite considerably. The second assumption is certainly misleading, because thinnings in young crops are nowadays much heavier, and they start much earlier than indicated in Bulletin 10.

In view of the possible errors inherent in the primary assumptions, the method of calculation adopted, although reasonable, is probably too elaborate, and aims at a degree of accuracy which is unobtainable. Starting with the assumption that the average of all stands (allowing for gaps in stocking, etc.), is Quality III, would it not have been much simpler, and probably just as good a guess, to assume that between the ages of 15 and 30 years, $\frac{1}{3}$ to $\frac{1}{2}$ of the current annual increment is removed in thinnings? For third quality Sitka spruce, these increments are approximately 200—240 cu. ft. per acre, per annum: and for most other species, $\frac{1}{2}$ to $\frac{2}{3}$ of that. The annual thinning yield per acre for Sitka spruce is therefore approximately 60—80 cu. ft. per acre, and for other species 30—60 cu. ft., or for both species combined, about 50—60 cu. ft. This figure multiplied by the number of acres over 15 years of age in 1956, should give a figure for the total thinning yield in that year, which would be about $1\frac{1}{2}$ to twice that given by Mr. Dier. In practice, most stands are thinned later than at 15 years, but the fact still holds that $\frac{1}{3}$ to $\frac{1}{2}$ of the increment put on from that age onward is removed in thinnings, and whether this accumulated increment is removed at 17 years or at 25 does not materially affect the issue.

PROPOSALS FOR A THINNING PLAN

BY D. A. WOODBURN

NOW THAT MANY forests are reaching the thinning stage, some type of plar which would enable the Forester and District Officer to plan the course o thinnings for several years ahead, and so obtain an estimate of the expected yield within the next few years, would be of great use. The framework of such a plan should be such that the time of thinning is not tied down to the year stated in the plan ; but rather that the plan should be capable of modification to suit a change in time of thinning, if silvicultural conditions or shortage of labour should warrant a postponement, or conversely if a speeding up of thinning operations becomes possible in some particular area. Maps to act as visual aids to any written scheme of operations are useful adjuncts since they can show the forester at a quick glance the stage which any particular area of the forest has reached.

The type of map necessary to serve the scheme outlined below is the Forest Map, which is divided up into compartments and then into sub-compartments according to the distribution of each species. Each sub-compartment would be designated by a letter from " a " onwards.

A tabulated statement comprising all the compartments and sub-compartments showing species and area would assist in later estimation of yields from thinnings. An example of such a statement is shown below :

P. Yr.	Cpt. No.	Area, acs.	Sub. Cpt.		
			No.	Species	Area
34	14	34	a	S.S.	12.5
			b	N.S.	4.5
			c	D.F.	2.5
			d	N.S.	11
			e	D.F.	1.5
			f	J.L.	2

Having obtained prints of the Species Map, the forester would use one print for first thinnings only, one for second thinnings only, one for third thinnings only and so on, the number of prints depending on the number of thinnings to be made before the final crop is left standing on the ground. Thinning operations for three years ahead, which is probably as far ahead as one could safely prescribe such operations, could then be marked on the maps, by cross-hatching in pencil those sub-compartments which the forester considers require thinning within that period. Depending on the number of the thinning, whether first, second, third, etc., the hatching would

be drawn on the respective species map, and the year for the treatment pencilled in within each sub-compartment. At the end of one year those sub-compartments which were actually thinned as proposed would be hatched over in ink and the year of thinning also inked in. Sub-compartments not thinned as proposed could be left as they were on the map until the end of another year. Also at the end of one year the forester would prescribe one more year's thinning programme, in order to keep his 3-year programme up to date.

Records of these future thinnings could be kept in tabular form as shown below to run concurrently with the mapping :

FOREST YEAR 1948

No. of Thinnings	P. Year	Cpt. No.	Sub-cpt. No.	Estimated Yield, cu. ft.	Actual Yield, cu. ft.	Remarks
1st	30	24	a b d			Light
2nd	27	18	a c			Medium
Total Yield of Year ...						

Estimated yields could be obtained either from Yield Tables, if applicable, or from past thinning yields if such are available. Actual yields would be obtained from felled measurements. In the remarks column the forester could add any information which he wishes to insert for his own future guidance, such as degree of thinning, number of stems per acre taken out, and average volume per stem. Sub-compartments not thinned in the year proposed could be interpolated into the following year's table or preferably added to a space at the bottom of the form, purposely left blank for any such additions to the programme.

An extract from the actual yields shown on the previous forms could be kept up to date for each compartment, showing what volumes have come out of each, somewhat as in the manner shown below :

Compartment Number.....

Sub. Cpts.	Yields of Thinnings in cu. ft.					Total Yields, cu. ft.
	1st	2nd	3rd	4th	5th, etc.	
Totals ...						

A scrutiny of yields from the earliest thinnings in the older P. Years of a Forest, would assist the forester to make more accurate estimates for the younger P. Years following.

Treatments have been prescribed in this plan by sub-compartments since, where a compartment is not composed of one species throughout, those parts containing a quicker growing species would be ready for thinning earlier. The writer has found that an enlargement of the ordinary six-inches-to-one-mile map to a twelve-inches-to-one-mile scale is useful for showing thinning operations, since it allows more space to insert the species, the number and the date of thinning within the sub-compartment. (Such enlargements can be made easily and cheaply by photo-printing.—Ed.).

Eventually, as the whole forest passes through each successive stage of thinning, each Thinning Map in turn will be completed and become redundant, having served its purpose ; but the plans should be preserved as records of the work done. Such Thinning Plans and Maps must, of course, be regarded as integral parts of the General Working Plan for each forest.

THE SELECTION OF THINNINGS BY FOREST WORKERS

BY E. C. KIBBLE

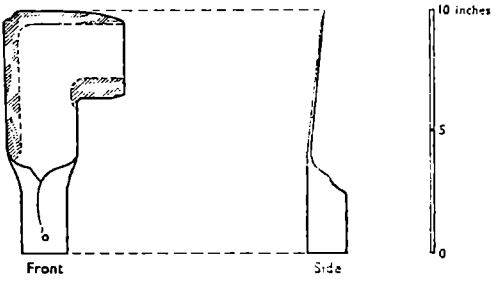
IN THE PAST the practice at Eggesford Forest has been for the forester himself to select trees for removal in thinnings. But recently the large area—some 900 acres—of Douglas fir and Sitka spruce planted between 1919 and 1934, all due for thinning under the three-year programme, has made that procedure impracticable. Selected forest workers, mainly ex-servicemen with only about six months practical experience in the woods, have been successfully instructed to select and fell the trees to be removed in the thinning as they go along.

A width of four rows of trees is considered at one time, as this is found to give a good impression of the degree to which the canopy as a whole will be opened up. The trees felled in these rows are extracted down the space between the two centre rows, which has been found to be the most economical method. At the outset courage is needed by both the forester and the workers who undertake the marking. But the men gain skill and confidence with experience, and take far more interest in their work than was the case when they had merely to cut down trees marked by someone else.

HIGH PRUNING WITH CHISELS

BY H. CRUIKSHANK

AT THE REQUEST of the Director of Research and Education, Gwydyr Forester Training School, temporarily stationed in the New Forest, carried out preliminary high pruning tests with a chisel invented by Captain Wolryche-Whitmore.



HIGH PRUNING CHISEL

This chisel, which is shown in the accompanying diagram, is in the shape of an inverted L, weighs $1\frac{3}{4}$ to 2 pounds, and has three cutting edges, two horizontal and one vertical. In the socket, which is at a slight angle to the blade, a handle of any desired length is fixed by means of a small bolt. The operator, while standing at a short distance from the tree, thus protecting his knuckles and at the same time obtaining a good view upwards, is able to slide the blade up the stem without damaging the bark. The end of the pole is grasped by both hands held close together, the chisel is laid against the stem below the branch to be pruned, and a long steadly blow is delivered. This is more effective than a series of short jabs. Small branches are easily severed by one upward stroke, larger ones by two upward strokes. If these fail to cut through the largest size of branch encountered, a third downward stroke completes the operation.

In the test the chisels were fitted with poles 4, 5, 8, 10, 12 and 14 feet in length. These were of unseasoned Douglas fir, $2\frac{1}{2}$ inches maximum diameter. Pruning saws were fitted with corresponding poles and the two types of tool checked against each other in plantations of European larch, Douglas fir, Norway and Sitka spruce, Scots and Corsican pine. The type of saw used had a 16-inch curved, non-adjustable blade of 18-gauge metal, with 6 teeth per inch, cutting on the down stroke only.

In each plantation, after the trees were marked, the chisels were used in sequence, the shortest-handled first, each successively longer handle following until each tree was pruned to a height of 18 feet. The saws were in similar sequence. Each operator pruned upwards until the end of the pole reached chest height. This usually meant that each length of pole removed one whorl of branches, and the intervening epicormic shoots when present.

Detailed figures for each species were obtained. These are not quoted here as the tests were not exhaustive. From these preliminary figures, however, and from the experience of the operators, several general conclusions were reached :

1. With Douglas fir, European larch, Norway and Sitka spruce, the chisels did first-class work and were approximately 50 per cent. faster than the saws.

2. With Corsican pine the chisels were about 30 per cent. faster.

3. With Scots pine, although the chisels were faster, the work was unsatisfactory. Due to the swelling of the stem at the branch whorls, and the upswept branches, either the bark was damaged or snags were left.

4. The chisel mounted on the shortest pole was not, as might be expected, the most efficient. With branches over 1 inch in diameter, insufficient upward thrust could be obtained to sever them with one blow.

The most efficient lengths of poles were found to be those of 6, 8 and 10 feet, pruning 13—14 feet. They are reasonably easy to operate and are not heavy enough to cause undue fatigue. The 12 feet pole, though slower in use, was reasonably efficient. Pruning with the 14 feet pole proved very fatiguing, necessitating frequent changes. This was most noticeable where the branches were difficult to remove.

A decided disadvantage of the two longest poles employed is that their size and weight hinder the worker in his attempts to evade the falling branches.

5. Although branches of about 2 inches in diameter were removed more quickly with the chisels, the quality of the work was inferior to that of the saws.

6. Owing to the necessity for direct upward strokes with the chisel, six different pole lengths were necessary in order to prune to 18 feet. With the saws, pruning to this height could be carried out with three lengths of pole. The pole lengths employed enabled the saws to prune 18 inches to 2 feet higher than the chisels.

7. The maintenance of the chisel is simple. This is a decided advantage over the saw which can be maintained only by an expert.

As a result of the test the following suggestions are put forward with a view to increasing the efficiency of the chisel.

a. Chisels set at varying angles to the poles might be tried in order to ascertain the most efficient working angle.

b. The upward stroke of the chisel might be even more effective if the cutting edge were set at a small angle to the horizontal.

c. The vertical edge has a very limited use and therefore seems unnecessary.

d. Some form of eye protection is most essential, as during the operation debris is continually falling on the operator.

In this preliminary test Captain Wolryche-Whitmore's chisel has proved itself worthy of further consideration. It is cheap, speedy, efficient, easily manipulated and maintained and—a very important point—is preferred to the saw by the men who have used it.

THE WORK OF THE SAMPLE PLOT PARTIES

BY F. C. HUMMEL AND T. W. IRVINE

BEFORE THE 1914-1918 war, the Board of Agriculture had collected and published measurements of some plantations of special interest, and the Arboricultural Society journals contained a good deal of useful information on the rate of growth of various plantations, but as there had been no uniform method of collecting or presenting this information, it would have been difficult to co-ordinate it for the preparation of yield tables.

The heavy fellings necessitated by the first world war, however, brought matters to a head. It appeared that most of the well stocked woods would disappear and no record would be kept of their growth. It was an opportunity that could not be missed, and in 1917 the Board of Agriculture in England and Wales, and the Timber Supply Department in Scotland, began the systematic collection of statistical data by establishing temporary plots which varied in size between 0.2 and 0.5 of an acre—the method is described in detail in Forestry Commission Bulletin No. 10 (unfortunately now out of print although its tables are still available).

With the formation in 1919 of the Forestry Commission, one of the first tasks of the Research Branch was to work up the data collected from these plots in the form of yield tables. These tables, which were based on 1,100 plots of the then six main coniferous species were published in Bulletin No. 3 (also out of print).

These tables fulfilled a useful purpose and contained much valuable information that was new, but as they were based on temporary plots whose past was often unknown and probably unsatisfactory, these tables were clearly only provisional. The next task was therefore the establishment of permanent sample plots ; the two main objects being first the collection of data on the rate of growth and yield under proper management, in order to improve the existing yield tables and prepare new ones for the more recently introduced conifers, and secondly to study the effect of different thinning treatments upon production—both in quantity and quality.

A limited number of plots that had been established by the Board of Agriculture in the Forest of Dean were taken over, and some new plots were established there and in a few other old Crown Woods, but as the State did not possess many areas where growth was sufficiently far advanced, most of the early sample plots were established in privately owned woodlands. The owners of these have always been most helpful in offering facilities for the work and have taken an active interest in it.

By 1928 these permanent sample plots were beginning to throw fresh light on the subject of growth and yield, and accordingly Bulletin No. 10 was prepared, in which the tables for Douglas fir, Corsican pine and Japanese larch were extended and a preliminary table given for Sitka spruce.

The first plots to be established in a plantation formed by the Commission were in a 12-year-old Black Italian poplar stand at Rendlesham in 1934. In 1939, of the 242 plots established 174 were on private estates, but since then many of the Commission's own plantations have reached the thinning stage—this is the time at which plots are usually established—and during the past nine years 120 plots have been established in state forests.

Now it is our policy to establish plots on private estates only when nothing equivalent can be found in Commission woods. Losses due to wind throws, fire, glazed frost and war fellings, amount to 90, leaving 277 plots under measurement. These are now worked on a triennial cycle—being thinned if necessary every 3 years but with main crop measurements taken every six years. In older plots these intervals are extended to 6 and 12 years respectively.

Within the next five years it is proposed to establish 30 or 40 new plots annually, the aim being to get 60—80 plots for each of the more important conifers, spread over the whole range of site qualities and thinning treatments. This is considered the minimum required to bring our yield tables up to a satisfactory standard of reliability and to prepare stand tables, assortment tables, thinning tables, volume tables and other tables that are of practical use to the forester in the field. As in the past, the new plots will be established in sets of 2 or more wherever there is a sufficiently large area of uniform growth, in order to find out how different types of thinning affect production and to provide living field demonstrations of these effects for the benefit of foresters. It is, perhaps, a point that needs emphasizing that sample plot work, unlike more fundamental research, is not an end in itself, but mainly a means of providing foresters in the field with the information they want, and on this basis will sample plot work be judged. It must, however, be remembered that trees do not grow in a day and that it takes a great deal of material to produce reliable results ; this explains why our output may as yet appear to be small compared with all the effort put into sample plot work.

This is not the place to discuss the technical details of sample plot work, but a few remarks on the thinning grades employed may not be amiss. There appears to be a common belief that the thinning grades used by the research branch bear little if any relation to practice ; and indeed there is quite a lot of evidence to support this view because there are several plots, particularly older ones that, according to our present standards, are obviously underthinned. They have been left as they are because the superiority or otherwise of heavier thinnings can only be demonstrated if lightly thinned plots are available for comparison.

Such plots must then be considered as a demonstration of what not to do, and perhaps we should put up notice boards to that effect. Nowadays, newly established single plots are usually subjected to the type of thinning that is considered most suitable for the crop, and very heavy and very light thinnings are normally only included in series where there is a moderately thinned plot as well. The need for these series lies in the fact that we are by no means certain whether the moderate thinnings at present in vogue are the best means to achieve certain objects of management, and it is only by trying both heavier and lighter thinnings that we can hope to get certainty.

Even within a given severity of thinnings, foresters quite rightly feel that some of our plots have not been thinned strictly according to silvicultural principles. Why should this be so ? In practical forestry a rough differentiation between light, moderate and heavy thinnings is often adequate, but for research much more precise definitions are essential in order to insure that results from different localities are strictly comparable. A great deal has been said and written about the definition of thinning grades, but the fact remains that no system has as yet been devised which combines precision of definition with adequate silvicultural latitude. This, quite frankly, is a defect and we are trying to remedy it, but it would go too far to state how the problem is being tackled.

Until the autumn of 1946 there was only one sample plot party, which divided its time more or less equally between Scotland and the South, although at times the party was mainly Scottish. It is, however, recorded that one Scotsman in the party, when his six months sojourn in England and Wales was over and he was driving North towards his beloved Western Highlands, always paused when crossing Carter Bar to wipe the dust of England from his car !

For the last year there have been two sample plot parties in the field, one based on Alice Holt and working in England south of Chester and in Wales, and the other based on Edinburgh and working in Scotland and Northern England. Each party has its area split into three parts, in each of which the party works for the greater part of one year, thus fitting in with the triennial remeasurement cycle. Being continually on tour, moving from one plot to another and from one lodging to the next, the parties lead a strenuous and varied existence and many are the tales they can tell of their adventures.

The actual travelling from place to place has always been beset with snags—for 25 years the party travelled by train, staggering under the burden of cycles, luggage and the old green tool chest, and with the cries of the station staff—" It's you we're waiting for," ringing in their ears. Now the parties are mechanized, but new snags have taken the place of old as, one painfully realizes when on one's back under the truck, petrol goes up one's sleeve and down the neck as yet another blockage in the feed pipe is cleared.

But it is the sample plots themselves which provide the most vivid memories, particularly the plots that have excelled in growth, such as the *Abies grandis* at Novar (Ross-shire), which at the age of 41 years (it was blown 2 years later) had produced 12,500 Hoppus feet of timber per acre, or the celebrated Sitka spruce plot at Dunster which is described as growing " in a little field where previously were only a few scraggy apple trees " and now at the age of 37 years carries a volume of 9,500 Hoppus feet per acre. The oak plots of the Dean, the new sycamore plots at Friston, the underplanted European larch plots at Haldon, the pine plots at Culbin, are among the other plots of special silvicultural interest, and it is hoped to describe some of these in future numbers of this Journal.

FIRE PROTECTION AT NEWTON DALE

BY A. E. LEWIS

THIS FOREST IS situated in a typical Yorkshire dale, through which a branch railway runs. For approximately four miles the line adjoins the forest, which is also flanked by open moorland. In such an area as this there is a very heavy fire risk, mainly from the railway, and to a lesser degree from the moor. During the last three years a record has been kept of every fire attended to, and the month. The totals are :

Fires	*F.Y.* 45	*F.Y.* 46	*F.Y.* 47
In Plantation	17	47	18
Put out before reaching Plantation	95	138	76
Moor	—	—	3
Totals ...	112	185	97

This gives an average of 5 to 1 fires put out before reaching plantation.

The following table shows the distribution of fires throughout the year :

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
F.Y. 1945	—	2	55	32	7	3	—	13	—	—	—	—
F.Y. 1946	—	15	60	87	15	—	8	—	—	—	—	—
F.Y. 1947	—	—	—	27	16	6	1	46	9	—	—	—

These figures clearly show that the spring months from February to May have the greatest fire danger, with March or April as the worst month, according to the weather in each particular year. Dry weather in July, August or September leads to a second, though less serious, period of risk. The danger of fire remains throughout the year. There is not a month in the year when one can say there is no danger of fire—I have known of fires from January to December.

Can fire be prevented ? I do not think it can, but by taking precautions beforehand a great deal can be done to localise fire, and prevent its spread. One man in the first few minutes can stop what could become a very serious fire in half an hour.

To do this it is necessary to make a close study of local conditions : wind, weather, countryside, and train services, plus the instructions in the standard fire plan. Men should be sent to work near known danger points during dry weather. In acute danger periods it is often practically impossible to carry out any forest operations except fire duties. It is policy to study the Working Plan to make operations fit in with danger periods, so as to have labour available for fire fighting.

Owing to the remote position of this area it is impossible to get any local assistance, and we have to rely on our own devices, which I think is all to the good. Towards the end of last summer it was found necessary on two occasions to call in military assistance to two moor fires which seriously threatened the Forest ; they gave very valuable assistance, and I was greatly impressed by the use of the " Walkie Talkie " (a portable wireless set) and its possibilities as used to keep communications open.

SNOW DAMAGE OF THE WINTER 1946-47

BY H. FRANK

VERY FEW WILL recall the great snowstorms in the year 1895, when much damage was done to plantations and property ; anyhow, the writer has only information that has been handed down by the older generation. I have a more vivid recollection of the winter of 1947, when snow fell early in January, but it was not until the 3rd February that the big snowstorm came, driving from the east and working north-east. Then forest operations ceased, roads became blocked, and hamlets, farms and foresters' houses were isolated. Snow and wintry conditions lasted until the last week in March, when forest operations were again resumed. This caused seasonal work to be very late, also very droughty weather followed which caused a larger percentage of plant deaths than usual.

But the worst was not known until stock was taken of the damage, including miles of rabbit netting laid down and the invasion of rabbits from adjoining land. Acres of Scots pine on deep ploughing by R. L. R. plough had to be firmed, whereas Sitka spruce stood the test.

On the top land, some 800 feet above sea level, snowdrifts along the walls were 10 feet deep, and one chain wide, and it was here that the major damage was done. Scots pine 6 feet high had 60 per cent. with branches stripped, 20 per cent. broken down and only 20 per cent. not damaged ; a pitiful sight. Even the nursery did not escape, for the storm played havoc with the lath shelters.

There was only one consolation—fire danger was absent.

LONGITUDINAL SPLITS IN GROWING CONIFERS

BY R. J. G. HORNE

DURING THE SUMMER of 1947, longitudinal splits were observed in growing Sitka spruce and Norway spruce in Aberdeenshire. The incidence was fairly widespread. It was observed in plantations of fifteen to twenty years of age at Forest of Deer, Kirkhill, Kemnay, Pitfichie and Midmar. The main species affected was Sitka spruce, but there were at all the forests mentioned a few split Norway spruce as well.

The trees affected are all particularly well-grown trees of the dominant class, carrying heavy crowns. They are growing on sites which can fairly be described as moist. There is no evidence that trees grown on what might be considered over-dry sites for spruce, were affected any more than those on more suitable sites. The splits in Sitka spruce are spiral and extend upwards from right to left. In Norway spruce, they are more nearly vertical.

In one or two cases the splits start at ground level, but mostly from heights of six to eight feet. Splits vary in length from three to fifteen feet. They are up to one inch wide and from two to three inches deep.

The splits were first noticed by boys who were pruning Sitka spruce at Kirkhill about the middle of July. They were then found on search at other forests. It cannot be emphatically stated that they were not present at an earlier date. In our search, we found several trees which had been split several years ago, which had grown over, leaving scars similar to those often seen in silver fir.

It has been suggested that these splits are associated with the particularly dry and hot summer of 1947. An unusual contraction caused by excessive transpiration, coupled with the fact that the spell of dry weather had reduced the normal supply of water available from the soil, may have been sufficient to have caused a crack similar to the spiral seasoning cracks we see in Sitka spruce poles.

It has also been suggested that the splits were caused by excessive growth—that girth was being laid on in such abundance that the fibres burst —that, in fact, the trees were literally bursting with health. Expert opinion supports this theory, but surely then, years ago, we would have been familiar with this phenomenon in the west, where growth is so much faster than in the north-east. It can, however, be acknowledged that while the growth in the west is undeniably greater over the whole growing season, it may not be faster. It is probably true that trees there start growing sooner, and continue to grow longer in the back-end.

We experienced arctic conditions in this locality during the winter of 1946-47, and it has been suggested that we have here only frost cracks which we did not notice till the middle of summer. Frost cracks in spruces are uncommon in this country, as are winters such as that of 1946-47.

In some parts of north-west America, the natural home of Sitka spruce, the coldest Aberdeenshire winter might well be commonplace, but there the annual growth may be closer and the structure of the wood harder

and stronger. So during last winter we may have had temperatures approaching those enjoyed by the tree in its native mountains, at work on a stem structurally unsuited to such severity. We had, in fact, an extreme winter and an extreme summer at work on a tree reared in a temperate climate.

Though the trouble is not a very serious one, against which we must seek some measure of protection, it is an interesting one, which we hope our research branch will investigate. For what it is worth, I suggest that we refrain from brashing the trees on our ride sides and those along the borders of our plantations. Some foresters have long advocated this for a variety of reasons. Mine is that the rise and fall of temperature will be, in some measure, controlled. Excessive transpiration will be checked by the exclusion of hot winds and strong sunlight from the lower crowns, which cannot suddenly acquire the power to control transpiration.

Even if only 300 of the very best spruce in a plantation of about 100 acres are ruined by these splits, it is a serious enough matter in these days of want. If happily it be that the lovely summer of 1947 was responsible for this loss, we may sleep easily—" We will not see it's like again."

DAMAGE BY SQUIRRELS

BY W. H. MARSTON

BEFORE THE END of last century, British foresters were fortunate in that they had only one species of squirrel with which to contend in their arduous task of forming plantations of good, sound timber. During the past few years the red squirrel has suffered great reduction in numbers, having now become almost extinct in certain southern districts. On the other hand, the American grey squirrel seems to be rapidly increasing in certain parts of this country, causing great concern by the damage it is doing, especially in hardwood plantations.

Generally speaking, the damage caused by these two species of squirrel differs considerably. The British red squirrel generally frequents coniferous plantations, and its feeding habits appear to be especially adapted to conifers. Scots pine seems to be its favourite tree, where often it will be found damaging the leading shoots in plantations ranging from 10—20 years old, particularly from May to July while the sap is most active. From observations it appears that they peel off the outside bark and feed on the more succulent inner cambium layer. The damage mostly appears on the last 4—8 feet of the main stem, which is often completely girdled, or peeled in patches of various sizes. The effects of the damage on the value of the timber vary according to the extent of the peeling. Where tops are completely girdled the flow of sap is stopped, and the leading shoot either dies or decays ; it is very often broken off by wind. Later, one finds that one or more lateral shoots take the lead, resulting in a distorted stem, with a reduced timber value. Small patches which have been peeled will often callous over and become covered by new bark after a period of years.

The grey squirrel, which is rarely found amongst conifers, has a much wider food range than the red, being especially fond of fruits, and often of garden produce. In its destruction of buds and shoots of young trees, it resembles the red ; in its habits of peeling and girdling it differs considerably, as it will often be found on stems from 15—60 years old, and not always in the higher reaches of the tree, but commencing at ground level and working upwards. Species most favoured are beech and sycamore ; extensive damage has been caused in the Dean Forest to young plantations, of these two species, and I have also noted damage on oak, ash and chestnut.

Where the grey squirrel is found in conifer plantations, it appears to be after seed-bearing cones, generally in early spring, when other foodstuffs are scarce. It has also been noted for the destruction of wild birds' eggs ; this habit could have very serious effect on the numbers of insectivorous birds in our plantations.

Shooting and trapping appear to be the only method of destroying the grey squirrel. Domesticated animals, inhabiting surrounds of plantations, have been noted to destroy quite a number ; but of the two methods previously mentioned, shooting seems to be the most favoured and successful. Trapping, if adopted, would have to be by tunnel.

A 12 or .410 shot-gun is the best weapon, although keen sportsmen often use a .22 rifle. An added asset to shooting is the use of a well-trained

dog to mark trees in which the squirrel is sitting, since squirrels can easily evade the keenest eyes by remaining motionless.

In the Dean, the issue of permits to trustworthy people recommended by the Forester, and the paying of a bounty of 9d. per tail for all squirrels shot, has been the chief method of control. This could be quite a profitable recreation, when cartridges cost only 22s. per 100, though any rise in the price of cartridges might necessitate an increase in the rate of bounty.

The number of grey squirrels destroyed in the Dean in the past 3 years totals 8,559.

VOLE DAMAGE

BY A. M. FRASER

ON A RECENT VISIT to Darnaway Estate, I was shown an area of about three acres of young Scots pine (about five years old) extensively damaged by some animal or bird. The terminal and lateral buds of a large percentage of the trees were eaten out ; the greater part of the outer scales were left and the interior of the bud had been eaten. All sizes of plants were attacked up to those of a height of six feet, which is approximately the height of the largest trees in the plantation. No damage was done to any part of the main stems, so one might readily assume that this was the work of some destructive bird.

Damage by the capercailzie was observed on the smaller plants in the same area. This damage is easily recognized as the caper devours, along with the buds, part of the stem and needles. On examining a number of plants, vole droppings were found high up on the stem, so I was forced to conclude that the damage was the work of a vole.

It might be of interest at this stage to give a short history of the area. The ground originally carried a crop of hardwood, mostly oak. After the oaks were removed, Scots pine was planted. The vegetation is mainly grass with large patches of wood-rush (*Luzula campestris*) ; young broom, which is fairly abundant, is at present being cleared.

This being old woodland, the writer is of the opinion that the silent depredator is the bank vole (*Clethrionomys glareolus britannicus*) which is a more nimble climber than its relative, the short-tailed vole (*Microtus agrestis hirtus*). The latter is more commonly found in open country. The bank vole has been suspected in the past of eating buds of conifers. Over-zealous gamekeepers who kill out stoats and weasels may, in some measure, be responsible for the increase in numbers of the voles. The broom, too, would have given them a large amount of protection from birds of prey.

I have seen similar damage before, and have probably been satisfied that the damage had been done by black game. In the present instance, there is no reasonable cause to doubt that voles are the cause of the damage. As the damage is unusual, it would be of interest to know of similar cases, when they are found.

INSECT PESTS IN NORTH-WEST GERMANY DURING 1946-1947

BY H. S. HANSON

DURING THE WAR YEARS, it was my unenviable duty to locate and record infestations of injurious forest insects which developed as a result of the abnormal conditions created by the heavy wartime fellings in coniferous areas in Britain. When, in the spring of 1947, I received instructions to proceed to north-west Germany to investigate and report on the status of insect pests in German forests as a result of post-war fellings carried out in that country, with special reference to the Spruce Bark Beetle, *Ips typographus*, I undertook the task with feelings of fatalistic resignation.

Happily, however, because of the extremely efficient manner in which the British and Canadian forest officers had organised and carried out their duties, under very trying and difficult conditions, it soon became apparent that the task of writing a report would not be an unpleasant one, but might be difficult because there was little to report.

It is true that a considerable amount of unpeeled, winter felled material remained in the forest when the beetles emerged from hibernation in the spring, and that some of this material had become infested with *Ips typographus* and other species of bark beetles, and had been conveyed to the ports. This was almost inevitable because of the abnormally severe weather conditions which persisted until late into the spring, and suddenly terminated in a burst of almost mid-summer heat.

So far as bark beetle infestations in the forest were concerned, with the exception of a relatively small quantity of infested material in Sachsenwald, it was extremely difficult to find specimens of *Ips typographus*. The only infestation encountered in standing trees was in an area controlled by a local Forstmeister, and did not come within the scope of the North German Timber Control operations.

For the collection of parasites of *Ips typographus*, one of the aims of my visit, it was necessary to rely upon wind-falls lying in more or less isolated situations.

One certainly did hear complaints from the local inhabitants about the manner in which *Ips typographus* had been allowed to increase, and about the damage that had been caused during the early stages of the timber operations. But the beetle-infested trees had been removed during subsequent fellings and no permanent damage to other surrounding crops could be found. The outstanding fact was that since the British and Canadian forest officers had been asked to co-operate in the control of the bark beetles, they had all become " beetle conscious " and had carried out control measures conscientiously and efficiently. Some idea of " what might have been " may be gathered from the following extracts of a report of conditions in other parts of Europe, taken from the *Allgemeine Forstzeitschrift*, 2 Jahrgang, Nr. 9, 1947.

" *Assessment of the damage due to the attacks of Ips typographus in the southern part of Wurtemberg*

In Bavaria the damage, caused in the year 1945, amounted to about 350,000 festmeters of spruce wood, the damage by new attacks in 1946 to

2,400,000 f.m. This corresponds to a sevenfold increase. 3 million festmeters are considered to be in danger. The southern part of Baden reports a total damage of round 740,000 f.m. from 1945 to 1946, and a sixfold increase due to beetles. The northern part of Wurtemberg cut 185,000 f.m. wood damaged by beetles, chiefly in the regions of Aalen-Heidenheim and Brenz. Heavy damage was also reported from the Harz, the forests of Thuringen, Czechoslovakia and Austria. The Swiss frontier districts are threatened by the vast, damaged region of Singen-Radolfzell. In the southern part of Wurtemberg beetle attack has resulted up to now in a dying off of 500,000 f.m."

During my visit I travelled over most of the Harz forests in the British zone, in company with Forstmeister Oedekoven, and saw little sign of beetle damage. The following is an extract from a letter from him written in November, 1947 : " In my district there is not much infestation. The worst places are in the Russian part of the Harz. If you are up at Bramelage and look to the east, you see large blocks and whole compartments killed by the beetle."

The above quotation is in itself a tribute to the efficiency with which members of the staff of N.G.T.C. have carried out their duties.

CONTROL OF *IPS TYPOGRAPHUS*

These accounts clearly indicate what a destructive pest *Ips typographus* may become when conditions are favourable for wholesale reproduction. On the other hand, the absence of severe damage in the British Zone in spite of very extensive felling operations, demonstrates very emphatically that bark beetles need not be allowed to develop to pest proportions if forestry operations are conducted systematically and conscientiously, with due regard for the proper protection of growing crops in the surrounding district.

Under normal forest conditions *Ips typographus*, and most of the other bark beetles, are kept in check by their natural enemies, also by various combinations of ecological factors which tend to regulate population densities. Fortunately the fauna of Britain is exceptionally rich, both as regards variety and numbers, of the natural enemies of bark beetles and other insect pests. Many species of parasites and predators are much more abundant in this country than in any of the areas I visited in north-west Germany. One important species, *Ipocoelius seitneri* Ruschka, a Hymenopterous parasite of adult bark beetles, not formerly present in this country, has now been imported for the purpose of distribution in Britain in the event of *Ips typographus* becoming established as a resident breeding species. In fact, it seems probable that large numbers of this species will have been imported automatically along with the host beetles. Unfortunately it is also likely that a hyperparasite of this species, *Eutelus typographi*, may also have become established here.

CONTROL OF *HYLOBIUS* AND *HYLASTES* IN NORTH-WEST GERMANY

As in this country, *Hylobius* and *Hylastes* are regarded in Germany as very important potential forest pests. At the time of my visit both these insects were remarkably scarce. This was doubtless accounted for by the fact that, owing to the shortage of fuel, all the stumps of trees in the majority of felling areas had been removed by blasting and were supplied as fuel to

the local inhabitants. Unfortunately the demand for fuel could not be met by stumps and roots ; large quantities of material suitable for pit props supplemented the fuel supply.

OTHER FOREST INSECT PESTS

Although not associated with post-war felliings, two other insect pests observed in north-west Germany are of considerable importance. It is not considered likely that they will become established in Britain, but a keen lookout should be maintained and, if observed, their presence should be reported.

Dendroctonus micans Kug. (Scolytidae). This is the largest of the European bark beetles and is related to some of the most destructive species of North America. The adult beetle is 7 to 9 mm. in length, and is black with yellowish hairs.

The insect occurs throughout central Europe and ranges as far east as Siberia. It normally breeds in the bark of spruce. During recent years it has become a serious pest in Sitka spruce plantations in north-west Germany, also in Holland and Denmark. It is particularly dangerous and destructive to Sitka spruce in the pole stage, especially when the trees are growing on unsuitable sites. The insects appear to prefer trees which have been damaged by deer, rabbits or other vermin, or trees damaged during haulage operations, as when thinnings are extracted carelessly. Also trees which have been heavily pruned. The beetles become established in the bark in the region of any form of injury. These injured trees may form a nucleus of infestation from which the population spreads to attack healthy trees. The sex ratio is about one male beetle to 15 to 20 females, and the insects breed in colonies. The parent beetles form feeding tunnels in the bark and excavate large chambers in which the eggs are laid in clusters. One female may lay from 40 to 90 eggs. The larvae feed collectively in closely packed irregular rows, side by side, and leave a mass of debris behind them as they proceed. Transformation takes place within the excavated area, and the young beetles proceed to feed in the bark until sexually mature. Pairing then takes place and a second generation may be started without emergence from the bark, or the beetles may emerge and attack other trees.

Lightly infested trees may survive for two or three seasons but heavily attacked trees die rapidly.

Dendrolimus pini L. (Lepidoptera). This is one of the most destructive moths in coniferous forests in Europe and Asia. A severe infestation completely defoliated several hundred acres of pine trees in Gartow Forest during 1947.

The adult insect is a large clumsy moth with a wing expanse of from $1\frac{3}{4}$ to $2\frac{1}{4}$ inches in the males, and from $2\frac{3}{4}$ to $3\frac{1}{4}$ inches in the females. The colour is very variable, ranging from reddish brown to bluish grey, with a light crescent-shaped spot on each fore wing.

Life Cycle. The moths emerge during July as a general rule, and copulation takes place near the ground, often on the stems of the trees. Each female may lay from 200 to 300 eggs in clusters of from 10 to 150 on twigs, branches or on the bark of the stem. The eggs are at first bluish green but later turn grey, and are almost as large as hemp seed. The eggs hatch after 14 to 18 days and the young larvae feed at first by gnawing the edges of the needles. But as they get larger they destroy the needles completely, and at a later stage when the trees have become defoliated the larvae destroy the buds and the bark of leaders and small branches.

In the autumn, the larvae descend to the ground and hibernate among the litter or between the litter and the soil. In some cases the larvae have been found hibernating in crevices in the bark of the stem and under bark scales. In the spring, the larvae ascend the trees and resume feeding. At this stage they devour large quantities of food ; according to one authority each larva devours about 800 pine needles during the course of its development. The full grown larvae are extremely variable in colour, are rather gaudy in appearance and measure 2½ to 3 inches in length.

Pupation takes place in a cocoon which may be attached to twigs or branches, or may be spun in crevices of the bark. Under normal conditions at low elevation the life cycle is completed in one year. But when climatic conditions are unsuitable for normal development, the larvae hibernate during a second winter and the life cycle then takes two years for completion.

Economic status. Scots pine is the favourite food plant, but other pines are readily utilised and various other species including Norway spruce, Sitka spruce, Silver fir and Douglas fir, are also attacked and destroyed. The insect develops to pest proportions most readily in warm dry situations, where the soil is light and sandy and the surface conditions are exceptionally favourable for hibernation during the early larval stage.

The larvae and pupae are attacked by numerous natural enemies and it is very doubtful whether the insect would be able to develop to pest proportions in Britain. Certain very closely allied species occur in this country, but are very heavily parasited and are also attacked by many kinds of predators including birds.

Several other moths which are regarded as very serious pests in Europe in coniferous forests, occur in Britain but are normally controlled by biotic factors. The Pine Looper *Bupalus piniaria* L. is one example. This species is fairly common in many pine areas in Britain, but seldom causes much damage. The eggs and larvae are heavily parasitised, and this insect seldom becomes very numerous.

ATTACK BY CATERPILLARS ON A BEECH PLANTATION

BY F. B. K. PURSER

DURING MAY, 1947, plagues of caterpillars attacked crops and trees in various parts of the country, and one read and heard a lot about them, both in the Press and on the radio. Sad to relate, a plague of these pests decided to attack a newly planted beech plantation at Collingbourne Forest, Wiltshire. The presence of the caterpillars was first noticed on May 24th, but only in small numbers. However, by May 26th the entire P. 47 beech area, comprising some 77 acres, was almost completely defoliated, and the buds of plants that were just beginning to flush were eaten away. The area presented a very sorry sight, particularly disappointing because only about 2 per cent. deaths had been noticed before the attack, and there had been no frost damage. In addition, some 62 acres of beech planted in Forest Year 1946 were attacked, and there defoliation amounted to 40 per cent. A small amount of damage occurred in older beech plantations. Surrounding coppice and hardwood scrub of all species was almost completely stripped of leaves.

The area was inspected by an entomologist from the Ministry of Agriculture and Fisheries, Bristol, but he found that no practical steps could be taken to prevent any further damage. It was at first thought that the area might be " dusted " from an autogiro, but as the beech at Collingbourne are planted under a birch pole cover, this method was considered impracticable.

Samples of the caterpillars were sent to Dr. W. Laidlaw, of Edinburgh, and also to Dr. R. N. Chrystal, of Oxford, for identification, and samples were also taken by the visiting entomologist. It was found that the majority of the caterpillars belonged to four species, two belonging to the Geometridae, and two to the Noctuidae. Those belonging to the Geometridae were *Himera pennaria* L.—The Feathered Thorn, and *Phigalia piloseria* L.—The Pale Brindled Beauty. Belonging to the Noctuidae were *Taeniocampa gothica* L.—The Hebrew Character Taeniocampa, and *Miniosa W. V.*—The Blossom Underwing.

Eventually, the P. 47 beech showed signs of recovery, and a second flushing was seen on a large percentage of the plants. As if to complete the damage started by the caterpillars, the prolonged summer drought set in, and by the end of the summer practically every plant had the appearance of being dead, although many of the stems remained green.

The replanting of the area in the following season was at first considered essential. But, owing in part to the shortage of beech planting stocks, it has now been decided to postpone action until P. 49. By then, it is hoped, more survivors will be found than are now apparent. Those plantations established before P. 47 which suffered from the attack, have recovered and now show no adverse effects. No defoliation was observed on coniferous trees.

Forester B. R. G. Hammond makes the following observation : " The cause of the outbreak is unknown, but as plants imported from different sources were attacked to an equal degree, it appears probable that some factor peculiar to the locality induced the attack. A possible explanation is that an unusually large number of parent moths and butterflies had settled and laid their eggs at this particular point, after having been blown across the adjoining treeless expanse of Salisbury Plain, which lies directly to the south and west. No increase in the population of butterflies and moths in the forest was noticed after the plague of caterpillars had ceased."

CANKER ON YOUNG CONIFEROUS CROPS

BY T. R. PEACE

RECENTLY A NUMBER of cases of canker on pole stage coniferous plantations have been reported, some of them sufficiently serious to have caused appreciable damage to the crop. Cankers on Sitka spruce have been reported from areas as far apart as Durris on Deeside, Canonbie in Dumfrieshire, the New Forest, and Dunster in Somerset ; cankers on Japanese larch, apparently associated with brashing, have been reported from Allerston Forest in Yorkshire, and from Coed-y-Brenin and other forests in North Wales ; canker on Norway spruce, possibly connected with high pruning, has been reported from Drummond Hill in Perthshire, and cankers on *Pinus contorta* eighteen years old from Achnashellach in North Scotland.

Work on these cankers has only just started. It would be easier to assess their importance, if more was known of their occurrence, and how severe the attack was in each place. The more cases we know of, the more are we likely to be able to associate the canker with particular sites or treatments. I should be grateful if foresters with appreciable amounts of canker on any of their conifer crops, other than European larch, would report full details through the normal channels to : the Pathologist, Forest Research Station, Alice Holt, Farnham, Surrey. European larch is omitted because it is already known to be attacked frequently by canker due to frost and possibly the fungus *Dasyscypha*. Details in the report should include species, age, approximate percentage affected, and whether any have been girdled, any evidence you may have for connecting the canker with brashing, pruning or any other operation, the year when the canker was first noticed, and any other information which you think may throw light on its cause.

Reports have also come in from the New Forest and from a number of forests in the East of Scotland, of cracks in the stems of spruce. These cracks are deep, often reaching well into the wood, and may be ten feet or more long. Information on the occurrence of this type of injury, again with full details, would be welcomed.

UTILIZATION

BY J. E. MAUND

FROM NOW ON THE thinning of plantations will rank as one of the most important silvicultural operations. Due to acute shortages of labour during the war, considerable arrears of thinnings have to be made up and, to add to these difficulties, it was impossible to do much towards the building of roads in advance to facilitate the removal of the thinnings.

Careful consideration and action is now being given to the general layout and state of existing roadways, also to the formation of new ones, thereby appreciably reducing the cost of extracting the produce to the highway. There still remains the need, however, to devise satisfactory methods of reducing the cost of removal of the thinnings from the compartment itself. Prior to the war these were removed either manually or with horses, poles being carried or tushed distances of up to two hundred yards. Ways of reducing the cost of these operations are most important now that the Department is working in such a large way ; any reduction means the saving of a considerable sum of money throughout the country. With this object in view, I believe that the formation of permanent extraction routes throughout each compartment will become a standard practice.

The number and disposition of these racks will depend on the existing system of rides and topography. Where conditions permit it is an advantage to form lanes throughout the compartment twelve to fifteen feet in width, at intervals of two to three chains apart, depending on the species and rate of growth, to permit the entrance of lorries directly into the plantations ; such conditions are found in East Anglia, where the easy nature of the ground, together with the perfect natural drainage, renders the extraction of thinnings a fairly easy matter. Where this form of removal is impossible, the rack will enable some type of tractor to tush or winch out the poles to the compartment ride ; or in certain other cases enable a light system of overhead cables to be erected ; or on very steep slopes, permit the fixing of sectional chutes if the volume of produce justifies the expense.

No hard and fast system of racks can be laid down. Each area and in some cases even parts of a compartment must be considered separately. Each extraction lane must be laid out with the object of bringing the poles or converted produce to the loading site the easiest possible way. They should be aligned previous to the marking of the first thinning, and the racks formed by the removal of one or two rows of trees, depending on the original planting distance, or preferably a track cut twelve to fifteen feet in width at an angle to the rows of trees. A small amount expended on pruning, where necessary, is far wiser than wasting money on extracting thinnings from an unracked compartment.

One of the main drawbacks of racking is that a small proportion of the potential final crop trees is removed, but this is far outweighed by the increased volume out-turn of the first thinning, and the fact that these access routes will lessen extraction costs throughout the greater part of the rotation.

NOTES ON PRODUCE IN THE NEW FOREST

BY I. R. B. MARSHALL

FOR CLEAR FELLINGS, the following rotations have provisionally been fixed for the New Forest plantations : Scots pine, 100 years ; Corsican pine, European larch and Douglas fir, 80 years ; oak, 150 years.

A three-year thinning cycle is in operation among the younger crops throughout the Forest. Older crops which do not require such frequent attention are thinned on a six-year cycle.

Preparation : Almost entirely carried out by forest staff. This work lends itself to the adoption of piece rates and these are universally applied. Two men working as a team constitute the usual unit, but other teams are common such as two men and a boy, a single man (who thins small conifer), and a man and his daughter : the latter turn out some of the best piles in the district.

Costs of preparation, which are included below, may be a valuable guide to some. All rates include felling, trimming out, cross-cutting, and also pointing in the case of piles and stakes.

1. *Timber and Large poles.* Rates per cubic foot : Hardwood 2½d. ; Conifer 2d.

2. *Pitprops* have differential rates according to category and size, and are priced per dozen props. A working average is 5s. per 100 foot run.

3. *Cleft oak fencing piles.* (Three piles equal one cubic foot). Rate per cubic foot 1s. 2½d., extraction 3d. The return for piles is exceptionally good. At roadside the selling price is 5s. 3d. per cubic foot. Similar category oak marketed for timber is sold at 1s. 2d. per cu. ft. " at stump."

4. *Ladder poles.* Species required are Douglas fir, the spruces, and thuja, which are prepared down to a 3-inch top diameter. The rate given is 1d. per foot run and extraction costs are : up to 25 foot at 7d. per pole, above 26 foot at 9d. per pole. Marketing price at roadside is 4d. to 7d. per foot run, depending upon length and top diameter.

5. *Scaffold poles.* All conifer species are suitable down to 2-inch top. The rate is ½d. per foot, and extraction costs are as for ladder poles. Marketing prices are slightly lower than those for ladder poles.

6. *Cordwood.* Where timber is also prepared, the rate is 10s. per cord, but with scrub only up to 15s. is given. Extraction cost is 7s. 6d. Price at roadside is 30s. per cord.

7. *Conifer stakes.* Rate for preparation is 1s. 6d. per cu. ft. Extraction cost 4d. This material is sold at a wholesale price of 2s. 1d. per cu. ft. at roadside ; fortunately a market has been secured for all so far produced.

Extraction. Most of the timber is sold " at stump." Occasionally, as in a thinning of a plantation where it is especially desired to reduce the risk of damage, extraction is carried out by forest staff. All other kinds of produce are extracted by contractors' own facilities. There are long established local hauliers, well distributed through the forest, who with horse and cart or light timber wagon will extract smaller produce at the piece work rates quoted above.

Four types of tractor, owned by the Department, have been used for extraction, as follows :—

1. *Fordson Major* with half track, which has some of the advantages of a caterpillar and can draw a trailer. It is high built and can readily negotiate stumps, but the two small front wheels tend to become non-effective in muddy places. Hauls up to 1 ton.

2. *Fordson Rear-Winch* which is very suitable for placing on a ride and winching out lighter types of produce from a plantation without entering into it ; it is thus particularly useful for extracting felled mother trees from a natural regeneration area.

3. *Caterpillar D.*2 seems to be most at home with a medium size timber wagon on flat ground, where it can haul from 2-3 tons of pitprops, etc.

4. *Caterpillar D.*4 is considered to be the largest which should normally be employed. Very useful for hauling large timber and heavy transmission poles. Larger tractors require plenty of working space, which is generally not available.

Reflections. The majority of forest units are perhaps not so fortunate as the "New" in having stands of mature and nearly mature crops. With a "normal" forest, having all age classes represented by equal areas, it is possible to arrange for an equal annual volume of thinnings and fellings. It is not claimed that these conditions are present in the New Forest, but with 15,000 acres of potentially productive ground, and on the basis of 70 cubic feet per acre per annum, the average annual volume should equal over 1 million cubic feet per year.

In actual fact, because of the large area of slow-growing oak, and with over 4,000 acres of wartime fellings, the present rate of production is about 250,000 cubic feet per year.

To show that the "raison d'être" of the forest was fully achieved, it may be noted that during the recent war over 12¼ million cubic feet of timber was marketed. Supposing that all this timber had been made available for housing, then on the basis of 1.6 standards per house, this quantity would have been sufficient for over 44,000 houses.

EXTRACTION PROBLEMS

BY WILLIAM GILMOUR

THESE ARE MANY and varied according to the type and nature of the terrain on which a plantation has been established. It is obvious that the problems of the hilly West Coast of Scotland are not those of the more level East of England.

Many of the problems which are becoming more apparent have their origin in the early layout of plantations, when the sole object was to clothe the naked hills with a mantle of trees. A very commendable object indeed, but one to which future management and foresight appear to have been sacrificed. Present day extraction problems can be traced, in a lesser or greater degree, to the urgency with which all planting programmes were undertaken.

Admitting then, that insufficient attention has been paid in the past to the siting of extraction rides, and that little or no planning has yet been done to link up individual plantations as parts of a larger whole, let us remember that in all future operations, this must be one of the major points to be borne in mind.

A new system of layout has occurred to me lately. It is usual in the West of Scotland for the Commission's areas to border on a main road or farm track running at the foot of a hill slope. In these circumstances I recommend that the rides should be laid out diagonally to the main road instead of at right angles thereto. They would thus split up the area into a series of square blocks by their intersections ; with smaller triangular blocks along the roadsides and at the top of the afforested area. Inspection paths would run parallel with the contours, linking the intersection points of the rides. Rackways for chutes or ropeways would run across the contours, following the line of steepest slope down to the road.

The advantages of such a layout are readily apparent. The angle of the ride lines to the slope facilitate an easier gradient where the use of mechanical transport is practical ; and from the point of view of fire protection, all parts of the plantation are readily accessible. This layout does not outrage amenity, whilst it does retain the advantage of straight lines.

CHRISTMAS TREES FROM NORWAY SPRUCE THINNINGS

BY A. G. STEWART

AT LLANTRISANT FOREST, 12½ acres of P. 22 Norway spruce were given a first thinning during November and December, 1947. The thinning was purposely carried out at this time in order that all unsuitable tops could be disposed of as Christmas trees. The spruce had been planted at 4½ feet spacing, and the thinning was of the light/medium grade. An average of 465 stems per acre were taken out in the thinning, this figure including the complete rows removed at approximately 30-yard intervals to provide extraction racks.

1,825 Grade I Christmas trees resulted from the thinning and by their disposal, £360 was realised. The total cost of their preparation—including haulage by tractor, trimming, and putting up of orders, amounted to £42, giving an extra profit of £13 9s. 0d. per acre on the thinning operation. It will be noticed that one good Christmas tree resulted from every three poles felled.

H.T.P.D. EXPERIENCE IN RELATION TO FORESTRY

BY D. N. WILLIAMS

IT MAY BE WORTH WHILE to record some of the experience obtained in the Home Timber Production Department, especially that relevant to current forestry practice.

This experience may be roughly classified in the three categories of labour, production, and tools and machinery.

Labour. This was of a very varied order, from the first-class English timber-cutter to the completely inexperienced labourer, and also included Dominion Forestry Corps personnel. One of the main experiences gained was, apart from the purely human one of assessing the value of a man, the fixing and supervision of piece-work rates, especially as regards felling and extracting produce. Day-work, as far as I was concerned, was practically non-existent. Of course, this did mean, in certain cases, big wages, especially as the men often worked seventy hours per week, but the essential point was that the *unit cost* was less than it would have been on day-work.

In the case of felling big timber we also had to bear in mind the pay of the trade employees. The wages these firms paid their skilled timber-cutters was generally about £12 per week—conditions which still continue. Generally speaking, piece-work can be fixed for nearly all jobs, but the essential thing is adequate supervision. This ought, of course, to be accepted as the normal procedure, and I do earnestly suggest to our Foresters that they could advantageously use piece-work a great deal more than they do. I am sure the ex-H.T.P.D. personnel will agree with me on this.

The question of dealing with the Dominion Forestry Corps was different, although I employed a good number of them on piece-work in the evenings and week-end on pitwood production.

Production. As my aim is to keep to T.P.D. experiences relevant to current forestry practice, I will not deal with the question of big timber, sawmilling or charcoal production, but confine my remarks to the production of pitwood, telegraph poles, wood-wool, etc.

Generally speaking, our pitwood production was easier than present F.C. work, inasmuch as we were usually clear-felling. In these cases we always "trenched" the work. Generally a pair of cutters took 6—8 rows at a time, piling the broust on the two sides, and cutting the poles at so much per pole (based on 1½d. per cu. ft. approx.). Alternatively they cut and converted at the same time at so much per score of props, either an all-in mixture of lengths, or else at so much for each different length of prop. Configuration of the ground and condition of extraction routes, etc., were the chief factors in deciding which method to adopt. If, as in many cases, the lorries could go right up and down a trench, we always cut and converted, so as to save double extraction.

Now, in our present F.C. production work this cannot be done, as we are only dealing with thinnings. We are also hampered in some cases by previous lack of foresight in laying-out plantations, and also by the non-provision of stacking-ground. This is a point, I believe, where H.T.P.D.

experience should help a good many. They will appreciate the advantages of the provision of stacking grounds adjacent to compartment boundaries, where such are extraction routes, and also will realise the value of central dumps where these are feasible. In many forests the plantations run right up to the outside fence, leaving no exterior extraction route—a fault that could be obviated by forethought in the original lay-out.

I also think the provision of more rides, which are potential extraction routes in our plantations, is necessary—at least my experience of pitwood extraction leads me to that view ; this is more important still in connection with fire-danger, as in years to come counter-firing may have to be practised to a larger extent than it is at present.

The acquisition of plantations also gave valuable experience in computing volumes and values of timber.

Tools and Machinery. T.P.D. experience taught most of us a good deal about the use and care of felling tools, especially saws ; whilst the experience gained with the various types of extraction gear used will be of great value to most people dealing with F.C. work, whether production or ploughing. The eternal question of what type of tool is preferred is very difficult, and cannot be standardised, as the innate conservatism of the average Englishman is so great that he is not likely to be prevailed upon to use unaccustomed tools.

PUBLIC RELATIONS AND FORESTRY

BY DENNIS HEALEY

THE RELATIVELY NEW practice known as Public Relations is now extensively employed by Government Departments and other official bodies, and may best be likened to the maintenance of a two-way traffic. From the departure platform, for instance, there must go forth interpretation of a Department's policy, with the aim of encouraging an informed public opinion and virile support for the Department's operations, as well as sympathetic understanding of its difficulties. To the arrival platform there should come information which reflects public reaction to, and any criticism of, the Department's work, so that policy and operations may be aligned to the national, and thus the public, interest. When all is said and done, in the final issue it is public opinion which decides what the nation needs and how these needs shall be met.

A dozen or more major campaigns are being carried out at the moment and will be familiar to the reader. The most important work of interpretation at the time of writing, is that of explaining to the general public the full implications of the economic difficulties that beset us, so that we may not only hear but heed the exhortation to work or want. The public's attention is being focussed on reasons why our food is in such short supply, and the housewife is told how she may best make use of the family's rations; the cause of Empire is being prosecuted, with emphasis laid on the value of development of resources and of a sound Commonwealth economic policy; recruitment to the mines is being urged, while the advantages to the nation of a comprehensive health service are being expounded. Less extensive, but nevertheless important, campaigns are being directed to special sections of the community, and I am reminded of one campaign in particular, for if ever proof were needed as to the value of public enlightenment this venture provided it.

In the belief that, if the great majority of babies born each year were immunised just before their first birthday, diphtheria would be eliminated in this country as an epidemic disease, the Ministry of Health in 1941 launched an appeal to parents, and mothers in particular. By various public relations methods, details of the provision of a free immunisation service and of the measure of protection given to small children were brought, and are still being brought, to the notice of parents, with the result that by June of last year nearly 7,000,000 infants had been immunised. In 1945 there were 720 deaths from diphtheria and 25,223 cases, the figures being the lowest ever recorded. Deaths in that year were only a quarter of the pre-war average, and the total number of cases less than half. Deaths and cases have continued to decline and, although I have before me only the figures from the Registrar General's survey of the 126 Great Towns in Britain, it is noteworthy that in these towns last year cases totalled only 6,775—4,492 fewer than in the previous year; there were 128 deaths compared with 239 in 1946.

The goodwill of an understanding public is obviously of great importance if long-term work such as that involved in the rehabilitation and extension of the country's forests is to remain unhampered by, say, restriction in finance and the scale of operations. But discounting the broader aspects and concerning ourselves only with examples of a domestic nature, where the

Forestry Commission is concerned on one hand lies the need for invoking a forest sense on the part of the public, if for no other purpose than the securing of protection for our forests. On the other hand, there is need for the Department to be fully aware of, say, any serious recrudescence of the hardwood—softwood planting controversy or of that concerning afforestation and hill sheep farming ; of criticism of the housing, road-making policies, and so on.

On balance the Commission is more concerned—at least at present —with interpreting itself to the community than in countering criticism, which, happily, is not widespread. But in putting forward the case for afforestation or interpreting any Departmental—or, for that matter, commercial—policy, there exist only limited publicity media which may be used. Over and above these agencies it is impossible to go without introducing undesirable " stunt " publicity ; the measure of success of any Department's work in " selling " itself, therefore, depends precisely on the adequacy of specialist staff and the flexibility and ingenuity of use made of the existing media, which are as follows : Press ; broadcasting ; films ; the spoken word (i.e., lectures, school education) ; exhibitions and display material (including posters) ; and the facility visit (for example, by the public to a forest area).

I have given these publicity instruments in the order in which I feel they lend themselves to application to the Commission's operations and forestry generally. In the Press, a Public Relations Officer may, by fair dealing and mutual confidence, find a powerful ally. The influence of the Press has been steadily growing over many years, perhaps more especially since, in the 18th century, advertisements first appeared in newspapers. I recently read an article which told how public consciousness of the value of self-advertisement or interpretation had at that period just begun to awaken, insofar as newspapers were employed as the medium. The writer quoted a notice which was printed in an American newspaper in 1892. It ran :

> " Yesterday the Lord summoned away the jeweller, Seibald Illmaga, from his shop to another and better world. The undersigned, his widow, will weep at his tomb as will his daughters, Hilda and Emma—the first being married and the latter is open to an offer. The funeral will take place tomorrow, etc."

If I remember rightly I believe the widow had added, as an afterthought, that removal of her husband's business to other premises would not adversely affect the service previously given.

Yes, the Press is likely to remain the most effective medium through which forestry's gospel may be spread, for these are days when a vast proportion of the public is newspaper conscious, taking its Press seriously, trusting it and relying on it to some extent to formulate what may be their uncrystallized opinions on some national issue or other. Moreover, and as a logical consequence, to-day the Press is enjoying circulations such as have never been known before, and one article on forestry, appearing in a single newspaper, may well reach several million people. In England it is particularly the case, too, that a single news item about forestry may reach very many thousands of readers as the result of its being used in several leading provincial newspapers.

Of the remaining media I have enumerated, one must take due cognizance of the power of the B.B.C. in influencing public thought, for listeners to-day total an astronomical figure. Films, I believe, have an even greater part to play in public relations than is the case at present, and even now no one can discount their effectiveness as a means of visual education.

The official documentary films we saw during the war achieved much, for a number focused attention on the valour and achievements of our fighting services, and placed the latter in their right perspective, at a time when a degree of depression might well have pervaded the home front. *Desert Victory*, *Target for To-night* and *Theirs Was The Glory* are, of course, among the epics.

One foresees a wider use of the spoken word, the employment of which has much to commend it. To a statement in the Press, on the radio, or to a passage in a film, the public can find no immediate method of challenge if further enlightenment be sought ; yet the lecturer is, so to speak available for questioning and for leading his audience into useful debate. Extended use may in the future be made of the exhibition, and I feel that few who saw displays of the calibre of " Britain Can Make It " will fail to applaud their value.

In one way or another, all the media I have listed may be used in furthering the cause of forestry. Yet if this is to be the case to the fullest extent, I believe it to be imperative that aid should continue to come from the field, so that a flow of news of operations with public appeal may be properly disseminated to the public.

THE SOIL SURVEY OF GREAT BRITAIN

BY W. H. GUILLEBAUD

IN OCTOBER, 1947, the first meeting was held of a newly created body called the Soil Survey Research Board. The Board was set up by the Agricultural Research Council for the general planning and co-ordination of soil survey research in Great Britain. The members include the heads of the Soil Research Station of Rothamsted, Hertfordshire, and the Macaulay Institute, Aberdeen, a number of leading agricultural scientists, members of H.M. Geological Survey, and representatives of one or two other Government Departments, etc. The chairman is Professor G. W. Robinson of Bangor University. The writer was appointed to represent the Forestry Commission on this Board.

Soil survey has had a somewhat chequered history in this country. The earliest work done was about 1907, but the most complete of the older surveys was one made by Hall and Russell, of Kent, Surrey and Sussex, published in 1912. These early surveys were all based on geology, the assumption being that each geological formation gave rise to its own type of soil. It was soon realised that this was too simple an assumption to cover the facts—certainly no forester would fall into such an error as far as his woodland soils were concerned—and better methods were then developed.

Soil survey work has always been stinted of funds, there was no adequate prospect of a career for the surveyors, and two wars have intervened, so it is not surprising that progress has been slow and fitful. Up to the present date only about six counties in England and Wales have been completely surveyed on a scale of one inch to the mile, and these are only so-called reconnaisance surveys, of rather limited value. The area mapped in detail on a scale of six inches to the mile is relatively very small.

Modern soil survey is based on the soil profile as the unit of study. Soils showing the same general soil profile characters and developed from the same or similar parent materials (rocks) form a soil series. These soil series are distinguished by name and are mapped. In practice the difficulty often arises, that the distinguishable soil series may occur, but in such small areas, and in such a complicated pattern, as to be almost impossible to map. In that case some grouping of allied soil series becomes necessary.

It has now been decided to set soil survey work on its feet, as it were ; to organize it properly, appoint an adequate staff of surveyors to enable the whole country to be covered in a reasonable time, say between ten and twenty years, and to publish the maps, probably on the one inch to the mile scale as each sheet is completed.

The Director of the Soil Survey is Dr. A. Muir, who is now at Rothamsted. The work in England and Wales will be based on Rothamsted and that in Scotland on the Macaulay Institute.

The recruiting of fully trained surveyors is going to be a slow business, and it will take a number of years before the scheme can come fully into operation. As far as the immediate future is concerned, the Ministry of Town and Country Planning is pressing for survey work to be concentrated on areas in which it is specially interested—satellite towns and so on, so that

it is not likely that there will be much progress in the type of country with which we foresters are chiefly concerned. The position in this respect may be rather better in Scotland.

The present proposal is that the 2½-inch-to-the-mile sheet shall be the unit for survey purposes (field work would be on six inches to the mile maps) and that the whole of the land on each sheet tackled, below about 1,500 feet elevation, will be surveyed and mapped. This means that any woodland or waste land occurring within the boundaries of the sheet will be mapped for soil types on exactly the same basis as the adjoining agricultural land.

A question that may arise to the minds of some is : What is the point of a detailed soil survey, and is the great cost involved really justified ? There are several answers to this and here are some of them :

1. Practically all developed countries consider soil surveys necessary, we in this country lag far behind the United States of America for example.

2. Soils form an important class of natural bodies and deserve systematic scientific study just as much as do the rocks.

3. A soil survey is necessary as an inventory of the land, which is, after all, our chief national asset. All sorts of national problems depend on the best use being made of the land, and intelligent planning must be based on the knowledge of how the different types of soil are distributed.

4. As far as farmers are concerned it is true that the individual farmer knows his soil and its potentialities far better than any soil surveyor can tell him, but that applies only to crops to which he is used. When it comes to new crops, such as linseed for example, it should be possible in course of time, on the basis of the soil survey, to give more effective advice as to the soil types and even the manurial treatment suitable to the crop. There may be several new crops in the future.

Finally, how do we foresters come into the picture ? From time to time during the past ten years or more, a good deal of pressure has been put upon the Commission to take on special staff to map its soils in detail. We have resisted this pressure, partly because soil survey work is such a slow job that unless we trained up a large staff for the purpose we should have planted most of our land before the surveyors produced their gaily coloured maps. A second point is that a great deal of long term and elaborate research will be needed before we could use with any confidence the soil types as a valid basis on which to make our choice of species. The farmer with his annual crops can afford to chance his arm now and then ; if he makes a mistake one year he is a wiser man in future. But the errors of the forester are more heavily penalized.

This is not to decry the value of a soil survey to the forester. I have no doubt that with better knowledge of soil types we shall be able to avoid certain errors in the choice of species which have been made in the past. But taking it by and large we have no reason to apologise for the results of the past twenty-five years of afforestation in which we have been guided as to choice of species by a combination of experience, an eye for topography, a knowledge of the vegetation, and a broad appreciation of the nature of the soils with which we are concerned.

I am inclined to think that it is in the broader field of land utilization, e.g., in providing a more objective basis for distinguishing between improvable and non-improvable rough grazing, that the greatest value of soil survey to the forester may lie.

SURVEYING AND MAPPING FOREST AREAS FROM AERIAL PHOTOGRAPHS

BY MICHAEL LONG

AS A RESULT OF THE publicity given to aerial photographs during the war, Foresters and District Officers may think that aerial photographs of their areas would solve their mapping and census problems, and the following observations apply to the conifer areas which have closed canopy in the West Conservancy of Scotland. It is not intended to lay down hard and fast rules, as photographs vary quite considerably, but the value of aerial photographs for map-making is very great.

The photographs used were taken by the Royal Air Force for use by the Ordnance Survey, on a scale of approximately six inches to the mile, using a camera having a focal length of twenty inches. Each photograph covers about one and a third square miles ; this means that the aircraft (Spitfire, Mosquito, Anson, etc.) were flying at approximately 17,500 feet above the ground.

It is impossible to classify species in a tabular form, and to apply this to all photographs, as detail on the photographs varies according to time of day, time of year and age of stand, etc. ; but on one sortie of Ardgartan Forest (Argyllshire) the boundaries between the following species were easily recognised, for the variations from white to black on the photograph represented *Abies nobilis*, Lawson cypress, European larch, Norway spruce, Scots pine, Sitka spruce, Hybrid larch, and Douglas fir. With a stereoscope (three dimensional image) a difference of height of seven feet was easily seen, and from these photographs, rides, species, density of stocking and height differences can be recognised. On Lennox Forest, just north of Glasgow, (approximately 500 acres) the following species were identified :—Hybrid larch, Sitka spruce, Sitka spruce mixed with Scots pine, Scots pine, Mountain pine, and *Pinus contorta*.

The mapping of rides, species, densities and height classes took 24 working hours, and this was made up as follows : 10 hours in the office mapping rides and differences from the photograph on to a six inch Ordnance Survey map, 10 hours ground check and 4 hours in the office completing and inking in the map. (The average size of the stands was about 8 acres). To survey this area by chain and compass, after the fringes of the stands had been brashed, might have taken between 15 and 30 days. As a rough estimate, up to 400 acres could be mapped and ground checked from aerial photographs per day, depending on the size of the stands and the clearness of the photographs.

The accuracy of this type of mapping depends on the topography of the ground. In flat or uniformly undulating ground mapping is as accurate, or even more accurate, than chain and compass survey. In rough mountainous areas great care must be taken owing to distortion, but if there are enough streams or burns to tie-in on the Ordnance Survey map, the accuracy is as great as with chain and compass surveying.

The amount of training required depends on the person studying the subject. Four or five days should be sufficient to teach a beginner the theory of aerial photography and to point out most of the difficulties which

may arise, and when he understands these principles, practical work will increase his capabilities. The identification of boundaries of species, etc., is relatively easy with good photographs ; transporting this data on to a map without the use of a mirrored stereoscope is difficult on any ground which is rough and mountainous.

The cost of the photographs is negligible ; ten photographs are required for a strip of 3 miles by $1\frac{1}{3}$ miles. At a cost of 5d. a print, this works out at 4s. 2d. per 4 square miles. Allowing for overlap of photographs, it may be as high as 8s. 4d. per 4 square miles.

Good photographs of a forest area which has closed canopy can give one a good idea of species, density of stock (unthinned, first thinning, second thinning, etc.), rides and height classes. The mapping of these can be very quick and easy with the correct instruments. In Canada and the United States, lumber companies estimate the volume of stands from aerial photographs with the same degree of accuracy as strip surveys on the ground, and it takes far less time.

WEATHER AND WORK

BY G. E. LAWSON AND D. S. MORLEY

FORESTERS ARE ALL TOO fully aware of the subject of "costs" and it is often assumed that when costs are high, labour is not doing its best or else supervision is not what it might be. That there are other factors is, of course, known, but it is doubtful if the full effect of inclement weather on output is realised. The Lake District is probably in no worse a position than parts of Wales and West Scotland, and no claim is made that it is outstandingly wet, but the following figures will serve to enlighten those Foresters who do not get, but no doubt often wish for, a little more rain to decrease their expenditure on fire protection.

RAINFALL DATA IN INCHES

The figures under "Highest recorded" and "Lowest recorded" refer to extremes occurring in any January, February, etc., over the period from 1938 to 1947. The averages were taken over the same period.

Month	Ennerdale Forest			Hardknott Forest		
	Highest recorded	Lowest recorded	Average over 10 years, 1938-47	Highest recorded	Lowest recorded	Average over 10 years, 1938-47
January ...	14.30	2.00	9.19	16.34	4.25	11.28
February ...	12.50	3.00	7.25	15.90	3.33	8.78
March ...	10.75	1.30	5.70	8.70	1.11	5.81
April ...	6.13	1.12	4.31	6.90	1.30	5.29
May... ...	8.85	1.00	4.88	9.80	1.75	4.98
June... ...	11.25	1.10	5.74	9.30	1.34	5.55
July... ...	16.99	3.70	8.04	11.83	3.50	7.58
August ...	15.40	3.65	7.77	17.00	4.42	9.15
September	12.50	3.30	7.85	13.54	1.86	8.05
October ...	19.48	2.90	9.73	19.76	4.47	10.79
November	14.50	2.05	8.76	20.47	3.39	10.64
December	14.61	1.10	8.19	15.80	3.73	9.17

Yearly Figures			Yearly Figures		
Highest	Lowest	Average	Highest	Lowest	Average
114.67 in 1938	64.60 in 1941	87.41 over 10 years, 1938-1947	122.32 in 1938	86.60 in 1945	97.07 over 10 years, 1938-1947

These figures are taken from a rain gauge at 400 feet elevation in the valley bottom and it is interesting to break them down further. At Hardknott Forest in 1945, the total rainfall was 86.60 inches. Rain fell sufficiently to be recorded on 212 days out of 365, i.e., 58 per cent. of the year. On 83 days the fall was $\frac{1}{4}$ inch or over, equivalent to 4 hours' heavy rain or about 8 hours' drizzle. The maximum fall in any one day was 1.79 inches. In 1944, when the annual fall was 99.40 inches, rain was recorded on 235 days.

There are occasions in which snow fell sufficiently heavy for instance, to cut off Ennerdale for several days, and frosts occur which make skating possible on lakes and tarns. Despite all this we fence, drain, turf, and plant, and are occasionally rewarded by a visit from Headquarters !

NEW FOREST COMMITTEE

BY D. W. YOUNG

THE NEW FOREST is a very wonderful and lovely part of the country, and whilst the first interest of the Forestry Commission in it must be as a source of timber, many other interests are involved which must receive constant and careful attention.

There has been a great deal of talk about National Parks in recent years. Though the New Forest never has been and probably never will be defined as a National Park, it has been such in all but name, almost from time immemorial. Camping has been allowed, under what the Camping Club of Great Britain has described as ideal conditions, for nearly half a century. Ever since the advent of the motor car the forest has been increasingly used as a picnicking resort and every Saturday, Sunday and public holiday thousands of people may be seen enjoying *al fresco* meals on the open heaths or under the shady trees, and yet, because the forest is so large, covering some 140 square miles, it is never over-crowded. Anyone can walk for miles through parts of the centre of the forest, often without seeing a single soul, even on these holidays.

The forest is also important as a common and, though it is still very under-grazed, the common rights are more fully used there than in any other common in the South of England.

As a nature reserve its wonders are as yet barely known. There are a few plants to be found in the forest which are not found anywhere else in the country. The same is true of insects, and as regards birds there is no other part of Britain that has so many and so wide a variety, native and migrant, as the New Forest. All of the reptiles known in the British Isles and all but one of the amphibians are to be found in the forest. Amongst quadrupeds, there are five kinds of deer, two kinds of squirrel, badgers, foxes, rabbits, hares and a variety of mice, shrews and the like, as well as other animals. These do not exhaust the interests of the forest. It has a legal position peculiarly its own, a direct evolutionary outcome from the ancient forest laws. This peculiar legal position does not ease the task of administration, though it adds to its interest very considerably.

The statute under which the forest is administered at present is the New Forest Act of 1877. It is seventy years old. During this seventy years, the population of the country has nearly doubled. The capacity of its railways has more than doubled : the motor car and aeroplane have been invented and brought to a high state of efficiency, and electricity has entered into our daily life to an extent never dreamed of. It is not surprising, therefore, that the statute has become obsolete, indeed, it has been obsolete for many years. This Act has been called the " Commoners' Charter " and everybody has hesitated to touch it for fear of being charged with some wicked ulterior motive. Life had to go on, however, and things like the widening of roads, making of playing fields and tracks, the erection of power, telephone and telegraph lines, strictly contrary to forest laws, had to be permitted during pleasure.

During the war some of the most outrageous things were done. Some 8,700 acres were enclosed and made into aerodromes, bombing ranges

and camps, with hundreds of huts, and scores of acres of concrete for runways, standings and the like. These things had to be allowed, the country being in the desperate position it was. They were none the less regrettable, and perhaps even more regrettable is the tendency of people of all kinds, counting on the precedent of the war, to seek to press their own particular schemes, often quite foreign to the nature of the forest. Organized holiday camps and motor racing tracks, for instance. In the course of years the river of legal fictions has become a flood, and the statute very much of a dead letter. The law must be reinforced but many would prefer to drift on as we have been doing rather than to lay hands on the sacrosanct charter.

One matter has cropped up, indeed it was urgent before the war broke out, which makes a new Act of Parliament a matter of urgency. This concerns the Verderers' finances. (The Verderers form an official body which controls grazing on the unenclosed forest land). When the Verderers were reconstituted in 1877 they were given half the balance of money paid by the railway company when their lines were taken through the forest, amounting to £7,017. (Verderers' share £3,508). Apart from that they were empowered to charge a 1d. rate on properties from which common rights were derived and a marking fee on every animal turned out, subject to certain maxima laid down in Schedule 1 of the Act. The rating proposal proved quite impracticable from the start, and the interest on the capital and the marking fees were their only source of revenue. The numbers of animals turned out since the 1914-18 war had been falling off year by year and the Verderers had to draw on their capital to make their yearly budget balance. In 1939 only £150 actual capital remained. They had reduced the number of agisters (men who look after the animals turned out) to two, and their annual expenses were about £570. Less than 1,800 animals were turned out and marking fees at the maximum allowed (2s. 6d. per head) could only bring in £225 a year. The position was desperate and the Verderers had sent out an S.O.S. when war broke out.

Before the outbreak of hostilities, the War Department had started exercises in the forest, however, and the compensation obtained therefor temporarily relieved the situation. When the Air Ministry took first the bombing ranges, and then the aerodromes, the compensation amounted to considerable proportions, and the Verderers were in a position to appoint four agisters instead of two, and to increase their wages as the agricultural wages increased. The end of the war, however, found them in a precarious position. It is true the numbers of animals turned out had nearly doubled, but even 4,000 animals at a marking fee of 2s. 6d. could only bring in £500, and their expenses had increased from £570 to nearly £1,500. As soon as compensation ceases they will be in queer street.

It was in these circumstances that the New Forest Committee, comprising the Rt. Hon. H. T. Baker, P.C., Lord Lucas of Chilworth and Mr. George Langley Taylor, was appointed. The Committee was given very wide terms of reference : " To investigate the state and condition of the New Forest and, having due regard to existing rights and interests, to recommend such measures as they consider desirable and necessary for adjusting the Forest to modern requirements." When they started these enquiries, the members of the Committee were surprised at the number and wide variety of unrelated problems with which they were faced ; most people who read their Report, published by the Forestry Commission in 1947, will share their surprise. The Committee's recommendations cover 33 heads and under these heads are nearly 100 separate recommendations. It will be impossible here to set out in detail more than a few of these recommendations.

As foresters, we are naturally more interested in the proposals as they affect forestry in the New Forest. The woods cover some twenty-four to twenty-five thousand acres, and can be divided into three classes.

1. The Crown Freeholds, extending to 1,111 acres.
2. The Statutory Inclosures and enclosable woods : 17,672 acres.
3. The Ancient and Ornamental Woods : approximately 5,000 acres.

The Crown Freeholds call for no remarks. There are legally no difficulties in managing them on the best technical lines.

Of the Inclosures and Statutory enclosable woods under the 1877 Act, we can only keep enclosed up to 16,000 acres at any one time, and by agreement some 1,100 acres of these are managed in an amenity circle.

The condition of 5,000 acres of Ancient and Ornamental Woods is little less than tragic. These woods date back to time immemorial. The main growing stock consists of beech and oak, most of which have at some time been pollarded. They are rough, coarse trees of the kind that Rackham used to portray in his illustrations of fairy stories. Most are over 250 years of age, and many a great deal older. Ponies and cattle have grazed amongst them for years and there is no regeneration. The gales and snow storms of every winter take toll of a large number of them. As the law stands we can do nothing about it. It is contrary to the statute to enclose them, and without enclosure planting is useless.

The Committee has few recommendations to make with regard to the statutory Inclosures. The general indication is that they should be conducted on the soundest silvicultural lines, to get back as fast as possible the growing stock after the heavy war fellings which took nearly two-thirds of their volume of timber. A special plea is also made for the practice of forest aesthetics, and at the same time it is recommended that all gates should be left unlocked and the general public given freedom to roam through the Inclosures at will.

With regard to the Ancient and Ornamental Woods, the Committee recommends that the Forestry Commission should be empowered to enclose areas not exceeding 20 acres and plant them up with broad-leaved trees. These should be kept enclosed until the trees have grown out of danger from grazing animals, that is ponies and cattle. Only four or five people have the right to turn out sheep on the forest, and these rights are not at present exercised.

The Committee makes another recommendation with regard to forestry which is rather revolutionary, that is, that the Verderers should have power to permit the Forestry Commission to enclose and plant certain areas of poor grazing value as screens against urban areas. The Committee at the same time is anxious to provide some additional source of revenue for the Verderers, and has combined the two by recommending that the Verderers should be empowered to permit enclosure to a maximum of 5,000 acres, subject to the Forestry Commission paying as compensation 2s. 6d. per acre per annum for areas enclosed in this way.

This is an unprecedented proposal and may meet with a certain amount of opposition, but there is a growing spirit of co-operation in the forest, and it is realised that to put the Verderers on to a sound financial basis will be of incalculable benefit to the commoners. During recent years increasing interest has been shown in the common rights of the Forest, and this has taken the form of concentrating on the improvement of the grazing rather than, as in years gone by, on fighting the Crown.

The Committee paid a great deal of attention to the matter of commoners' animals and devote a considerable proportion of their report to the whole subject. It makes an interesting study.

The Committee's approach to the problem seems to suggest a way in which the problem of the idle commons in this country could be tackled. The fact that there are more than 4,000 head of cattle turned out on the New Forest at the present time, while nearby commons stand almost completely devoid of any stock, is solely due to the fact that in the New Forest there are four agisters to look after the commoners' animals, while on the other commons there is no one. It is a question of finance, and if parts of a common could be enclosed against animals, but not against people, and planted, a source of revenue would be provided. It would need only some slight amendment to existing legislation, which already provides for the regulation of commons, to make this possible to the mutual benefit of the commoners and the nation at large.

The report also deals with a variety of other matters such as the preservation of the Forest as a nature reserve, camping, playing fields, town planning and roads. All this brings out the complications which seem to be associated with a National Park, with regard to which no other Government Department has the same experience as the Forestry Commission.

WHY DID THAT ACCIDENT HAPPEN?

BY A. LIDDELL

THE COMMON EXPRESSION "Things are not what they seem" can easily be turned to present us with a truism as far as accidents are concerned; so if we read "Accidents are not what they seem" we come very near to a true picture of the facts.

Accidents in industrial operations can happen through four distinct types of causes. Some come about through the lack of proper safeguards on machines; some may be due to external factors over which the worker has no control; some to negligence on the part of others; while some may be due to factors inherent in the worker himself—carelessness, inexperience, or characteristics of the worker which predispose him to accidents. It has been stated after careful scientific investigations that 68 per cent. of accidents are still traceable to the human factor. It is this very high percentage which I would now invite you to examine with me here.

A young girl farm worker, during the recent war, was asked by her psychologically-minded doctor why she had fallen and broken her leg, and her astonishingly candid reply was that at the moment of the accident she had been struggling with a certain forbidden temptation. This bears out the findings of a well-known American psychologist when he says that he finds psychological causes contributing agents in most of the accidents he has studied.

There are deep hidden wishes in each of us; there are, lying under our conscious thoughts, strong subconscious urges of which we are totally unaware. Some of these urges and compelling forces may actually result in our taking refuge in an accident. We know nothing of these desires, but they control our lives in spite of ourselves; and the tantalising fact is that we can do very little to impede their onward rush. The American expert of whom I have already made mention has stated that it is not uncommon to find a wish for punishment in the subconscious. Due to early training, some people cannot get rid themselves of a feeling of guilt, and so, actually unknown to themselves, they crave regular doses of punishment. To such people accidents are welcomed as a expiation. How many such individuals are employed in the Commission forests? Only a few, do you think? Perhaps more than would be imagined. How many accidents forced unknowingly on a worker in the forests take place annually? You can reckon that in the light of these latest investigations there are bound to be a goodly few. It has already been mentioned that there is little that can be done to avoid those accidents born in the subconscious, but that little can be put into practice. The greatest antidote known is interest. Interest stimulates attention, and the reverse of attention is absent-mindedness. This absent-mindedness, which is akin to carelessness, is responsible for many accidents. It was responsible for the death of Pierre Curie, the discoverer of radium, as those who saw the film *Madame Curie* will readily recall. The argument, of course, must not be pushed too far. It is possible to do routine activity, such as carrying out repetitive work, and have some spare mental activity left over to engage in conversation or thought. However, it is necessary to keep the danger alive in our minds, and not carry this failing to the stage of "professorial absent-mindedness."

One further cause of accidents now presents itself—namely fatigue. This should be distinguished from a healthy tiredness. It may be a new conception to look on fatigue in some cases as unnecessary, yet many recent investigations have proved that it can be eliminated by a slight change here or an alteration there. It may be found a good means of relaxation for you, noble woodmen of the wilds, to figure out what small actions or occasions have a bearing on this point.

Unnecessary fatigue may also be due to the worker's being undecided what to do next, in his constantly having to make little decisions which he finds irritating. It should be remembered that anything which eases tension and strain will help in keeping fatigue at bay.

The effect of weather in producing unnecessary fatigue is also a very real one. Workers who spend years in rainy areas may become more easily tired than others. This is due to their mental attitude becoming affected by constant bad weather. The worker here again is quite unconscious of this effect on himself.

Much has been done to reduce this incidence of fatigue ; by the introduction of systematic rest pauses the worker is enabled to recuperate his spent energy. The theory which governs this rest pause should be carefully borne in mind. It is that it may be possible to reduce somewhat the fatigue before it has accumulated to any great extent.

Side by side with fatigue goes monotony. A worker starts off fresh in the morning, but as monotony begins to take effect, his work speed slackens and output drops. But monotony will begin to disappear with the incentive of the approaching cessation of work. The factor of monotony is then very real in its bearing on the incidence of accidents. The accident curve shows a rise with length of time at work, which proves that there is a close relationship between fatigue and accidents. A decline in the curve is noticeable towards the approach of any break or rest pause.

It has been established that accidents are not always due to carelessness on the part of workers, but some workers are more prone to accidents than are others. It has been shown that accidents do not distribute themselves by chance, but that they frequently happen to some workers and not at all to others. These conclusions were reached as a result of a recent investigation carried out by the Industrial Health Research Board.

Marbe, the German scientist, has actually formulated a law. His law is to the effect that " the probability that an individual will experience an accident can be determined from the number which he has already sustained." Viteles, an American investigator, found this true of all motormen in the transportation service of the United States. Investigations are already being carried out to enable " accident-prone " individuals to be singled out. If these findings are positive, the time is perhaps not far distant when it will be necessary to transfer to safer work those individuals who are liable to be involved in accidents.

IMPRESSIONS OF A FORESTER ON RETURNING FROM TIMBER PRODUCTION

BY W. WALTON

ALTHOUGH I HAD MADE some mental provision for the changes which I was likely to find, I was not prepared for the large-scale advance in methods which met me on my return from seconded duty with T.P.D. This was accounted for in part by the fact that my posting was to a new and unfamiliar forest, but even so it was apparent that much progress had been made. Particularly was this apparent in regard to mechanical equipment, where, among a forester's other attributes, he can now claim to be a moderately skilled mechanic. Labour, too, has changed in that men do not now seek forestry as a temporary job to tide them over, but rather as an occupation which will provide themselves and families with a steady and fair income all the year round. Long overdue was the provision of forest clerks which now gives the forester more time for the technical administration of the forest, notwithstanding the fact that forms and returns have increased correspondingly. Nursery fertility is receiving a larger share of consideration than before, particularly in regard to humus content, which is now being returned to the soil in the form of compost rather than in direct application of weed-breeding farmyard manure. There are other changes, perhaps small and insignificant when performed automatically through long use, but which can be relied upon to upset a strange forester's calculations.

REMINISCENCES OF KERSHOPE TRAINING CAMP

BY J. H. PLATT

KERSHOPEFOOT CAMP, situated some 23 miles north of Carlisle and on the exact border of England and Scotland, was the first Forest Worker Training Centre to be opened in the North-West Conservancy, and came into being, after many initial difficulties, on August 3rd, 1946. This short article cannot pretend to include all the various phases surrounding the establishment and subsequent running of a camp or hostel, and it is difficult to choose from the number of things which come to mind, as to which may interest the reader most.

There have been, on a quick survey, the excitement and administrative joys and snags of the inauguration, the oft-repeated heart-raisings and disappointments over proposed improvements and amenities, the pride felt in happy conclusions to difficulties as a result of team work. And also the happenings " on the side " from the basic job of a Trainees' Hostel—such as the inclusion, in the midst of a crowd of war-scarred veterans, of a batch of young ladies from the organisation known as " Youth Service Volunteers " —then the welcoming in our midst of a complete hostel from another Conservancy en route for new and better fields. In fact—reviewing the days that have slipped by, one is sometimes tempted to wonder if those who sat in higher places realise how much has had to be cheerfully accepted or overcome in ensuring the smooth running of our minor appendage—the F.W.T.S.

For it will be recognised that the bodily comfort, welfare, and mutual understanding of the trainee's mind, for 15 hours of his 24-hour day, goes a long way to ensure the success of the Scheme. All problems arising out of Hostel or Camp administration have direct bearing on the welfare of the trainees concerned—and subsequently on the Commission programme at the other end of the scale. The problems have been and are manifold, all tending to grow to mountains in the mind of the person who has to solve them.

First arrivals were men who had seen plenty of action during the war, and had grown very used to service routine. The acceptance of a new-found freedom was hard at first, because when not in action they were used to being able to reach out for most of those things which provided amenities, such as transport, entertainments and recreation. The position now was that they had to provide these things for themselves. At first there was an apathy amongst them—with the odd exception of those few who had been repressed, and now broke out in spasms of assertiveness. These few felt that " the world owed them a living " and no higher authority than themselves existed.

The first lesson which had to be quietly taught was that of everyone's responsibilities to the remainder of the community. The more reckless souls proved of great assistance here by being allowed to have their fling to a fair extent. Soon the game of " pulling the wool over the eyes " of the Forester and the Warden grew tame. (One of the main secrets of success has been found in the close co-operation of the Forester and Warden with a healthy respect on both sides for each other's capabilities in his own sphere).

The brave ones soon looked for new thrills—and were quickly corrected in their attitude after brushing with the authorities over little

incidents such as possessing service firearms, or riding cycles at night without lights. Two examples of near-serious cases were sufficient to convince everyone of the responsibilities which went with civilian freedom ; the job on hand then was to direct their energies into other channels. Never at any time, even in the hardest weather, were they led to think that they could " pack up and go home " (to Camp) and there were good subjects at night-time for " round the fire " discussions on impromptu lines. During these discussions one found the most interesting people hidden under dull exteriors—and gained a new respect for the thinking power of quite a few.

Only a short step from this stage came the formation of a camp library—with a trainee volunteering as librarian—after which came voluntary night-school classes. The job then took a hold on those who had doubted at first if interest could be sustained.

All work and no play would soon have soured many, and the next step was to get the men to realise that here—twenty-three miles from the nearest good-sized city, and four miles from the nearest village—they would have to make their own fun. The formation of an entertainments committee was a really difficult job, for too much interference on the part of the Warden, would soon have smacked of " organised " fun. After the initial and strenuous efforts of formation, the men were gradually brought to run it themselves in the knowledge that a guiding hand regarding policy and finance was all that was to be imposed upon them. The organising talent forthcoming was surprising and pleasant. They progressed steadily to a point where to-day, under the direct control and responsibility of the Warden, they have a fully legalised club with all its amenities, including a bar. Negotiations for a sports field have been under way by the Department for a considerable period. The ex-serviceman's mind, used to bringing matters to as quick a conclusion as possible, finds it difficult to understand that the process of getting a proposal for the provision of a sports field from taxpayers' money is, of necessity, a longish one.

A fair amount of tact is required to restrain the odd rebel who will go around blaming, without discrimination, the Department and those in authority. It is of real satisfaction when his grievances can be quietly dispelled by the wisdom and careful explanation of one of the trainees themselves—and nearly always it has been found that the disgruntled one becomes outtalked by one or other of the more far-seeing trainees.

From the start of the scheme to the present time there has come about a change in the type of trainee. They are no longer mainly composed of war-veterans of long service, but consist of younger chaps who have not suffered the same severe psychological upsets of long and active service. The atmosphere begins to be more " schooly." The first-comers appeared to wear an air of quiet doggedness and semi-cautiousness over future prospects. The more recent arrivals have an air of eagerness and a quicker capacity to learn, but would appear more easily swayed from what has become the main aim of the biggest percentage of trainees, that of getting to the Forester Training School.

Apart from the possibility of the scheme providing Forest Workers, and eventually Gangers, Foremen and Foresters, one of the most satisfying results so far has been the numbers who have " found themselves again " and settled quickly and happily back into civilian life, even though in some instances this has meant that trainees have left the Scheme to return to pre-war vocations. There can be little doubt in any observer's mind that there is something about forestry, and the Scheme in particular, that offers a man the chance to settle a perturbed outlook, and gives him opportunity to get

civilian life into focus. For this very reason the writer believes that those who persevere and get through to the school are bound to prove—in the main—natural forestry men, for they have found that they are part of the life, and the life is part of themselves.

The surprising thing—at Kershopefoot at least—has been the quiet and satisfied acceptance of camp life—for the majority of the trainees have spent anything from two to seven years in Service camps of one kind or another, during which much time was spent in dreaming of " home comforts." The secret here lies, it is thought, in the removal of any rule which was either restrictive or appeared reminiscent of the Services, and the human application of any rule which had to exist.

Much could be written of the peculiarities of individual trainees, such as the man who could eat 17 suet dumplings with a three-course meal ; the man who got separated from his workmates and later arrived breathless and excited asking if foxes would attack you ; the man who, when training was terminated, demanded twopence so that he could 'phone the Ministry of Agriculture and state his case ; and to write of these and the hundreds of other humorous and sometimes tragic happenings, would provide material for several articles.

POLISH LABOUR AT KERSHOPE FOREST

BY W. WALTON

HAVING BEEN IN CHARGE of large numbers of Polish workers engaged on normal forest duties and particularly nursery work, I should like to give some of my impressions on their working capabilities.

First, Poles are not easily adaptable, so that small gang jobs like fencing are best left to the ordinary forest worker, but they do score on the large operations, like mechanised lining out, weeding and draining. On such operations they are conscientious and extremely thorough. This latter is, in fact, sometimes disadvantageous in that they carry work such as turf laying, needing only approximate distances, to such accurate excess as to require a man to return twenty yards to correct a turf three inches out of position.

In handling these men it is most essential that one chooses a good leader and interpreter who may or may not be one and the same man. Petty grievances, which are many, can usually be ironed out by reference to the latter, who should be given to understand, for transmission to the rest, the terms of settlement, which should be given plainly and firmly. Piece-work quality and quantity compares favourably with the average British worker.

POLISH LABOUR AT GREYSTOKE

BY F. H. GUTHRIE

IN APRIL, 1947, it was decided to utilize Polish labour. Obviously the greatest difficulty was the language, and some very amusing incidents arose in the early months. On one occasion four of these Poles were erecting Nissen Huts when one of them came up flourishing his pocket dictionary and proudly pointed to the word "Tongs." It was some little time before I realised he was referring to spanners.

These Poles have nearly all come from different occupations, but two or three were employed on forest work in Poland. I had occasion to employ these men recently on Scots pine thinnings, and was surprised to see the very high stools of one to one-and-a-half feet which they left. As their knowledge of the English language had improved, it was possible to sift some of the reasons for this apparent waste. It appears that in Poland, when felling Scots pine or any pine woods, high stools were left and the bark peeled off to ground level. The wind and sun quickly dried out the stools. These stools were then left for two or three years, after which they were prised from the ground, collected together and the ends eventually sent to factories where resinous properties were extracted and the waste wood used for smoking bacon. With other species the ends were utilised for parts of cart wheels, axles, etc. The discarded roots were then collected by the peasants for fuel.

When the ground was replanted, a square turf was taken out every three feet, but instead of planting on the turf, the plant was inserted in the hole, the reason being that Poland has extremely hot summers and experiences very little rainfall, and what moisture there is collects in the holes.

A striking feature to the Poles here is the length of the grass and the number of drains. Very short grass and only occasional drains are found in Poland. I am told that each year until a tree attains the height of 5 feet or more, the soil is loosened round its roots. These Poles came from the pre-war Russo-Polish frontier, so this may not be the general practice throughout Poland. Species planted include Scots pine, Norway spruce, and beech.

In Poland before the war, wages paid to Forest workers employed by the State were 18s. per week, or 3s. per day for adults. This consisted of a six-day week, with no half-day on Saturdays. In addition there were no paid holidays. I am told the hours were 8 a.m. to 5 p.m., but understood in the first instance they were much longer.

Apparently there were many square miles of magnificent forests, their expression being that it takes three men with arms outstretched to girth the tree. They have very few rides, and large quantities of deer and wild boar are present. I am assured stags of the red deer are colossal, often as big as a horse. During the winter, which is usually very severe, the snow being from three to five feet in depth and lasting from 5 to 6 months, the deer are preserved by being fed with hay. Once every four weeks it is the custom of the forestry workers to take part in a deer shoot, the venison being ultimately sent to factories to be tinned.

In conclusion, here are a few items regarding social life in Poland. Although villages in Poland are considered larger than ours, there are no dance halls and no buses run from the villages to town. Boys and girls must be 18-19 years old before they are allowed to attend dance halls or cinemas. School attendance is for a period of seven years. Pre-war, cigarettes cost 7d. for 20, eggs fifteen for 1s. 3d., and suits varied from 10s. to 15s. each. Alcoholic drinks were considered very expensive. A bottle of whisky cost 7s. 6d. !

THE GERMAN FORESTER TODAY

BY G. B. RYLE

THE GERMAN FOREST and Wood Department (*Forst und Holzwirtschaft*) had, until 1945, been very closely controlled from a highly bureaucratic headquarters in Berlin, with General Göring, its nominal head, as *Reichforstmeister*. " He may have been our chief " I was told by a senior officer, " but he was not a *Forstmeister* : in Germany we are very jealous of the word *Meister*, which means that a man is complete master of his profession." With the partition of the country into the four Zones of occupation control, *Forst und Holz* lost its headquarters ; and because Zonal government of any Department was prohibited, the break-up was even more drastic. In the British Zone the Service was further split up into four Provincial entities, which were later reduced to three to correspond with the *Länder* of Schleswig Holstein, Hanover, and Westphalia-North Rhine.

The British occupation brought to the decapitated *Forst und Holz* a welter of new problems which sorely tried its efficiency and sadly exposed the weaknesses of a department which had suffered from over-centralisation and over-organisation. First came Field-Marshal Montgomery's order for " Operation Coalscuttle." The Ruhr coalfield was a shambles indescribable in thoroughness. The railway system was a tangle of twisted rails and burned-out trains. Winter was approaching and unless fuelwood could be brought into the towns immediately, disease, starvation and death would stalk the country.

It cannot be said that *Forst und Holz* excelled in this, its first big task, under the guidance, the pressure and the nursing of the British forestry administration. Plenty of magnificent forest was devastated and plenty of prime sawmill logs were split up into fuel wood. Meanwhile plenty of greatly inferior logs continued to be sent into the German mills for conversion into equally desperately-needed timber. In distribution, too, the Germans did not show great organising ability. The countryman and the villager had a comparatively cosy winter while the city dweller had to go into the black market for his woodfuel, or had to freeze.

By May of 1946 it was becoming evident that fuelwood supply would again have to be organised on as big a scale for the next winter, and the chief forest officer (*Oberlandesforstmeister*) for each Province was told to make his preparations and to begin early. Their general attitude, actually put to me in words in one case, was " Leave it to us and do not interfere : we will see that the goods are delivered." Throughout the summer they played experiments with root-grubbing or blasting, they cut into prime forest growth and built up their stacked cubic meters (*raumeter*) of cord-wood (square sawn both ends, staked and cross-tied so as to be exact in volume to the nearest centimeter). Deliveries into the towns had hardly begun by October. The rough forest growth, the derelict birch woods and (admittedly valueless) birch firebreaks were untouched. They complained of haulage difficulties but they did not concentrate on the roadside trees and woods. The manner in which they utilised the lop and top from timber and pitwood fellings was, however, a joy to see. The portable glorified chaff cutter which took all branchwood from four-inch down to the smallest twigs and spewed out centrifugally graded kindling wood chopped to about seven-inch lengths, was delightful.

It was not until the first frosts of winter 1946/47 descended and until British pressure made itself felt, that they really began to get the fuelwood business going again. Early in December, when the River Elbe was flowing down in slabs of ice twelve inches thick and as big as a house, we counted one lorry in three, and one horse drawn vehicle in two, to be the average ratio of transport engaged in fuelwood haulage.

The British export target and the employment of thousands of Displaced Persons, ex-prisoners-of-war, and finally of British troops under "Operation Woodpecker," brought another problem to *Forst und Holz*. They started by trying to measure every tree as it was felled, but our haulage was too fast and many logs had gone before their foresters arrived with their callipers and tapes. Also neither they nor the British Officers would always know from week to week whether the produce was going to be converted at the dumps for export, or for the Ruhr mines, or for the native pulp industry. It was difficult for their forest records, and one felt genuinely sorry for them because their statistics had been such models of accuracy for generations past. (Nevertheless I was surprised to see that they still use Yield Tables by Schwappach, more than half a century old).

Do not think that we were robbing the forests without paying. All timber exported to the United Kingdom was credited to Germany at world prices, based on the quantity actually shipped. All props or pulpwood sent to German consumers were paid for by the recipients at prices agreed between German and German through the aegis of the counterpart of our War Damage Commission (*Kriegschädensfestellungsbehörde*). Similarly, if we arranged to fell a privately-owned wood (*Privatwald*) or a Town forest (*Stadtforst*), arrangements were made for *Forst und Holz* to agree its value between the owner and *K.S.F.B.*, either by measurement standing or from existing forest records. Who pays whom between the Germans is entirely their own affair : all that is of importance for us is to ensure fair credit for any timber *leaving* Germany. If a rail wagon is robbed in transit, as very many are, it is their loss and a matter for their police.

In Lüneberg, where the writer did most work, the rate of forest devastation was considerably higher than elsewhere in the Zone. It was easy, flat, dry country. It was close to the port of Hamburg and to several delightful little places on the Elbe where loading wharves were constructed. It contained thousands of Displaced Persons from the Baltic countries, and above all we had an excellent team of keen officers, many of whom were permanent Forestry Commission men. We did not treat seriously the plea from the *Burgermeister* who warned us that trees breathed out health-giving oxygen, and that in our depredations we would starve the population, already lacking in food, of the very air they breathe ! We were not over-perturbed at the fears expressed that we were making them fell lime trees (one small avenue for their own fuelwood) and thereby ruining the honey harvest. Nor did we greatly worry about the proposal that we would convert Lüneberg Heath into (*a*) a barren dust basin or (*b*) a miasmic swamp. The reasoned arguments put forward by the *Landesforstmeister* that extensive clear fellings were going to render regeneration unnecessarily difficult were, however, worth listening to and we agreed that so long as the total supplies were not thereby reduced we would allow them to reserve a scattering of shelter or mother trees, or a network of shelter belts, in many of the pine forests. We had to disregard their own selections in plenty of instances, as they naturally marked all the best butts for reservation ! The principle, however, was a sound one and we gained considerably in co-operation thereby.

It had been agreed, too, that we should refrain from felling any of their registered stands of seed-collection trees. When I requested production of the register, I was presented with a typed list compiled by Forests, compartments and age-classes. The total area was astonishing and in many cases they included areas wherein we were already organised to start felling. On asking for the *original* register I was told (Oh ! their blue eyes can look so innocent !) that it had been destroyed in a British air-raid. It was subsequently learned that the list was a compilation of *all* the First-quality woods of eighty years old and upwards, to be on the safe side. There was no ill-feeling on either side when it was suggested that a revised list might be submitted. Anyhow, the quantities of seed the Lüneberg foresters use in their re-afforestation sowings could certainly be halved without detriment. Nearly all their work is done by direct sowing and one wishes we could do it with as little difficulty, and with such uniformly good results, in this country.

In nearly every case—though there are splendid exceptions—one can tell whether a forest is privately owned or otherwise, by its condition. Most of the smaller private woods are badly thinned or un-thinned, un-brashed and irregularly stocked. State control is almost limited to fixing the volume of the annual timber allocation to be supplied to the trade. The larger private forests employ trained foresters and compare well with the State or the Town forests.

Fire protection is not now at a high standard of efficiency. In a country where the whole population loves its forests, the fire risk has never been high. It is far worse now because of our own troops and the many wandering people of numerous nationalities. One is sorry to have to mention the first.

The German foresters have been peculiarly isolated from the rest of the world for a considerable time. We have been criticised for dismissing many of their best men under the de-Nazification policy. Knowing the status of the *Forst und Holz* staff in the eyes of the people, it is clearly vital to ensure its resuscitation free from all party taint. *Forst und Holz* has been severely disrupted by the war and its aftermaths, and while its reconstruction is a matter for them to organise themselves, we, both as the occupying nation and as foresters, will watch their development with interest.

Perhaps we have a further responsibility. Their executive authority *vis a vis* the timber trade and the consumers, is being handed back to them : their forest schools are re-opening and their apprentices are being posted to study their profession under selected *Forstmeisters*. Herein for a long time to come we must ensure that the Service becomes a clean one. Discipline by fear of denunciation must go. Political favouritism and nepotism must not be permitted to return. As we, and much of the rest of the world, have originally shaped our Forest Service largely from the old German teachers, so should we now help to give them back that which Nazism took from them.

WHAT O. & M. MEANS

BY E. C. SHANKS

"ORGANISATION AND METHODS" (shortened in the current fashion to "O. & M.") is the designation given to a division of the Treasury specialising in applying to the Civil Service the principles of scientific management, or rather of scientific method in management. The best results are obtained when these principles are understood and applied to all operations, whether taking place in the field or in the office. One of the clearest statements of the aims and practise of O. & M. is given in a Report to Parliament in August, 1947. This states :—

> "The purpose of O. & M. in the Civil Service is to secure maximum efficiency in the operation of the Government's executive machinery ; and, by the expert application of scientific methods to organisation, to achieve economy in cost and labour. The operations of the O. & M. service, although not directed primarily to securing reductions in staff, almost invariably result in the more economical use of staff. O. & M. is an advisory service ; recommendations resulting from a review are a matter for consideration by the Head of a Department and for adoption at his discretion."
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> (*Fifth Report of the Select Committee on Estimates, August*, 1947).

O. & M. operates sometimes on the grand scale. The Rt. Hon. R. G. Casey, on his appointment as Governor of Bengal, called for O. & M. experts, who in the course of their inquiries :

> "found every conceivable sort of anomaly and bottleneck. They found that quite unrelated functions had been added to departments for reasons that may have seemed good at the time, 100 or 50 or 25 years ago ; but which just did not make sense to-day. They recommended a completely new set-up of departments, with duties allocated to each on a logical and functional basis. They recommended demolition and rebuilding of offices, more space and light, more office mechanisation, fewer and more relevant returns. In fact, they showed clearly and logically that the whole administrative machine in Bengal was 50 years out of date—and they recommended how it could be brought up to date."

The methods used by the O. & M. specialists who were engaged in this enquiry, were described in these words :

> "Their first question when they tackle a new enterprise, whether it is an industry or a Government Department, is : 'What is this show required to do ?' They quite properly insist on getting this down precisely in black and white. They then subject the head of the enterprise and the head of each branch and section to critical cross-examination as to his functions and how he carries them out, including his relations with the man above, and the people below, and the people on each side. They almost inevitably have considerable difficulty in getting individuals to be precise, particularly in the case of an old-established enterprise or department. When they have gone right through an organisation in this way they have a pretty good idea as to what it is all about. They then sit down with all the evidence

they have patiently collected and see what improvements they can work out. The flow-sheet of responsibility and authority is the main frame-work. When that is settled to their satisfaction, they deal with the location of typists pools, registry, telephones, messenger and despatch services, returns, accounting and all the rest. They examine all returns and reports, and endeavour to ensure that only the facts and figures that are really needed are made the subject of returns. They investigate the mechanical aids in use and whether more office mechanisation is justified and, if so, what sort. They investigate and report on the lighting, ventilation, sanitation, rest facilities and all else that has to do with the comfort and convenience of the employees. When all this patient and painstaking enquiry is carried out by intelligent individuals who have done the same sort of thing a great many times before in a wide range of activities, they are able to recommend changes that make a notable improvement in the smooth running and effectiveness of the enterprise under examination."

Origins. O. & M. is a continuation of development in management which has been evolving for at least the last fifty years. The " father " of scientific management, F. W. Taylor, although he had had a scientific academic training, started as a workman at age 22, and was promoted gradually until he became manager. In the 1890's he was evolving and applying in the United States, with outstanding results, revolutionary developments in the management of industrial concerns. " To find the one best way " was one of his many ideas. Up to 1939, however, there was no great interest in scientific management in this country, but a number of pioneers were spreading the gospel and were extending the groups and publications concerned with the subject, and were indexing the available information.

The mobilisation of industry—more complete than in any other country—during World War II, brought home to this country the fact that output per man could by scientific management be considerably increased. The interest in scientific management was widespread and maintained, and miracles of production were achieved. The present vital necessity for increased output to pay for our imports is continuing the search for means to increase PMH—production per man-hour. And to the nation, that is to all of us, increased PMH is vitally necessary not only from the export industries but from each and every one of us—from you and me. Some of the American's open mind for better methods is reflected in his country's amazing industrial performances. The British magazine *Business* (Feb. 1948) published a statement of the estimated output per worker in U.K. and U.S. in twenty-nine leading industries. In 28 the U.S. figure is from 10 to 448 per cent. more than that for the U.K., and only in one (fish-curing) is the British figure better. This large discrepancy is reflected in many ways. For instance, a standard 60-watt lamp costs 1s. 9d. here, but in the U.S.A. it costs in effect one seventh of that (10 cents which is equivalent in purchasing power to about 3d.). The present leading position (industrially) of U.S.A. was not attained suddenly, but was a result of a year by year search for improved organisation and improved methods, each successive improvement widening the lead over the " good enough for my grandfather, good enough for me " folk. The search for better methods becomes a geometrical progression. Just as one officer may, by adopting a better idea, step ahead of his slower colleague, he is thereby more likely to appreciate the even better idea when it turns up, and this would make him two steps ahead.

O. & M. in the Civil Service. Soon after World War I, the Treasury delegated an officer to study office machines and to suggest their use where appropriate

in the Civil Service. Early in World War II it was realised that ideas were more important than mere knowledge of machines.

Recruitment for the new Division—Organisation and Methods—was mainly but not entirely from outside the Civil Service—from industry and from the industrial consultants (who advised commercial concerns on a fee basis). Much good work was done, and Parliament through its committees has on several occasions pressed for a considerable extension of the work. Recruitment of those suitable for the work is the main limiting factor and, quite early, a training section was established to give selected recruits an introduction to the general aims of O. & M. work ; it being stressed that this was only to start them thinking and that the course would have to be supplemented by further reading and experience.

In addition to the Organisation and Methods Division of the Treasury, most large Departments now have their own O. & M. branches allied with Establishment under an Officer whose title is now to be widened to " Establishment and Organisation Officer." the " organisation " aspect of O. & M. work is the more important but " methods " (the study of procedures in detail) has a very high importance. Consideration of the one aspect is almost impossible without entering the other.

Objectives. The aim of O. & M. can be stated as the more effective use of human effort. There is probably no finality for this drive, but it is endeavouring by improving co-ordination, i.e., better organisation, and by eliminating waste of effort or material (which amounts to the same) to carry out the purpose of an undertaking at the minimum of cost.

If there is faulty co-operation vertically or horizontally in the organisation, effort is being wasted. If there is insufficient foresight, insufficient planning, insufficient co-ordination or insufficient control, there is likely to be further waste of effort. It is often difficult to diagnose troubles affecting an organisation, and though long experience in that organisation may help an executive to indicate at least some of the troubles, a specialist with either experience outside that organisation or alternatively with training in the principles of O. & M. (and preferably with both types of knowledge) is indicated.

Actual experience in the O. & M. type of work does develop an ability to quickly diagnose weaknesses in organisation or in procedures. A colleague who had very many years experience as an industrial consultant had this quality quite markedly. Incidentally, this officer, like most of us, had his idiosyncrasies, and one of these was his method of expressing savings in work. In some cases it is possible by producing a summary document to cut a load of work : for instance, to substitute one summarised invoice for ninety unit invoices. Each document may at a later stage be the basis for a cheque, an enclosure note, an envelope and several entries, etc. This saving of eighty-nine invoices etc., was expressed by my colleague as an 8,900 per cent. saving ! ! He would say that the necessary load was " one " and that any actual load must be expressed as a percentage of this.

Doing the Job. How does our specialist set about his work ? A brief description of the steps he takes may assist an understanding of the philosophy of O. & M., though it will be appreciated that the technique of individual operators may vary. On the general aspect, however, there is fairly general agreement that the service should be advisory.

The first step is the agreement of broad terms of reference, in order to define fairly clearly the scope of the enquiry. It is not always possible to do this precisely, and sometimes as the assignment proceeds it is necessary

to widen the original terms of reference or even to narrow the scope of the enquiry. The work has then to be planned, again roughly and subject to modification as the work proceeds. The next process, that of collecting and recording facts, is of the utmost importance. It has been described as " an extended personal enquiry on the spot " and each element of that phrase is carried out. Facts are to be recorded, not opinions nor pious hopes (such as some written instructions tend to be). The facts are recorded at first hand, i.e., from the man on the job, and the result of his work is followed through (from him backward and from him to final completion). All relevant facts are collected but no unnecessary detail.

What is collected ? The essence of O. & M. work is to get back to first principles, and accordingly the initial job is to establish the objectives of the unit, organisation or procedure. Not only the intended objectives, but also those as revealed by operations. The two do not always coincide. Similarly, the organisation's structure and the duties attached to posts are recorded (and similarly both " official " and actual). The relevant procedures are recorded, possibly with charts in order to assist the later analysis, and again perhaps there will be in addition a statement of loadings. If you analyse office work it can be resolved into the handling of a number of items or cases. If this number were to be doubled you might expect a call for more staff (that double " load " may not necessarily require twice the staff). As a rough measure, a figure of work loads is therefore usually given, but there is a possibility that this may not be evenly spread. In other words, there may be peaks, and staff, equipment, etc., have to be provided to clear the whole load in that peak period. To make a balanced record of the work involved, yet other details may be given such as staff and grades, equipment by types, trends, timetable of operation cycle, etc.

Theoretically, the next step is the analytical examination of what has been collected. In actual practice this tends to be carried out concurrently with fact collecting. The enquiries on the spot, and the following through of the work, are continually provoking thought on the part of the investigator, especially as he will by reason of his background be aware what minimal controls, checks and basic records would be broadly required. There will be a great deal of fitting together of all the information assembled, of getting it into the right perspective, of assessing the high lights and relegating the trivialities. Some of the questions asked at this stage will be :

Why must it be done ? Can it be eliminated ?

What makes the work necessary ?

When could it be done more economically ?

Where could it be done more economically ?
Check for duplication.

Who is the proper person to do it ?
Skilled or unskilled ?

How should the work be done ?
Layout. Accommodation. Equipment. Method.

So far the work on the assignment has been relatively passive. The next stage is synthesis—the active development and formulation of proposals. It may be difficult to see the wood for the trees. Probably the best way to arrive at a solution is to forget temporarily what has been seen, to get right away from the environment of the work and from the organisation. Then with the objective in view, one starts from first principles and builds on the basis of the minimum necessary. This synthesis is tested and rejected until a sound solution is found. Even so this is temporarily left and an endeavour

made to get another sound answer as different as possible from the first. Even a third solution is sought in the same way. The constant aim is to think in a straight line, eliminating hunches and prejudices. Parallels inside or outside the Service may assist.

It is unwise to assume that the answer is a mechanical contrivance. It is the basic method which is important, and whether the volume justifies a machine is another consideration. It is, however, desirable to give good control and measurement features, to assist day-to-day operation and to provide comparisons and checks. Normally any solution is well discussed before it reaches report form, but sometimes the report conference is a means whereby both the solution and the method of its presentation are checked.

In writing of "solutions" and "reports" I may have made some anticipation; but it does not, of course, mean that invariably there is a solution, i.e., a method better than the present one. Nor does it mean there will always be a report. It may be that the solution can be put into operation without a formal report or without even a memorandum on the subject. A report has, however, many advantages; it is concrete, it leaves no basis for misconception. It is a record for the future and a basis for any actual installation work.

A report would be in clear and concise terms and impersonal. It usually consists of (a) Introduction (and terms of remit); (b) Analysis of facts found (with detail in appendices); (c) Conclusions drawn; (d) Recommendations; (e) Concluding section.

Installation. Provided therefore that the full facts have been ascertained, the correct conclusions drawn, a logical solution offered and that all this has been presented in a well-reasoned report—and provided that the advice has been accepted—the next step is that of installation, a most interesting process and one demanding full concentration. The O. & M. report has dealt with—and rightly so—only main principles. In the course of installation of the new method (or organisation), however, a number of points usually arise, and though of secondary importance (or even less) they require prompt decisions, often before the main work can proceed. The very bringing forward of these subsidiary procedures, etc., for consideration, usually results in simplifications and improvements. In the majority of cases the new procedures (main and other) are soon running smoothly.

The Effect. And what is the result of this intensive work? The O. & M. investigator usually comes to a section which is hardly pressed. He claims some skill in his vocation but apart from that he is, in effect, an addition to that section and he does work—objective thinking—which those immersed in the day-to-day routine would like to be able to deal with—if they had the time. The O. & M. man's main concern is broad principles, i.e., to achieve the purpose of the unit or procedure in the most economical way. This re-thinking usually improves the standard of execution, but often in addition both economises in staff (and overtime) and gives those on the work increased checks on accuracy and a greater sense of achievement and pride in their work. Don't we want more of all those to-day?

ORGANISATION AND METHODS IN A CONSERVANCY OFFICE

BY T. FARMER

THE SUBJECT NOW commonly known as Organisation and Methods is no new one but has long been a matter of considerable concern to management. Recently O. and M. has been gaining in prominence and status, both within and without the Civil Service, virtually as a new science. The importance of O. and M., emphasized by the man-power problems of the War and the present crisis of under-production and full employment, has been publicly acknowledged. The Civil Service authorities have also recognised its value and have set up a special Division of the Treasury to further O. and M. throughout the Service. The new accounting system in the Forestry Commission is an example of what O. and M. can do, and it may be of some interest and value to review such activities in one Conservancy office since the reorganisation on 1st January, 1946.

Organisation and Methods—the order of the words is significant : the organisation must be settled first before the detailed procedures are worked out, although admittedly the methods to be adopted may have some direct influence on the development of the organisation. It may be safe to assume, therefore, that in our new Conservancy offices the emphasis so far has been on organisation, but will now be changing over to method ; this has been the case in the particular office whose experiences it is proposed to review.

The position in West Conservancy office in the early spring of 1946, before the expansion really began was briefly as follows :—

Staff : Conservator and District Officer for Private Woodlands
No Divisional Officers
One H.E.O. and one H.C.O.
Five or Six Clerks
Three or Four Typists

Organisation : Accounts Section (including Plants, Forest Produce, Stores and Mechanical Equipment)
General Section

Accommodation : One five-roomed office

State of Work : The Account was up to date and well organised. The Accounting Clerks knew their work and their duties were divided " horizontally " rather than " vertically " to avoid specialisation (i.e., each clerk was responsible for nearly all the work for a group of forests instead of specialising in one aspect of the work only).

The General Section was attempting to cope with the great variety and volume of other clerical work and was barely succeeding in " keeping the ball rolling." There was urgent need for organisation and a proper division of duties.

Filing System : There was a mixture of " Forest " files and General " Subject " files ; but the system designed for the pre-war Divisional office was already inadequate for the new Conservancy office and, owing to many changes of staff and consequent lack of continuity during the war, was in bad order. Complete revision was an urgent necessity.

By the end of May, 1946, the H.E.O. and H.C.O. who had been posted temporarily to the West, were replaced by two officers of equivalent grades who had recently returned from about six years service with H.M. Forces. It was decided that the H.C.O. should assume responsibility for the Account and all relative work, while the H.E.O. should undertake the reorganisation of all the other clerical work, recruitment and training of new staff.

Before the process of reorganisation is described, it will be useful to consider in general terms the functions of the Conservator and his H.Q. staff, and to define the principles on which the reorganisation was planned. Briefly, the Conservator and his H.Q. staff are responsible for receiving policy directions from higher authority : for interpreting and transmitting these directions to subordinate executive officers ; for supervising and controlling the subsequent action ; and for providing the necessary co-ordination, services, supplies, guidance, etc., to enable the subordinate staff to carry out their tasks : and secondly, they are responsible for collecting, examining and collating returns, reports and accounts submitted by subordinate staff for onward transmission to higher authority. Since the variety of work was so great and the volume likely to increase, the following decisions were taken as to organisation :—

(*a*) Work must be divided up into homogeneous " blocks."

(*b*) The staff must be divided into sections on a functional basis.

(*c*) Routine duties must be devolved from the Conservator and senior members of office staff.

(*d*) The filing system must be revised on a " subject " basis and rendered capable of indefinite and orderly expansion. Owing to lack of staff for purely registry duties, and the probability of badly divided office accommodation, files should be de-centralised to office sections and not held in a central registry.

After securing the necessary additional accommodation, the first step was to deal with the filing system.

Accordingly, all files were grouped into fourteen roughly homogeneous sections (e.g., Accounts, Stores, Establishment, Plant Supply, Estate, etc.), and were re-numbered accordingly. A prefix number indicated the File Section Subject, and a second number indicated the actual File Subject. For example the Establishment File—Subject " Cycle Allowances " is numbered 5/62, 5 being the Establishment File Section prefix, and 62 being the index number of the individual file. All accounts, stores and other appropriate files were then allocated to the existing Office Accounts Section under the H.C.O. Accountant. This was accomplished and operating by the end of June, 1946. Then the recruitment of new staff made possible the training and setting up of a new Establishment Section under an Executive Officer responsible for all establishment, training and education matters. The appointment of a Conservancy Labour Officer made this section complete, and it was operating smoothly in a separate two-roomed sub-office, with a copy typist permanently allocated from the typing pool, by the end of September, 1946.

In August, 1946, the posting of a second H.C.O. enabled the creation of an Estates Section to deal with all Forest Workers' Holdings, Small Tenancies, etc. The imminent devolution of the considerable volume of estate work from the Land Agent in Director's office at 1st October, 1946, rendered the creation of such a section urgent. This was achieved in time to accept the devolution in reasonably good order. The new section operated well from the start and succeeded in maintaining continuity, but in view of the seasonal nature of the estate work, particularly as regards farm management and rent collection, the full year to 1st October, 1947, had to elapse before it could be claimed that the Estate Section, working to an out-stationed Estate Divisional Officer, had been able to cope satisfactorily with all the duties allotted to it.

The new accounting procedure was introduced as from 1st October, 1946, and involved a fairly large-scale devolution of work from H.Q. Finance Branch to Conservancies. This inevitably led to a great deal of hard work and readjustment in the Accounts Section during the ensuing quarter. The new system, several unfortunate losses of trained clerks, incidence of sick leave, and the rapid increase in the amount of mechanical equipment in the Conservancy, led to the Monthly Account falling into arrears in the first month or two of 1947. Overtime had to be resorted to, and it was decided to devolve from the Accounts Section proper all work concerned with stores, plant supply, vehicles, and mechanical equipment. A subsidiary Stores Section, supervised by the Accountant, was set up to deal with this work for both the forest and estate branches of the Conservancy. This step was in accord with the long-term policy of making the Accounts Section a common-service for the whole Conservancy, responsible for purely accounting and costing functions. Accounts Section was gradually to be relieved of responsibility for determining what should be paid and how it should be costed. The other sections were to examine invoices and certify for payment (for example, Establishment Section deals with motor car and pedal cycle allowances, workmen's compensation, calculation of F.W.T.S. allowances, checking of pay sheets as regards the *rates* of pay, etc. Stores Section would check invoices, obtain certification, deal with stores ledgers, and attend to " Standard Heading " before passing to Accounts Section for payment. Estate Section prepares rent demands, posts rent ledgers, checks and " standard heads " receipts for sales of livestock, wool, and other farm produce).

The Stores Section is still evolving, but became more independent in the summer of 1947 after the appointment of a second Executive Officer to the office and the posting of a Divisional Officer (State Forest), to whom the section is also responsible for certain clerical work such as plant supply, forest and nursery records, etc. The section might now be more aptly named " State Forests Records and General Stores Section."

The typing section was increased to a total of five—three shorthand typists and two copy typists—and this number has proved adequate. The section functions on a combined " pool " and " allocated " basis ; i.e., each typist is permanently allotted to a particular officer or section as required, but otherwise works in the pool.

There is a central registry and despatch office for dealing with incoming and outgoing post, but apart from two or three of the fourteen file sections, the files are de-centralised to and held by the appropriate office sections concerned. In practice the registry clerk assists the sections with the filing away of papers, and operates a resumption or bringing-up service on a centralised basis. The appointment of an Office Messenger and a Switchboard

Operator was indispensable, particularly in Glasgow where there are two offices in one building, four floors apart, and a third office in another building about 100 yards away.

A mappist was appointed to undertake tracing work, copying of maps, etc., and also the work of registering, indexing and recording movements of maps. This Map Section still requires organisation, probably as a common service so far as State Forest and Estate branches are concerned. Private Woodlands Maps and Engineering Branch plans are at present held separately within the two office sections concerned. A measure of centralisation may be possible at least so far as the practical work of the mapping staff is concerned.

So far as the future is concerned, the following points are under consideration :—

(a) Does the Divisional Officer (State Forest) require separate whole-time office assistance ? Or can the common-service stores section meet his needs without the difficulties of divided allegiance arising ?

(b) Should the clerical work in connection with forest produce continue to be dealt with by Accounts Section, or should it be transferred elsewhere to maintain the " neutrality " and purely accounting-costing functions of the section ? In considering this question it has to be remembered that the Accounts Section may expand with the development of the Dedication Scheme (depending on whether or not the Conservancy will be responsible for payments), and that further work would be thrown on the section if the Conservators were made responsible for Conservancy Engineering Branch Accounting.

(c) How is a possibly rapid expansion of clerical work in connection with the Dedication of Private Woodlands Scheme to be coped with ? At present the District Officer (Private Woodlands) has the part-time services of a shorthand typist-clerkess, but additional Clerical Staff will undoubtedly be required and should be recruited and trained *before* the work accumulates and not after.

As regards " Method," it is only now that the Chief Clerk is finding time, and heads of office sections are sufficiently experienced in their work, to undertake detailed examination of the various methods and procedures. A certain amount of revision and improvement has been achieved, chiefly where co-ordination and liaison between sections were necessary.

It may be of some interest to describe one or two procedures in detail, and at the same time to consider the respective roles of the Conservator and the Chief Clerk in the hierarchy. The Conservator is ultimately responsible for all activities within his territorial charge. The range of activities is very wide and diverse, and while the Conservator's functional and specialist assistants work to some extent direct to their respective chiefs at Headquarters (Director's Office), nevertheless the Conservator must be adequately informed on all aspects of the work and be in a position to co-ordinate and strike the balance between the various functions. The Conservator should, however, be relieved of as much detail as possible and all cases referred to him must be " served up on a plate " by the appropriate officer.

The Chief Clerk's role is difficult to define but, apart from the general duty of relieving the Conservator of all worries in connection with the paper work, is largely one of office management and co-ordination. He will be responsible in general for supervising the work of the five common-service sections of the office (Accounts, Stores, Establishment, Registry/Despatch, Typist Pool). He will also be responsible for ensuring that the

technical heads of branches are supplied with the office assistance they require, and for co-ordinating from the clerical point of view the work of technical sections (Estate, Private Woodlands, Engineering Branch, etc.), with each other as well as with the other common-service sections.

Bearing the above principles in mind, the following procedure has been evolved for dealing with in-coming correspondence. It will be noted that in the main the flow of papers after receipt, registration, and sorting is from the bottom up.

(a) *Correspondence from Higher Authority (Director and H.Q.)* : This is opened personally and read by the Chief Clerk, who then marks individual papers to officers or sections concerned in order of priority, indicating (i) the file reference where possible, and (ii) to whom they must be referred respectively for action and for information. The papers are then registered. Papers of an original nature on important or policy subjects the Chief Clerk takes to the Conservator personally, and subsequently leaves with Conservator for his action, deals with himself, or routes to other officers or sections for action. Replies to Conservancy correspondence on important or policy subjects are related to their respective files and previous correspondence, before presentation to the Conservator by Chief Clerk. Papers of a routine nature are routed to the appropriate officer or section for attention and attachment to the relative files, and they may then be passed *upwards* through office staff to technical heads, and even to Conservator, for information or decisions.

(b) Correspondence from other conservancies and the public is dealt with as at (a) above.

(c) *Correspondence from Conservancy staff.* This is opened and sorted by the Registry Clerk. All papers from District Officers are read by the Chief Clerk and routed by him for information or action to the appropriate officer or section, where they are attached to the relative files and dealt with or passed upwards for attention as necessary. All correspondence of a routine nature, returns, accounts, etc., are routed by the Registry Clerk to the appropriate office section in the first place. It is the section head's duty to see they are related to the appropriate files and that senior officers or other sections are informed or consulted where necessary.

It is considered that this system effectively relieves Conservator and technical heads of detail, while ensuring that direction from above is interpreted and disseminated *downwards*, and matters of importance from below are filtered *upwards*.

It should be mentioned that all outgoing correspondence is signed by or for the Conservator who is ultimately responsible for the contents. All incoming correspondence, unless clearly marked "personal" is regarded as addressed to the Conservator, although a special marking such as "for attention of D.O. Estate" would in practice be dealt with accordingly.

In conclusion it is suggested that steps be taken to co-ordinate the development of O. & M. in Conservancy Offices, and that both visits by Senior Officers from Directorate and H.Q., and regular meetings of Conservancy Chief Clerks be arranged to this end. The desirability of uniformity for control purposes, inter-change of staff, and general efficiency must be obvious.

OFFICE MANAGEMENT

BY L. A. CHAPLIN

OFFICE MANAGEMENT—something everyone of us benefits from or suffers under, according to individual circumstances, but who can define the term really satisfactorily ? To me it is the stock-in-trade of a Chief Clerk in the same way as any specialist officer has his stock-in-trade. But what a difference in the method of acquiring it, and for that matter, dispensing it ! On the one hand years of practical and specialised academic learning with text books to fall back on when rusty patches occur, and on the other, just the hard school of experience after a general education and the acquiring of a Civil Service Certificate. It is a matter for debate whether a course of training in general principles of organisation and methods would be beneficial. Common sense allied with experience is just as valuable when coping with everyday occurrences, whether it be the situation caused by the office cleaner leaving the immersion heater on full all night, or devising means of getting three people's work done by two bodies.

The basic principle of office management, whether it be a war-time office where urgent necessity governs method, a mixed military and civil office in an occupied country where improvisation is the only method, or an office expanded beyond recognition embarking on an uncharted future which is tied to certain regulations, some antiquated and some not fitting the case, is the same—*team spirit*. The specialist must be tactfully reminded that office work is necessary—evil or not—and the office staff must be kept aware that they must serve the needs of the specialist. Let us have a system, but if the system is not sufficiently "elastic," the system must be adapted to meet those needs. Clarity of purpose greatly assists good management—let us be certain that we can see the wood and the trees.

FOREST ROADS

BY MAJ.-GEN. H. W. P. HUTSON

IN THESE LEAN post-war years the preparation of a comprehensive forest road plan may seem a matter of little moment. Projects, in these days, no matter how austerely conceived, are liable to be "cut," and "cut" again. Knowing all this a forester will probably be disinclined to give much of his time to the preparation of very long term road plans. None the less, I would counsel him to do so. In our present circumstances, a complete plan is more than ever necessary, so that if reductions are required they may not become mere haphazard slashing, achieving the immediate saving, but perhaps, by slashing in the wrong direction, at a cost which will be regretted later. A plan of the whole system is wanted as the outline of what is desirable, and into it the bits and pieces which become practicable are fitted, each a definite part of the full structure although built individually.

Just as the forest working plan serves as a control for a succession of separated tasks, so there must be an overall plan for roads. In making the plan, the first step is to decide the basic data upon which it should be calculated. We must know what mileage is required for the proper roading of a forest, and at what stage of its growth the roads should be constructed. An examination of the road system in the German forests, coupled with calculations of savings in haulage costs, indicated that five miles of road per square mile of forest would be suitable, and since the prime purpose of the roads to facilitate extraction, it is clear that every forest of twenty years growth ought to be roaded. The basic data thus obtained, the plan is merely a matter of arithmetic. To-day we have about 147 square miles of forest over 20 years old, this means 735 miles of roads wanted at once. A further 620 square miles are planted and will be in need of roads—3,100 miles of them—within the next 20 years ; so we have a total of 3,835 miles required by 1968. This means working at an average rate of 192 miles a year. In addition, there is the annual new planting, say 78 square miles, calling for 390 miles of roads, and bringing the total annual requirement to 582 miles. In some places roads will exist already, and to allow for this we will reduce our total by 20 per cent. This leaves about 450 miles of roads as the minimum annual programme over the next 20 years.

Whatever mileage financial restrictions permit us to build, can be apportioned between Directorates according to their respective quantities of high priority work, and their facilities for carrying it out. Ultimately the problem is presented to the forester, who will have to decide which parts of his forest road plan he will pursue, and which parts can be left out with the least disadvantage. His problem will be simplified if he is able to consult a previously worked out complete road system for his forest. Sections can be placed in order of priority for execution ; more often than not the controlling factor in settling priority will be the volume of timber to be extracted, but other issues will require consideration as well—time saved by reducing lorry mileages, quicker turn-round by improved going, lower fuel costs and maintenance charges by smoother travelling. It is only by weighing up these and similar factors for the various alternatives, that the forester will be able to make wise decisions as to the location of the limited lengths of roads he is in a position to build.

What part does the engineer play in the forester's planning? The forester will put his requirements to the engineer, a road from A to B, with say the following forestry considerations : guarding against opening a forest to wind, the provision of a collecting depot for produce, or access to a group of holdings. Nearly always there will be items such as these which will influence the choice of alignment. To meet the forestry considerations may mean deviating from the soundest route from the engineering point of view, and it is the duty of the engineer to point out the implications of such deviations, and particularly the differences in cost. A warning may be advisable here. It is not only the costs of construction which have to be taken into account, but also those of subsequent maintenance ; in road-work the latter will often be of predominating importance. For example, whilst a short stretch of steep gradient might save a considerable length on an easier slope, it might, none the less, not prove more economical owing to the extra work required on the steep section to guard against scour and also to prevent slipping by vehicles.

The best results will be obtained when the forester and the engineer are each thoroughly conversant with the other's point of view. Only too often does one find, to take a very prevalent example, a conflict over specification. From the forester comes pressure for something lower. It is inspired by the pursuit of cheapness and thereby of a greater mileage. The engineer resists. He is fearful for the safety of his road, and is unwilling to take chances.

It is felt that the factors underlying the problem may not be properly understood. It is the soil beneath the road, the sub-grade, as it is called, that carries the load, and the necessity for strengthening this is generally inescapable. There are various methods of effecting this ; you may either reduce the wheel pressure transmitted to the sub-grade, or you may directly strengthen the latter. The former method is effected by the provision of a stone base laid on the top of the sub-grade, and the thicker the base the greater will be the reduction of wheel pressure. The second method, by which the sub-grade itself is strengthened or stabilised by the addition of other materials, gravel it may be, and by compaction, will generally be preferable. In either event, the sub-grade, either as it exists or strengthened, will have to be protected by drainage against loss of bearing capacity through the penetration of excess water. Now, provided that the supporting power of the soil has been properly assessed, the engineer is bound by certain definite limitations in his specification, and should he recommend less than these he would be failing in his duty. Although the engineer cannot claim precision in assessing the supporting power of the sub-grade, he is none the less, by reason of his training and his experience, the expert, and as this assessment is his responsibility his judgment should be accepted.

Many forest road plans include a proportion of roads classed as fair weather only ; the proportion varies enormously depending on individual opinions as to their serviceability. In this country dry periods cannot be counted on to be of sufficient duration to dry out a fair weather road to the proper extent. This type of road will, of course, carry its load only when dry. Its use at any other time would damage or destroy it. It will be evident, therefore, that in this country the fair weather road will have a very limited serviceability.

This is not to say that there is no call for a cheap and quickly constructed road. On the contrary, it is needed very badly. Unfortunately this is not easy to attain ; the answer may lie in a waterproof earth road. This is possible now, where only wheeled traffic is required to use the road,

but the process does not provide a surface which will stand up to the passage of tracked vehicles. Since earth is the commonest engineering material, a solution of this problem which makes use of it would clearly be attractive.

In conclusion, the engineer staff in the field now forms part of the Conservancy organisation, and the forester and the engineer, both there to serve the needs of the forest, will find that working as a team they each have their own parts to play in the evolution of a sound forest road system.

TIMBER EXTRACTION OVER CLAY SOILS

BY J. F. CLARK

DURING MY SEVEN YEARS with the Home Timber Production Department, I found that the extraction of timber to the sawmill proved the greatest worry. In Norfolk, Suffolk, Cambridgeshire, Northants and Bucks, the extraction was over heavy clay soils. Drains had been neglected and coppice in places covered the extraction routes. In Bucks, one wood had really good rides for extraction and I found that they had kept like this for nearly 40 years. They had been treated with clay burning, known in Cambridgeshire as "Ballast Burning." This was done as follows :

First plough up the ride which is to be burnt and give it time to dry. This should be done in late spring or early summer as the work is more easily done during the summer months.

Commence by lighting a fire with brushwood or faggots, then add oak tops, or other good hard wood which may be available ; when well alight add some slack or small coal. When the fire is going well start forking or shovelling clay clods on top. When a layer of clay about 12 inches has been added, then another layer of wood and coal should be put over that, repeating the process alternately. If the fire shows any tendency to erupt, keep piling clay on the vent to stifle it and so prevent the heat escaping.

Quite a large conical heap can be made and the fire kept burning for a week or longer until the whole mass has been completely burnt. Afterwards leave it to die down and cool before spreading it to the required thickness on the ride. This should be 6 inches or so in depth. Two or three heaps can be kept going at the same time.

THE RESEARCH ENGINEER

BY W. H. GUILLEBAUD

THE APPOINTMENT OF Mr. T. Kneale as Research Engineer fills the long-felt need for an engineer who will devote his time to the study of the mechanisation of forest work. It is a vast field covering the mechanisation of nursery and planting operations, fire protection, timber extraction and transport, as well as sundry items such as cone collection and peeling machinery.

Mr. Kneale was first appointed in January, 1947, as Plant (Machinery) and Stores Officer, working under General Hutson. He took up his new duties as Research Engineer on March 1st, 1948, and is attached to Directorate of Research and Education.

It is obviously impossible to cover the whole field of mechanisation at once, so after reviewing the various projects in hand at the moment, as well as the many suggestions for development that have come forward from time to time, the following provisional programme has been drawn up :—

1. *Projects actually in hand.*

   (a) Design and production of a small sulky for extraction of thinnings.
   (b) Design and production of a wheeled hoe of the Planet Junior type for weeding transplant lines. These are in hand and prototypes are being made at the Chirk Depot.

2. *Major Projects*

There are various operations on which a great deal of time and money have been spent in the past. Ploughing is one such project and lining out in nurseries another. Before any further developments can be planned, it is clearly necessary for the Research Engineer to investigate the existing types of machines and their performance. The sand distributors used in some nurseries for covering broadcast seed beds are a minor project in the same category.

This is long-term work from which results will only gradually emerge. In addition there is a large field for work on the handling of produce, including the question of type of vehicle, development of chutes, cableways, etc., and the use of simple hoisting equipment.

3. *Other matters needing attention in due course.*

These include : (1) Steam sterilization of nursery soils.
(2) Development of tools for weeding plantations and for brashing.
(3) Seed collection.
(4) Machines for peeling posts and props.

The preliminary action needed is a review of existing types of machines.

GRIZEDALE FOREST AND ESTATE

BY W. J. RAVEN

GRIZEDALE IS ONE of the most interesting forests from an estate management point of view, and probably one of the Commissioners' most pleasant units. This 6,000 acre estate, situated in the Furness area of Lancashire and on the southern fringe of the Lake District, is usually approached via the small and interesting township of Hawkshead, a friendly little place with narrow streets and quaint old houses, which is associated with the poet Wordsworth and with Beatrix Potter who wrote many charming books for children. Incidentally, there is an excellent small hotel which should satisfy the most discriminating traveller. It is quite an event to stay in Hawkshead, the tenants on the estate who want something have an uncanny knack of tracking you down ; the old builder who knows all the answers lies in wait for me first thing in the morning, and the garage man not only pours in petrol but also friendly abuse on my head (and the Commission in general). His language and dialect are most fascinating.

As one approaches the forest from the direction of Hawkshead you climb up a steepish hill, and then the Grizedale valley gradually unfolds itself as you descend the road which runs right through the centre of the estate. The greater part of the property was purchased from the late Mr. Brocklebank who owned Grizedale Hall. This is a residential property of considerable size which housed prisoners during the war, but which is now in the process of being restored to the lessees who run it as a holiday home. A part of the extensive range of outbuildings is at present occupied by the Ministry of Works direct labour force, who are building our new houses in the valley at somewhat staggering cost.

The estate is about five miles long but it is not very broad, two miles would be the average. Coniston Water lies on the west side and Esthwaite Water to the east, with Windermere not far away. Seven farms stretch down the valley, but one has been broken up and two more are coming into hand this year. This presents an admirable opportunity to reorganise the boundaries, to plan permanent farm units, and to allocate plantable land.

In the centre of the estate lies the village of Satterthwaite, which is very tiny and consists mostly of F.C. property. It is an ideal village from the community point of view as it has a church, and public house, and a school, not very far away. It is therefore reasonably possible to build round this community and form a forest village. There are six new houses already being erected and more will probably follow at a later date. I should like to see Grizedale developed as a model forest estate, for which I think it is well suited. The local people are keen, progressive and ably organised ; they run a Sports Club, hold various social events, produce a news sheet, and are now interested in the possibility of converting and equipping a building for a village hall. This proposal is at present being worked out ; the Education Authority may make a grant, and I have made provision in the planning scheme to allocate a field for sports and recreational purposes. If this scheme materialises it is hoped not only to hold dances, social events and similar functions but also to have evening classes and lectures in various subjects, including forestry. The opportunity is great and I hope it will not be lost.

The administrative centre is tending to move out of Satterthwaite into the Grizedale Hall locality which is about 1½ miles to the north. Here the Forester has a good office, and a house just opposite is being prepared for his occupation. There is also a sawmill which is being equipped with new machinery, and in due course we hope to have a joiner's shop to house our estate carpenter. The Ministry of Works are in the process of building four new cottages not far from Grizedale Hall, and we are developing this locality as well as Satterthwaite. The general scheme is to develop the village centre at Satterthwaite, with secondary development at Grizedale Hall to the north, and at Force Forge at the south end of the estate ; and this, together with a few outlying tactical cottages, will provide for the efficient working of the property and yet not lose the advantages of the community group.

Altogether we have fourteen houses at present being built ; this includes one tactical pair which occupy a lovely position on the shores of Coniston Water. Amenity considerations are inclined to be very troublesome in the Lake District, although we have not encountered any serious difficulty at Grizedale. Strangely enough, traditional type cottages were designed here to fit in with the landscape, but after discussion it transpired that the Societies concerned with Lake District preservation actually preferred the " Rural Airey " because of its simplicity. They are to be roofed with the local green slate which is very attractive, but I am not sure that I share the view that the " Airey " is the most suitable type of house.

The history and nomenclature of Grizedale is interesting. All the Furness lands originally formed part of the territory administered by the monks of Furness Abbey, which was a noble building until it suffered destruction at the hands of Henry VIII. The Grizedale valley used to be heavily wooded and still is to some extent, although wartime felling was extensive. It was the hunting ground and timber forest of the monks, and there is still plenty of wild life, including red deer. Woodland industries such as the making of bobbins, basket making and charcoal burning, thrived here until comparatively recently, and still continue in the neighbourhood. I hope we shall live to see it a first-class timber forest, and whatever the opinion of amenity organisations, there can be nothing nicer than a well-ordered forest on the slopes and thriving agriculture in the valley. If we are left to work out our own problems, I think success is round the corner, but there are rumours of land transfers to the Ministry of Agriculture and this might prove unfortunate.

It is interesting to note that Lawson Park, which is a fairly recent acquisition on the western side of the estate, was one of the three original sheep farms of Furness Abbey. The Herdwick sheep which are common to this district are probably the hardiest breed in the country. They are said to have originated from a Norse ship wrecked on the West Cumberland coast, and they have a habit of depasturing on the stormy side of mountains which saves them from being overblown by snow. One of our farms in the Duddon valley (not Grizedale) is said to have possessed the first flock of Herdwick sheep, and the tenant always maintained that they had an extra rib, but I never had the chance of verifying his story. The Duddon Valley is not far from Grizedale, and Eskdale which is adjacent contains the famous sheep farm of Butterilket which is also F.C. property. David de Muncaster granted this farm to the monks of Furness Abbey in exchange for another farm, so it also was once included in the abbey dominions.

The Norse settlers colonised the Lake District and many of the local names are of Norse origin. Grizedale is derived from " griss " which means a pig, and swine pasturing was a common practice in this area in days

gone by. " Saetr " is another Norse name, meaning a sheiling or summer grazing; " thwaite " is a very common word and means a field sloping to a flat, or a piece of reclaimed ground, and it was probably applied to any clearing in the original forest. " Beck " meaning a fast-moving stream on a stony bed, and " fell " which is a mountain or upland, are other examples of old Norse words in common use.

When descending that valley road I always feel the pride of ownership, which since I am not the owner is perhaps rather a queer thought, but nevertheless excusable in view of all my plans for the future. It is an interesting and absorbing task to plan out the forest estate from all angles, not just the forestry alone. The Estate Officer's task is not entirely one of bricks and mortar, contracts and lettings ; a little local knowledge goes a long way and helps to provide for the well being of the Estate and the people who live there.

FOREST HOUSING

BY W. J. J. PORTLOCK

HOUSING IS A very important factor in the fulfilment of the future vast forest programme, for houses mean labour. Unfortunately the land to be afforested is situated in places where local labour is practically unobtainable and consequently has to be imported. Naturally, one cannot import numbers of people without providing houses and social amenities, especially as such labour cannot remain on a temporary basis. In the initial stages the difficulties may be overcome by providing hostels and camps, but this form of accommodation is exceedingly temporary, and after years of war, families do not wish to be continually separated and feel the need of a permanent home. This subject is best treated under the two heads of new houses and adaptations.

NEW HOUSING

In North-East England Conservancy some 3,000 to 4,000 houses are contemplated over the next fifty years, which programme is to take the form, in many cases, of complete new villages with all the amenities that normally go with a village extending up to 350 houses. Other forms will be community groups, i.e., smaller numbers of houses either on their own or linked to existing communities, and in a few cases tactical houses, i.e., houses built on a site selected for a specific purpose such as forest protection.

Of the proposed village sites one of the largest, and that with the highest priority, is to be at Stonehaughshields near Wark, Northumberland. Others will be at Kielder Castle—ultimately 200 houses, Plashetts and Mounces Hall—100 each, Comb—200, Chirdon—100, Catcleugh, Redesdale —120 ; besides several smaller ones of 50 to 100 houses.

The houses proposed are to be of traditional type (i.e., not prefabricated), and as can be seen the whole question is of long-term policy. Much unseen work has to be done before the first brick can be laid, such as preparation of a well-planned scheme, obtaining clearances from the Ministry of Town and Country Planning, other government Departments and local authorities, and ascertaining if a selected site has an adequate water supply and drainage facilities. Where the water is drawn from a river or burn, the installation of a purification plant may be necessary, whilst drainage schemes sometimes require pumping stations.

The architectural features have been left to the Ministry of Works and a nominated architect, and in most cases a well-defined plan has been produced, using either semi-detached or terrace houses, zoned at eight to ten to the acre. Accommodation provides two rooms down, three bedrooms, bath and usual domestic quarters. As to the cost, this varies according to site, but as most sites are entirely undeveloped with no existing sewers and water mains, these have to be provided, with correspondingly high costs. The total cost of each house averages between £2,000 and £2,500.

ADAPTATIONS OR CONVERSIONS OF OLD HOUSES

This form of housing usually provides good and adequate accommodation either as a temporary or permanent dwelling. There have been

seven such adaptations in this Conservancy during the year, all providing for bath, hot and cold water and indoor sanitation.

The planning of an adaptation is in some ways more difficult than planning for a new house, as one is limited to certain existing factors, such as size, height and architectural features and, therefore, one has to plan accordingly. On the other hand converted houses often give larger rooms than present-day new ones, as the size of new houses is at present restricted. On the other hand, they often lack certain essentials in modern buildings, such as damp-proof courses, and while the provision of same is not impossible, it would be very expensive ; to overcome this difficulty the rendering of the walls internally with water-proofing cement has proved quite satisfactory. Owing to the high costs of new building, even old properties that were scheduled for demolition prior to the war are now very often worth converting ; and compared with new building conversion is reasonably cheap, ranging from £500 to £1,000 per house.

Providing the main structure of any old building is not beyond repair, one can normally convert the property to a reasonably modern building. In the case of small cottages it may mean adding a lean-to structure in order to provide for bath and larder. Water supplies, or lack of these, may cause great difficulty, as many of the old cottages depended upon a spring or well and the level of the spring or well may be such that it is impossible to take a piped supply by gravitation. One is then forced to look for a fresh supply or consider some form of pumping arrangements. Outbuildings also are capable of conversion provided they are of such a size as to give reasonable accommodation.

EDMUND BURT AND HIS LETTERS FROM THE NORTH OF SCOTLAND

BY JAMES FRASER

IN READING THE GENERAL Scottish history of Burt's time, the early eighteenth century, very frequent references to his letters are found, and these references are sometimes found repeated in papers on forestry. It appeared that a careful examination of everything that Burt has to say about the Scottish woods might give some idea of forestry conditions in the parts of the country which he knew well.

Burt's "Letters" consist of twenty-five letters written in the year 1727 and a twenty-sixth letter written in 1736. He came to Scotland in 1725 and, according to the account given by Sir Kenneth Mackenzie, appears to have remained in the Highlands of Scotland up to 1741, when the British Treasury administration of the Seaforth Estates ceased. Sir Kenneth suggests that it is probable that Burt continued to have employment connected with the Highlands right up to 1745, although he probably did not continue to live in the Highlands after 1741. Burt's chief duties were connected with the administration of two of the unsold forfeited Highland estates, and in addition he had certain other administrative duties to perform under the supervision of General Wade. He was a civilian employee of the British Treasury and had no military rank. His duties "gave him every opportunity of observing the population of the Highlands north of Inverness, but did not take him into the region where the roads were being made, except on his occasional visits to the South." Burt was created a Justice of the Peace in Inverness, and the appointment was strongly resented by the local justices. The appointment was doubtless necessary for his administrative duties and he had no illusions about his popularity in the Highlands, and probably he had little cause for friendly feeling towards the Highlanders.

Burt's letters were published first in 1754; he died in 1755. At this present date, when a forester reads the letters and remembers the long interval between the first letter and the publication, it appears strange that Burt did not take the trouble to reconcile the various statements which he made about the Scottish woods. The letters, however, were written to a friend who appears to have thought of Scotland and Scotsmen very much as Burt did. They were not written for foresters. In general, he is so discreet with regard to the exact districts of which he writes that the value of his remarks is very much decreased. He is not equally discreet in his remarks about the people, and is very free in his comments on the morals and intelligence and behaviour of the Highland people. Although in his preamble he carefully qualifies the general application of his statements, there is little doubt about his general opinion. He appears to have set for himself certain high standards of the correct official attitude towards his recently reconquered countrymen, but it is very evident that he found the greatest difficulty in maintaining these high standards. In his judgment of the behaviour of the Highlanders and of their affairs, his own lack of consistency is just as blameworthy as the inconsistencies which he condemns.

The parts of the country in which he appears to have travelled are :—the Great Glen from Inverness to Fort William, the side valleys of the

Great Glen, Glen Moriston and Glen Garry, the Black Isle, a small part of the Strath Spey region, and a small part of Ross-shire to the north and west of Inverness. He knew also the country on the line of the military road south from Inverness, and had a slight knowledge of the east coast road from Edinburgh to Aberdeen. He appears also to have had a second hand acquaintance with Strath Glass and its side valleys. To Burt the heather-clad hills of Scotland were particularly repulsive when the heather was in full bloom, and the ice-polished tops of the hills reminded him of scabbed heads. In fairness to Burt it may be remembered that in his time no correct tourists' standard of scenic beauty had been established, and that he was probably a very honest man. His personal attitude towards the conquered Scots was the attitude of most of his countrymen of the time.

His statements about woods and trees are very contradictory and, although he had discovered early in his Scottish travels that Scottish townships looked most attractive at some distance, he did not learn to value Scottish woodlands in that tolerant way, even for short periods of time. With great joy, he relates the discussion between one of his fellow countrymen, an English officer, and a Highland laird. The officer was unwilling to exchange a single apple tree in his native Hereford for the whole of an extensive Highland estate. Again, in speaking of bird life of Scotland, Burt explains the scarcity of many species by the absence of trees in which the birds may build their nests. His knowledge of bird life may have been a trifle shaky, if one draws any conclusions from his remarks about ptarmigan and capercaillies.

Burt is somewhat severe on the work of an earlier author in which attractive plantations of Scotland were described, and he suggests that the enthusiasm about the plantations only goes to show the rarity of other woods. Salmon, in his work, tells of how Wade's military workers at Fort Augustus, Inverness and Fort George were held up in 1725 owing to non-arrival of timber from Norway. One must remember that at that time there were reserves of timber in Glen Garry, Glen Moriston, Strath Glass, Cawdor, and Strath Spey, all within fairly short distance of some of the military works. Nairne, in an interesting account of Scottish forestry written in 1893, records that in 1665 " a ship of prodigious bigness, for bulk and burden—never such a one had been seen on the north seas—was built at Inverness from fir and oak wood supplied from Dalcattack by Lord Lovat." That forest is now part of the Commission lands. Burt was also aware of certain timber cruising work that had been carried out by surveyors sent out by the Admiralty, and it appears reasonable to suppose that he might have had access to the reports, if he had wished. He makes somewhat disparaging remarks about Aaron Hill, who was one of the enthusiastic promoters and supporters of the timber producing schemes of the York Building Company, and who is credited with the development of efficient rafting of timber in the Spey. Burt did forecast the probable financial failure of such schemes as the Company developed in Rothiemurchus, but the failure was not due to lack of timber but to careless and extravagant working. Burt might have studied Hill's methods of timber extraction with some advantage to his chief. In letter sixteen, Burt refers to the only one fir wood which he had seen, and his visit to Glen Garry has been referred to above. It is not easy to identify the one wood to which Burt refers. The description of the visit to Glen Garry was given to demonstrate the unreasonable behaviour of the Highlanders to the English company who had negotiated a sale of timber for smelting of iron brought from Lancashire.

On the other hand, when Burt writes of the cattle lifters, he refers to the woods in which the raiders hid the cattle, and when he describes the building of roads over bogs, he describes how the work was done with the

trees of the country ; in the description of deer drives, further mention is made of the Scottish woodlands, and ptarmigan are said to feed chiefly on the tender tops of fir branches. When he enlarges on the difficulties of his travels, he complains of entangling woods. In his description of the miserable housing of Inverness, he tells of how the planks in the ceilings and partitions of the houses show round bored holes. Those, he states, had been made to allow the planks to be tied together and drawn away by horses from the place of sawing. He must, therefore, have known of the sawing work and of the woods. The holes referred to were plugged up, but the plugs dropped out as the wood dried. The statements are hard to reconcile and in no place does he give any idea of size or extent of woods, or sizes of timber growing in the woods. The most useful information about the woods conveyed in the letters is that about the great difficulties of transport. The accounts given of the carts and horses and harness are good and it is difficult to imagine how timber of even moderate size could be drawn from the woods. Scarcity of horse feeding and a high death rate of the Inverness horses did indeed provide a cheap way of feeding the beagles kept by the garrisons !

Short references are made to the woods at Culloden, which Burt says were established by sowing and were protected from hare damage by drystane dykes. Some of the Culloden woods may have been sown but there is evidence that others were planted. He does not hide his opinion that the woods to his way of thinking were of very moderate importance. Burt states that around Inverness there were no rabbits to be found, and as times for the men of the country were hard, it is easy to believe that the statement is accurate.

Although the letters are of interest and are intensely amusing, especially to the men of North Scotland, they give very little information that is of value to a forester.

Lest it should be concluded that only Englishmen were liable to give distorted and one-sided accounts of the woods of Scotland, attention may be directed to the essay written by Brigadier Mackintosh of Borlum in 1727. His statements were equally misleading with regard to the existence of Scottish Woodlands of his time.

ONE JUMP AHEAD

BY J. P. LENMAN

THE ACCOUNT WAS SEVENPENCE OUT. The Accountant could not find it. Neither could I, but being a Chief Clerk would not, of course, admit it. All the way back to the office the problem of whether to round seven invoices down a penny each or slip a surreptitious sevenpence into a suspense account had occupied my mind. Passing the Public Assistance Board Office, I spotted, with the corner of my eye, a country-looking character frowning at the elegant brass door plate. He had a bunch of twigs in one hand and was worrying his whiskers with the other. It was the red face that stopped me. I had seen one like it before. I went back and cautiously enquired if he was looking for some place. Oh! Yes. He was looking for the Forrrestrrry Commishun. Ah well, I knew where that was—and I knew the Conservator was out. Going down the street the information was casually drawn that the bumps on the twigs seemed to be caused by " beasties " with red heads. He had a box of them in his pocket and had come all the way from Strathdon to find out about them.

Fortunately, I had not only studied this aspect of forestry in theory, but I had some practical experience as well and knew what to do. From the other side of the street, I showed the gentleman the Forestry Commission door and passed the next three quarters of an hour going quietly round and round the counters and the accounts problem in Woolworths. When I got back the Accountant was no further on with the sevenpence and had been more or less insulted by an awkward visitor who would not believe that any official in charge of the Forrrestrrry Commishun could be so ignorant in so vital a matter as the red-headed " beasties." I said it was a pity that I had had to go to the Bank ; repeated the Chief Clerks' chestnut that clerical staff nowadays didn't know anything about forestry ; and hinted that he would have been better off at an evening class than crucifying Ko-Ko with the local amateur opera company.

Since everyone knows that Conservancy Chief Clerks know more about everything than anyone else, perhaps the reason for this machiavellian performance should be told so that Juniors will (—very unlikely) take heed.

The story goes back a bit to my first year or two with the Commission. Chief Clerks knew even more then. I, as a Junior Clerical Officer, had received the same kind of hint as the Accountant got and was attending a Forestry Class.

Insects were troubling me. They all looked (—and still look) alike to me and the more I looked the more identical they became. The Chief Clerk had no trouble. You apparently counted the wings and counted the legs and with this combination looked at a book he had—and there it was.

About three o'clock that afternoon, in came the never-to-be-forgotten red face. It belonged to a Colonel from Glenbuchat with a mustard hat and a green suit. He had a matchbox with an insect that, in its millions, was eating up his home-made nursery. Was there anyone in who could tell him about it ? The Chief Clerk, in injured silence, held out an open palm. The animal seemed dead enough and I watched with almost professional interest as the Chief Clerk held it firmly with the thumb and forefinger while he picked at its back with a knife. I supposed that he was going to count the

wings. Anyway, they were stubborn and suddenly the body fell off the legs. There was a vain grab at the body and the legs were lost. That didn't shake *us*, however, and the mustard hat and green suit was firmly told about expecting identification of a dead body like that. He could come back if he cared, but he must bring several specimens—alive—in a box with holes. I was lucky enough to get him out before he exploded, and was solemnly warned when I came back to learn a lesson and count the legs first in similar circumstances.

Next morning in came the Chief Clerk with a huge reading glass, a pair of tweezers and an old book with the picture of a billious-looking butterfly on the front. Later in the day, sure enough, back came the Colonel with a box full of holes and a suspicious look.

The table was cleared and the reading glass and tweezers placed convenient for the right hand. The Chief Clerk was superb. He listened at one of the holes and smiled approvingly before sliding the box open. All I saw was a shower of leaping black pellets. One of them landed with a bound in the Employees Insurance Column of the paylist I was checking. I might have got it but the Chief Clerk also arrived with a bound—but he landed in the Net Amount Column—and we both missed it. The Colonel meantime had spied an individual still browsing in the box and had shut the lid on it. And still the Chief Clerk held his poise. One was enough. He more or less inserted an eye inside the box without opening it, and, having located the survivor, he ultimately got it on to the white blotting pad all right, but it was awkward because all that could be seen of the animal was its head waving backwards and forwards under his thumb. That was no use for counting wings and legs ; and there, two feet away, was the most threatening red face you ever saw. No wonder, of course, after all the trouble it had been put to collecting the specimens, to say nothing of the time and twice 14s. 2d. spent on bus fares. The tension broke as the Chief Clerk obviously hit on a solution. He pulled out his knife and with much relief and a little malice sliced off the protruding head. It gave one wobbly roll and was about to essay another when it was disdainfully flicked off the table, out of the path of science. The Chief Clerk then picked up the glass and leisurely removed the thumb.

Just as leisurely the insect took a full-blooded jump and disappeared in the same general direction as the head.

The row that followed was positively primeval, and when it had raged down the corridor and out the front door, the Chief Clerk, who had also been in the army, identified Glenbuchat, the Colonel, and the Colonel's "fleas"—and I learned what to do when I came down the street the other day.

P.S.

I know a story like this about a Technical Chief, but my own head is wobbly enough as it is.

J.P.L.

ADVENTURE ON HORSEBACK

BY W. J. RAVEN

I WAS DESPATCHED one day to make an acquisition survey of a remote tract of land in a comparatively strange district. I did not feel particularly enthusiastic, as my map indicated that not only was the area a large one but also wild and inaccessible. Not that this is particularly unusual in the North Country, but it did seem that the job was rather a " grim " one. I enjoy wild country and there is nearly always something of interest to find, but I do like company, and to me the loneliness and isolation of acquisition work is its worst feature.

The weather was poor, and it being mid-winter I only had four hours of daylight left by the time I reached the furthermost point to which I could drive a car. My worst fears were confirmed and I had about five miles to walk before I could reach my destination. Armed with the inevitable soil borer and a wad of 6-inch ordnance maps, I set forth on the last stage of my journey. The carrying of a soil borer and ordnance maps must be a highly developed art ; they are certainly very disturbing factors on acquisition work. I have carried maps folded in the pocket, rolled up under my arm, stuck in my belt and probably several other ways as well, but the result is always the same when you want to open them out. They wrap themselves round your body, between your legs, they flap about and not infrequently disappear " down wind " for thirty yards or so before you can catch up. I mention this just in case anybody who sits in a nice warm office with a big flat-top desk should wonder why he has to look at some dirty scraps of paper covered with crude pencilled designs and dirty marks.

The first day's work was rather disappointing. I cursed everybody and everything, and thought of " jeeps," " aeroplanes," " bren gun carriers " and other forms of locomotion which I felt sure could be used as an alternative to this foot-slogging and weary task. That evening I made the acquaintance of a farmer in the local inn. I soon learnt that he was a Forestry Commission tenant but detected no sign of hostility, and we had quite a friendly talk. I told him of my troubles and before we parted he had offered me a horse for the following day, which offer I gratefully accepted but not without anxiety, as I do not remember sitting on any sort of animal before except a donkey at the seaside.

The next morning was fine and the day looked promising. After breakfast I enquired the way to the farm and my farmer friend was waiting for me with what he described as " a nice quiet mare."

I found it awkward to attach the maps and soil borer to my person, to say nothing of the day's rations. Eventually I strapped a haversack on my back and the soil borer as well, and by the time I was all ready I felt rather like an alpine guide. With a few brief directions from the farmer I set out on my journey, and I must say he seemed a good deal less worried than I was. The mare plodded away, sometimes she walked and sometimes she trotted and sometimes went a bit faster still, but she was a very independent creature, and more often than not if I gave her a whack she would stop altogether and eat some grass. This habit was particularly disturbing, but she was quite indifferent to my presence on her back, moreover I think she

had a sense of direction to a certain neighbouring farm which I did not wish to visit, and it was not easy to keep her pointed in the right direction. Whatever her faults she certainly knew the ground all right, boggy patches were always avoided and I do not think she ever once stumbled, even though it was rough going in places.

I completed the outward journey without any difficulty until I reached the gate which gave access to the "inbye" lands and homestead. I leant down to close the gate and felt something snap which turned out to be the girth. I reached the homestead, on what was now a very insecure saddle, thinking I would obtain assistance from the tenant, but I had forgotten that the premises were unoccupied. After locating the stable I tried to lead the mare inside but for one reason or another she was most reluctant, and so I resorted to alternate pushing and pulling and after about ten minutes the manoeuvre was successfully completed. I found a few handfuls of hay scrapings which I thought might be welcome, but she eyed them with positive disgust so I shut the door and departed. Concentration on my task was not too good, I wondered what I should do about the saddle and even had fears that the mare might break out of the stable. However, she was still there on my return, so I packed my haversack with maps, thermos flask and other oddments, secured the soil borer to my back and led the mare out of the stable, whereupon she immediately made for the nearest patch of grass and started to have a good meal.

I tried to fix the girth with a piece of string but it was woefully insecure and each time I attempted to mount the saddle slipped. Darkness was approaching and I was quite anxious to start the return journey, so I manoeuvred the mare alongside a stone wall with the idea of scrambling up the wall and leaping on the saddle. As this would obviate the necessity for putting my foot in the stirrup, I thought I stood an even chance of keeping the saddle and myself on top of the mare. I tried this once or twice but every time I dropped the reins and made haste to scramble up the wall, so did the mare move away a few paces to a patch of grass. However, my efforts were at last rewarded and I landed fair and square in the middle of the saddle. After she had recovered from the shock we trotted off quite nicely on the homeward path.

The gate started the trouble once more, we passed through all right but as I bent down to shut it, the saddle gradually began to slip and I could not stop it. The mare realised that all was not well and decided to increase speed and within twenty yards I was in mid-air and the mare streaking off over the moor with the saddle beneath her.

I thought I had broken a bone or something as I could not get up, but the trouble was that the soil borer had embedded itself in the ground and was holding me down. I eventually dragged myself out, chased the mare, and after catching her set course for the nearest farm which was about three miles away. Here a friendly farmer fixed the saddle for me and I managed to ride home without further incident and was thankful to reach my destination.

I tried to pay for the hire of the horse, but my farmer friend would not hear of this, although he accepted with alacrity an invitation to the "local." Whereupon I proceeded to buy him (and what seemed like most of the farm staff as well) a drink. I departed later in the evening feeling much better, but rather sore in the nether regions.

I idly wondered on the way home whether the Treasury would accept a claim "To hire of horse—6 pints of beer at 1s. 4d.," but decided against submission.

MANUSCRIPTS FOR THE PRESS

BY H. L. EDLIN

THE PURPOSE OF THIS ARTICLE is to explain how manuscripts and illustrations intended for printing should be prepared for submission to editors. Attention to a number of small points will save a great deal of work in an editorial office, increase the chances of an article being accepted for publication, and lessen the risks of errors occurring.

First of all, since printers will only accept work on one side of the paper, only one side of each sheet should be used, whether it is typed, handwritten, or used for illustrations.

Secondly, editors frequently have to make minor changes in text, and have to add indications for the printer. So allow reasonable margins to work of every description. All typewritten matter should be double spaced ; handwritten work should likewise be so spaced as to allow of amendments being made.

Sheets of standard size should always be used, even for short notes. For technical articles, such as those in this Journal, foolscap is preferred. Quarto is usual for literary work. The pages should be numbered.

At the head of the article, set out its title in capitals, followed by your name as you wish it to appear, both being underlined. If the article is for this Journal, set out at the end of the article your name, address, and designation. Always keep a copy of work submitted.

CAPITAL LETTERS. For some peculiar reason, writers on forestry have a weakness for capital letters for common nouns such as : Forester, Working Plan, Nation, and Oak. Such words, unless used in some peculiar context, normally merit small letters only. Capitals should be reserved for the names of places, persons, and particular ranks, e.g., Japanese larch, Lawson cypress, and Forester Jones. Names of common trees and plants are given small letters in practically every forestry journal published in English (the Empire Forestry Review is an exception). Names of insects, however, usually carry capitals, e.g., Pine Weevil, but pine tree.

ABBREVIATIONS. Since this Journal is intended for trained foresters' familiar with departmental abbreviations, it includes a good deal of " shorthand." But if you are writing for a wider public, try to imagine what a phrase like the following would have meant to you before you began your forestry studies : " 29 ac., H.W., P. 08., B.U., S.P., P. 18., at 1,000 ft. a.s.l. on a N.W. slope in the N.E. (E) carried 2,000 c.f. q.g. u.b. p.a." I think you will agree that it would have been absolutely incomprehensible, but examples nearly as odd have turned up in Journal articles, and it is an unnecessary job for the sub-editor to have to write out " Sitka spruce " for " S.S." when it occurs twenty times in one article ; besides, now and again it may stand for " Scotland, South " instead. Remember, too, that M.P. may mean mountain pine in Argyll, maritime pine in Dorset, Member of Parliament in Westminster, and Military Police in the Army.

Contractions, except in special circumstances such as in tabular statements, should not be used.

ITALICS. These, like capitals, should be used sparingly. They are indicated by underlining the words to be italicised, and their purpose is to make a contrast with the rest of the text. They are commonly employed for the titles of books mentioned, for foreign words, and for scientific names of trees, etc. But where scientific names appear in headings, tables, or in long lists, it is not necessary to set them in italics.

NUMERALS. The general rule is to set these in words for all numbers up to one hundred ; above that number, use figures. Figures are, however, usually preferred for fractions and tabular work.

DISPLAY LINES. These are the headings that are set in a more prominent type than the main text, and are indicated by underlining, with or without the use of capitals. Restraint should be exercised in suggesting them ; most of us prefer to read a straightforward story rather than a page broken up by a variety of headlines.

DRAWINGS, MAPS, AND GRAPHS. If an illustration is necessary, it is best drawn in plain black and white for reproduction by the " line block " process. The finished drawing should be in Indian ink on white paper, white cardboard, or blue tracing cloth. If you are unable to provide a drawing good enough for reproduction, remember that many editors will prepare one from a clear pencil sketch. The best way to show size is to draw a simple scale at one side of the drawing ; then if the picture is reduced in size, the scale will be reduced proportionately. Drawings should always be somewhat larger than the likely size of the printed version.

Lettering can, of course, be drawn on the picture ; alternatively the title can be typed out on a caption slip, for setting up in print below the illustration.

A note in brackets, set within the text, is the best way of indicating where you would like an illustration to appear.

PHOTOGRAPHS. These require the " half tone " method of reproduction, and are not at present accepted for this Journal. If you are sending them elsewhere, select clear black-and-white glossy prints somewhat larger than the probable finished size. Any portions of the photograph to be cut out of the final version should be indicated in blue pencil on the back of the print. Captions may be marked on the back, or preferably typed on a slip of paper clipped to the print ; but do not let a wire clip touch the actual face of the print. To ensure the return of the print after use, it is advisable to stamp or write your name and address on the back. Negatives are not normally needed for Press reproduction.

THE FORM OF THE ARTICLE. To the novice a few words on the construction of an article may not be out of place. Most articles on scientific matters gain by having an introductory paragraph setting out the aim and scope of the paper ; then might follow the observations or facts or arguments, winding up with the writer's conclusions.

THE FORESTRY COMMISSION LIBRARY

Recent additions to the Departmental Library at Alice Holt Research Station include the following :—

Classification Number	*Title and Author*	*Library Serial Number*
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11.49	The Soils and Vegetation of the Bin and Clashindarroch Forests. A. Muir and G. K. Fraser. Edinburgh, 1940	24
12.1	Principles of Agricultural Botany. Alex Nelson. Nelson, London 1946...	48
12.11	Trace Elements in Plants and Animals. W. Stiles. Camb. Univ. Press, 1946	14
12.19	Illustrations of the British Flora. W. H. Fitch and W. G. Smith. L. Reeve & Co., Ashford, 1946	61
12.19	Manual of Cultivated Trees and Shrubs. A. Rehder. Macmillan, New York, 2nd Edition, 1947	29
12.19	Forest Trees of the Pacific Slope. G. B. Sudworth. U.S. Department of Agriculture, Washington, 1908	158
12.19	Die Laubgehölze. Gerd Krussmann. Paul Parey, Berlin, 1937	117
12.19	The Theory of Forest Types. A. K. Cajander. Acta Forestalia Fennica, Helsinki, 1926	69
12.19	The Ecology of the Scandinavian Beechwoods. B. Lindquist. Stockholm, 1931	147
12.25	The Identification of Conifers. A. Bruce Jackson. Ed. Arnold, 1946...	31
12.29	The Observer's Book of British Grasses, Sedges and Rushes. W. J. Stokoe, London, 1942	55
13.21	A General Text Book of Entomology. A. D. Imms. 6th Edition, 1946	100
4	The Scientific Principles of Plant Protection. Hubert Martin. Edward Arnold, London, 3rd Edition (reprinted 1944) ...	80
44.1	Suppression of Weeds by Fertilisers and Chemicals. H. C. Long and W. M. Brenchley. London, 2nd Edition, 1946 ...	45

FORESTRY ABSTRACTS

The problem of keeping abreast with the latest developments in the technique of forestry and its allied sciences, is one that faces every forester. Few of us have the time, the opportunity or the knowledge of foreign languages required to read all the numerous periodicals on the subject which now appear in practically every country of the world. Fortunately, all this published work is systematically summarised as it appears, in the quarterly periodical entitled *Forestry Abstracts*, compiled by the Commonwealth Forestry Bureau, Oxford.

In this useful work, intended to be "a working tool of all scientific foresters," the substance of every significant contribution to the literature of the forest sciences is condensed into a few readable paragraphs. These are classified according to their subject matter, for ease of reference, and a full bibliography is added, so that those who wish to read the papers in full know where to look for them. Every branch of forestry and timber technology is covered.

Anyone interested may subscribe to *Forestry Abstracts*. The charge for residents in Great Britain is 36s. per annum, payable to the Commonwealth Agricultural Bureaux, Central Sales Branch, Penglais, Aberystwyth.

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	Woking :	Hyett, S. (I).

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9 Downfield Road,
Bristol, 8
Telephone : 34029-30

CONSERVATOR	Popert, A. H.	
DIVISIONAL OFFICER :	Stileman, D. F.	(Private Woodlands)
DISTRICT OFFICERS I :	Ballance, G. F.	Bristol (Private Woodlands)
	Stocks, J. B.	Bristol (Utilisation)
DISTRICT OFFICERS II :	Grant, D.	Launceston
	Purser, F. B. K.	Devizes
	Vetch, C. F.	Bristol (Private Woodlands)
	Williams, D. N.	North Petherton
	Good, F. G.	(Estate)
ASSISTANT ENGINEERS :	Duncan, P. R.	Exeter
	Inglis, E. J.	Bristol
	Shillito, P. E.	Bristol

HIGHER EXECUTIVE OFFICER : Taylor, G. F.

FORESTERS :

1.	Dymock :	Beard, A. C. (II).
2.	Brendon :	Bowdler, T. C. (II).
3.	Eggesford :	Kibble, E. C. (II)
4.	Haldon :	Scott, G. (II).
5.	Halwill :	Wellington, C. R. (I).
6.	Quantocks :	Fairman, E. (II) ; Humphries, W. J. (II).
7.	Bodmin :	Pritchard, R. (I) (also at Herodsfoot).
8.	Haugh :	Milne, D. G. (Foreman).
9.	Wyre :	Pearson, W. (I).
10.	Wilsey :	Brown, A. J. (II).
11.	Bruton :	Jenkinson, G. A. (II).
12.	Dartmoor :	Williams, J. (Head) ; Wray, N. (I).
13.	Herodsfoot :	Pritchard, R. (I) (also at Bodmin).
14.	West Woods :	Reid, D. (II).
15.	Lydford :	Jane, T. A. (II).
16.	Collingbourne :	Hammond, B. R. G. (II).
17.	Hartland :	Wilkinson, W. E. (I).
18.	Mendip :	Fowler, J. (II).
19.	Savernake :	Wildash, J. T. (II) ; Simons, V. A. (II).
20.	Stanway :	Poll, E. A. (II).
21.	Braydon :	Bowman, P. (Foreman).
22.	Okehampton :	Smale, E. R. (II).
23.	Neroche :	Law, H. G. (II) ; Rayner, J. R. (II) ; McDonald, R. (II).
	Plymouth :	Whale, R. S. (II).

ENGLAND, NEW FOREST

The King's House,
Lyndhurst,
Hants.
Telephone : Lyndhurst 300.

DEPUTY SURVEYOR :	Young, D. W.	
DIVISIONAL OFFICER :	Rouse, G. D.	Lyndhurst
DISTRICT OFFICERS II :	Marshall, I. R. B.	Wimborne
	Semple, R. M. G.	Lyndhurst
CHIEF CLERK :	Coote, R.	

FORESTERS :

1.	New Forest :	
	Rhinefield :	Williams, L. H. (I).
	Stockley :	Adams, J. H. (I) ; Fulford, A. G. (II).
	Lyndhurst :	Liddell, J. (I) ; Gowlings, J. (II) ; James, H. B. (II).
	Lodgehill :	Broomfield, G. (II).
	Holmsley :	Cuff, E. W. (II).
	Holidays Hill :	Green, F. J. (II) ; Coles, L. H. (II).

	Shave Green :	Holloway, A. T. (II).
	Roe :	James, A. L. (II).
	Godshill :	Longman, F. C. J. (II).
2.	Parkhurst :	Lewis, C. J. (II) (also at Osborne).
3.	Wareham :	Colwill, S. W. (I) ; Aston, O. R. T. (I).
4.	Ringwood :	Laney, H. (Head).
5.	Ferndown :	Watkins, S. (I) ; Coles, L. H. (II).
6.	Brighstone :	Butchers, H. J. (II).
7.	Combley :	Warne, R. (Foreman).
8.	Gardiner :	Parsons, F. F. G. (II).
9.	Osborne :	Lewis, C. J. (II) (also at Parkhurst).
10.	Charmouth :	Green, W. J. (Foreman).
11.	Shalfleet :	Harvey, D. R. (II).

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 : Wylie, N. A.
DEPUTY GAVELLER,
MINES : Tomlinson, A. R.

ASSISTANT ENGINEERS :	Adderley, C. J. H.	Parkend
	Dobson, L. G.	Lightmoor

CHIEF CLERK : Morris, T. W.

FORESTERS :

1.	Dean Forest :	
	Dean :	Walker, A. E. (Head) ; Phelps, S. E. (I).
	Highmeadow :	Davies, D. L. (I).
	Dean (North) :	Lees, G. (I).
	,, (North, Lea Bailey) :	Roberts, G. (Foreman).
	,, (Highmeadow) :	Watson, F. (I).
	,, (East) :	Buffrey, A. (II) ; Allison, G. (II).
	,, (West) :	Daniels, P. (II).
	,, (School) :	Davies, C. H. (II).
	,, (Centre) :	Lee, J. J. (II).
	,, (Cockshoot) :	Lloyd, F. O. (II).
	,, (East) :	Marston, W. H. (II).
	,, (South) :	Lewis, A. E. (II).
	Nagshead Nursery :	Parry, H. M. (II).
2.	Tidenham Chase :	Jones, H. (Foreman).

DIRECTORATE FOR SCOTLAND

OFFICE OF DIRECTOR : 25 DRUMSHEUGH GARDENS, EDINBURGH.
Telephone : Edinburgh 33561.

Director :	H. C. BERESFORD-PEIRSE	
Conservators :	MACKIE WHYTE, J. P.	(Estate)
	NEWTON, L. A.	(Private Woodland and Acquisitions)
	WATT, A.	(State Forests)
District Officer Grade I:	FORREST, G.	(Acquisitions)
District Officers Grade II :	CASSELS, K. A. H.	(Acquisitions)
	THOMSON, W. P.	(Nurseries)
Personnel Officer (Engineering) :	MASSIE, J. McF.	
Planning Officer :	CRANE, W. A.	
Mechanical Engineer :	BLANE, J. W.	
Chief Executive Officer :	HANDFORD, F. C.	
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

53 Church Street,
Inverness.
Telephone : Inverness 223.

CONSERVATOR :	Fraser, J.	
DIVISIONAL OFFICER:	Fitzherbert, J. T. L.	Inverness
DISTRICT OFFICERS I :	Crawford, A. R.	Inverness (Private Woodlands)
	Fraser, A. M.	Inverness
	Spraggan, D. S.	Fort Augustus
	Dickson, J. A.	Alness
DISTRICT OFFICERS II :	Drummond, R. O.	Dornoch
	Innes, R. A.	Dingwall
	Gascoigne, C. A. H.	Inverness
	MacLean, Jas.	Fort William
	Hughson, T. A.	Fort William
	Richards, E. G.	Inverness
CONSERVANCY ENGINEER :	Mullowney, V. L.	Inverness
ASSISTANT ENGINEER :	McMahon, C. D.	Inverness
MAINTENANCE ENGINEER (INDUSTRIAL) :	Skinner, R.	
FACTOR :	Gourlay, A.	Nairn
HIGHER EXECUTIVE OFFICER :	Nicholson, M.	

FORESTERS:

1.	Borgie :	MacKay, W. H. (I).
2.	Inchnacardoch :	Anderson, W. (Head).
3.	Portclair :	McEwan, J. (I).
4.	South Laggan :	Murray, R. (I).
5.	Achnashellach :	MacKenzie, A. (Jnr.) (II).
6.	Ratagan :	Murray, W. (H) (also at Glenshiel and Inverinate).
7.	Slattadale :	MacKenzie, G. (II).
8.	Glen Righ :	Murray, A. R. (II) ; Phipps, N. (II).
9.	Glen Hurich :	MacClymont, W. (I).
10.	Glen Urquhart :	Munro, G. (I).
11.	Culloden :	MacDonald, D. (I).
12.	Nevis :	Mackie, A. (I).
13.	The Queen's Forest :	Fraser, J. (II) ; Robertson, D. D. C. (II).
14.	Craig nan Eun :	Fell, J. B. (II).
15.	Craig Phadrig :	Murray, D. (II).
16.	Glen Shiel :	Murray, W. (Head) (also at Inverinate and Ratagan)
17.	North Strome :	MacLeman, A. (II) (also at South Strome)
18.	Salen :	MacKay, J. A. (II).
19.	South Strome :	MacLeman, A. (II) (also at North Strome) ; Mackay, J. (II).
20.	Findon :	Gordon, J. (I).
21.	Glen Garry :	Grant, J. D. (II).
22.	Kessock :	Gray, A. C. (I)
23.	Eilanreach :	MacPherson, E. (II).
24.	Dornoch :	Gunn, J. (I) (also at Balblair).
25.	Inverinate :	Murray, W. (Head) (also at Glenshiel and Ratagan)
26.	Balblair :	Gunn, J. (I) (also at Dornoch) ; Sutherland, R. A. R. (II).
27.	Clunes :	Officer, A. W. (II).
28.	Lael :	Macrae, D. J. (II).
29.	Fiunary :	Drysdale, A. (I).
30.	Glen Loy :	Grant, A. (II).
31.	Glen Brittle :	MacDonald, C. (I).
32.	Longart :	Brown, R. S. (Foreman).
33.	Leanachan :	MacKenzie, A. (Snr.) (II).
34.	Guisachan :	MacKintosh, W. (I).
35.	Ardross :	MacKay, K. (I).
36.	Inshriach :	Thom, A. (II).
37.	Millbuie :	MacKay, W. (I).
38.	Assich :	McLeod, D. M. (II).
39.	Morangie :	MacKay, A. (II).
40.	Kilcoy :	MacKenzie, A. S. (Foreman).
41.	Strath Nairn :	Frater, J. (II).
42.	Ferness :	Stobie, F. D. (II).

43. Strath Conon : MacKenzie, J. (I).
44. Strath Dearn : Sutherland, D. R. (Foreman).
45. Farigaig : MacRae, M. (II).
Munlochy : MacLeod, D. (Head).

SCOTLAND, EAST CONSERVANCY

6 Queen's Gate,
Aberdeen
Telephone : Aberdeen 26211

CONSERVATOR :	Oliver, F. W. A.	
DIVISIONAL OFFICER :	Bird, D. H.	Aberdeen (Private Woodlands)
DISTRICT OFFICERS I :	Stewart, I. J.	Aberdeen (Private Woodlands)
	Woolridge, T. H.	Aberdeen
	Gillespie, I.	Aberdeen (Acquisitions)
DISTRICT OFFICERS II :	Feaver, B. R.	Bridgeton
	Grant, G.	Aberdeen (Estate)
	Horne, R. J. G.	Kinellar
	Kennedy, J. A. M.	Forres
	Maxwell, H. A.	Banchory
	Murray, G. K.	Aberdeen (Estate)
	Rennie, J.	Crieff (Estate)
	Robertson, I. O.	Perth
	Shaw, R.	Dunkeld
CONSERVANCY ENGINEER :	Blenkinsop, R. I. C.	Aberdeen
ASSISTANT ENGINEERS :	Fowell, R.	Aberdeen
	Fowlie, T. G.	Kirriemuir
	Johnstone, G. M.	Blair Atholl
HIGHER EXECUTIVE OFFICER :	Lenman, J. P.	

FORESTERS :

1. Monaughty : Watt, D. M. (I).
2. Kirkhill : McDonald, W. (I).
3. Montreathmont : McConnell, J. (I) ; Stewart, A. C. (II).
4. Culbin : Milne, W. G. (I) ; Stewart, E. A. (II).
5. Edensmuir : Scott, J. (I).
6. Tentsmuir : Mason, W. (I) ; Whyte, C. A. (II).
7. Drummond Hill : Ross, W. L. (Head).
8. Teindland : Urquhart, D. J. (I).
9. The Bin : MacKay, W. (I).
10. Speymouth : Robbie, J. D. (I) ; Clark, J. F. (II).
11. Blairadam : Ritchie, M. A. (I) (also at Glen Devon) ; Ross, Archibald (II).
12. Drumtochty : Grigor, E. (II).

13.	Kemnay :	Allan, J. (I).
14.	Midmar :	Hendry, J. B. (II).
15.	Deer :	Thow, J. B. (II).
16.	Scootmore :	Murray, G. J. A. M. (I) ; Seaton, J. A. (II).
17.	Clashindarroch :	Kennedy, J. A. (Head).
18.	Roseisle :	Grant, A. (Snr.) (II).
19.	Blackcraig :	Reid, J. (II).
20.	Carden :	Mitchell, F. M. (II).
21.	Inglismaldie :	Skene, W. F. (Foreman).
22.	Durris :	Paterson, S. H. A. (Head) ; McMaster, A. J. (II).
23.	Newton :	Lamb, J. A. (Head) ; Coull, G. (II) ; Grubb, J. A. (II).
24.	Newtyle :	Douglas, W. S. (II).
25.	Alltcailleach :	Munro, A. A. (I) ; Reid, J. K. (II).
26.	Kinfauns :	Russell, J. C. (I).
27.	Whitehaugh :	Duguid, C. (II).
28.	Craig Vinean :	Gilbert, Geo. (I).
29.	Glen Devon :	Ritchie, M. A. (I) (also at Blairadam).
30.	Lossie :	Scaife, C. (II).
31.	Keillour :	Marnoch, D. (II).
32.	Tilliefoure :	Anderson, F. (I).
33.	Blackhall :	Pacey, R. H. (II).
34.	Rosarie :	Pennet, H. (II).
35.	Pitfichie :	McDowall, C. (I).
36.	Fetteresso :	Ross, Allan (II).
37.	Strathord :	Anderson, J. A. (II).
38.	Allean :	Corbett, J. (Head) ; Maxtone, J. R. (II).
39.	Auchernach :	Innes, G. C. (II).
40.	Gartly Moor :	Watt, W. J. (II).
41.	Dallas :	Hepburn, N. R. (II).
42.	Countesswells :	Cassie, A. (II).
43.	Pitmedden :	Allison, R. A. (II).
44.	Rannoch :	Whayman, A. (II).
45.	Tomintoul :	McRae, J. (II).

HEAD KEEPER :
Clashindarroch : MacDonald, S.

SCOTLAND, WEST CONSERVANCY

53 Bothwell Street,
Glasgow, C.2.
Telephone : Central 6868

CONSERVATOR :	James, J. E.	
DIVISIONAL OFFICERS :		Glasgow
	Webster, J.	Strone, Argyll (Estate)
DISTRICT OFFICER I :	Dier, H. V. S.	Aberfoyle
DISTRICT OFFICERS II :	Chrystall, J.	Lochgilphead
	Crystall, J. G.	Barcaldine

	Innes, P. A.	Kilmun (Estate)
	Johnson, W. A. J.	Lochgilphead (Estate)
	Long, M.	Glasgow (Private Woodlands)
	Petrie, S. M.	Benmore
	Robertson, S. U.	Benmore
	Woodburn, D. A.	Lochgilphead
CONSERVANCY ENGINEER :	Green, A. M.	Glasgow
ASSISTANT ENGINEER :	Gilchrist, R.	Glasgow
HIGHER EXECUTIVE OFFICER :	Farmer, T.	

FORESTERS :

1.	Inverliever :	Crozier, R. (I) ; Murray, R. G. (II) (Eredine).
2.	Glen Duror :	Campbell, R. W. (I) ; Robertson, D. A. (II) (Duror); Campbell, A. (II) (Ballachulish) ; Beaton, K. A. (II).
3.	Glen Branter :	McLean, A. (II) ; Gillies, A. (II) ; McCrorie, J. P. (II)
4.	Ardgartan :	Reid, J. M. (Head) ; McCaskill, D. A. (II).
5.	Barcaldine :	Cameron, H. (Head) ; Polwart, A. (II).
6.	Benmore :	Jackson, J. (II) ; Robertson, N. (II) ; Stuart, A. M. (II) (Island) ; Angus, R. S. (II).
7.	Glen Finart :	MacKay, A. (I) ; MacKay, J. F. (II).
8.	Fearnoch :	MacPhee, C. B. (II)
9.	Lennox :	Penny, T. (II).
10.	Loch Ard :	Sinclair, L. (I) (also at Garadhban) ; Ferguson, J. M. (II) ; Fraser, T. S. (II) ; Morrison, A. (II) ; Ross, D. H. (II) ; Mitchell, R. F. (II) ; Stout, H. C. (II) (Achray).
11.	Devilla :	Fairbairn, W. (II).
12.	Achaglachgach :	McCallum, D. (II).
13.	Knapdale :	Bain, J. R. L. (II) ; MacKay, D. J. (II) ; McKinnon, H. (II).
14.	Strathyre :	Cameron, A. (Head) ; Linder, R. (II) (Tulloch).
15.	Tulliallan :	Simpson, A. N. (Head) ; Martin, W. C. (II).
16.	Garadhban :	Sinclair, L. (I) (also at Loch Ard).
17.	Inverinan :	Rattray, W. D. (II).
18.	Asknish :	Kennedy, J. (H) (also at Minard).
19.	Carron Valley :	Fraser, E. D. (I) ; Hamilton, J. (II).
20.	Carradale :	Munro, D. (I) (also at Saddell) ; Gilmour, W. (II).
21.	Minard :	Kennedy, J. (H) (also at Asknish).
22.	Saddell :	Munro, D. (I) (also at Carradale).
23.	Kilmichael (South) :	MacRae, D. J. (II).
	Kilmichael (North) :	Ross, I. (II).
24.	Corlarach :	Morrison, N. (II).
25.	Glendaruel :	MacKenzie, I. H. M. (I) (also at Strath Lachlan) ; Small, G. (II).
26.	Strath Lachlan :	MacKenzie, I. H. M. (I) (also at Glendaruel).

SCOTLAND, SOUTH CONSERVANCY

Greystone Park, Moffat Road,
Dumfries.
Telephone : Dumfries 1156.

CONSERVATOR :	Thom, J. R.	Dumfries
DIVISIONAL OFFICERS :	Fossey, R. E.	Dumfries
	Penistan, M. J.	Dumfries (Private Woodlands)
DISTRICT OFFICER I :	Bennett, A. P.	Dumfries (Estate)
DISTRICT OFFICERS II :	Donald, R. R.	Palnure
	Fergusson, W. S.	Dumfries
	MacNab, J. D.	Selkirk
	Sutherland. W. B.	Lockerbie
ASSISTANT ENGINEERS :	Clark, T. L.	Dumfries
	Old, W. S.	Hawick
HIGHER EXECUTIVE OFFICER :	McGeorge, T. H.	

FORESTERS :

1.	Glen Tress :	Melville, J. (II).
2.	Cairn Edward :	Parley, C. W. (I) (Bennan) : Towns, K. W. (II) (Clatteringshaws).
3.	Newcastleton :	MacIntyre, J. F. (Head) ; McLaren, A. R. (II).
4.	Dalbeattie :	Watson, J. (I) ; McNaught, D. J. (II) ; Kirk, D. (II).
5.	Forest of Ae :	Brown, P. (I) ; Craig, J. S. (II).
6.	Edgarhope :	Slater, J. (II).
7.	Greskine :	Hunter, J. (II) (also at Auchenroddan).
8.	Auchenroddan :	Hunter, J. (II) (also at Greskine).
9.	Kirroughtree :	MacMillan, H. (Head) ; Cannon, F. J. (II).
10.	Fleet :	MacDonald, J. D. (I) ; Garrioch, I. M. (II).
11.	Kilsture :	Robertson, D. (II).
12.	Changue :	Clark, D. (II).
13.	Dundeugh :	McNicol, F. (II).
14.	Tinnisburn :	Broll, J. L. (II).
15.	Corriedoo :	Mowat, J. (II).
16.	Garcrogo :	Parkinson, J. W. (II).
17.	Laurieston :	Cameron, D. M. (II).
18.	Twiglees :	Robertson, W. J. (II).
19.	Castle O'er :	Irving, R. H. (II).
20.	Glen Trool :	MacRae, A. D. (I).
21.	Clauchrie :	Chisholm, M. R. (II).
22.	Shielswood :	(New Unit).
23.	Mabie :	Graham, A. (Head).
24.	Wauchope :	Dewar, J. D. (I).
25.	Carrick :	Calder, Robert C. (Foreman).

26. Elibank : Urquhart, G. (II).
27. Glen Gap : Carruthers, M. F. (II).
28. Craik : Harkness, J. R. (II).
29. Cardrona : Peddie, A. S. (II).
30. Craigieburn : Jamieson, R. A. (II).
31. Leithope : (New Unit).

Private Woodlands Forester : R. P. Steel (I) ; Stationed at Cardrona.

DIRECTORATE FOR WALES

OFFICE OF DIRECTOR : VICTORIA HOUSE, MARINE TERRACE, ABERYSTWYTH.
Telephone : Aberystwyth 367.

Director :	A. P. LONG	
Conservator :	COWNIE, F.	(Estate and (Acquisitions)
District Officer Grade I :	GODWIN, G. E.	Llandrindod Wells (Acquisitions)
District Officer Grade II :	KEIGHLEY, G. D.	Shrewsbury (Acquisitions)
Directorate Engineer :	CUTLER, R. V.	
Assistant Engineer :	CHURCHILL, C. F. H.	
Senior Executive Officer :	MACKENZIE, M. E. W.	
Plant and Machinery Officer :	BOWEN, T. C. W.	
Higher Executive Officers :	BRADFORD, E. H.	
	EDWARDS, F. le G.	

WALES, NORTH CONSERVANCY

35 Hill's Lane,
Shrewsbury.
Telephone : Shrewsbury 4071-2.

CONSERVATOR :	Best, F. C.	
DIVISIONAL OFFICERS :	Cadman, W. A.	(State Forests)
	Fairchild, C. E. L.	(Estate)
DISTRICT OFFICERS II :	Butter, R.	Corris
	Hampson, J. R.	Bettws y Coed
	Harker, M. G.	Dolgelly
	Owen, G. L.	Llanfyllin
	Peaty, C. E.	Caersws
	Saunders, H. J.	Shrewsbury (Utilisation)
	Shaw, J. L.	Shrewsbury (Private Woodlands)
	Walcot, H.	Shrewsbury (Estate)
ASSISTANT ENGINEERS :	Egerton, F. C.	Dovey Road
	Gladwell, L. B.	Dolgelly
	Driver, A. W. C.	Shrewsbury
	Orgill, R. G.	Chirk

HIGHER EXECUTIVE OFFICER : Mayhew, K.

FORESTERS :

1. Hafod Fawr :	Williams, F. (II).
2. Gwydyr :	Harrison, Percy, (Head) ; Carr, C. P. W. (I) ; Hughes, A. (II) ; Hughes, L. E. (II) ; Morris, O. I. (II) ; Royle, J. H. (II) ; Thomas, T. W. (II).
3. Coed y Brenin :	Lomas, J. (Head) ; Evans, J. F. (II) ; Jones, L. (II) ; Jones, T. G. (II) ; Harbin, W. B. (II).

4.	Kerry :	Jennings, R. J. (II).
5.	Beddgelert :	Evans, J. E. (I).
6.	Cynwyd :	Roberts, R. H. (II).
7.	Dovey :	Fraser, R. (Head) V ; Bell, H. C. (II) V ; Evans, A. C. W. (II) V ; Griffiths, I. L. (II) C ; Lloyd, I. (II) (Corris) ; Roberts, W. S. (II) (Bryncynfil, also at Cwmeinion) ; Williams, R. J. (II) (Corris) ; Powell, T. W. (II) ; Roberts, M. R. (II) (Corris).
8.	Radnor :	Yapp, P. (I).
9.	Cwmeinion :	Roberts, W. S. (II) (also at Dovey (Bryncynfil).
10.	Mathrafal :	Reese, W. H. (I).
11.	Tarenig :	Hughes, J. W. (II) (also at Bryn Mawr).
12.	Bryn Mawr :	Hughes, J. W. (II) (also at Tarenig).
13.	Myherin :	Jones, E. T. (I) ; Price, G. (II) ; Griffiths, E. (II).
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