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FORESTRY COMMISSION.

No. 10: APRIL, 1931.

Editing Committee:
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FRASER STORY.

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EDITORIAL.

A NUMBER of Divisional changes have taken place during the past year.

Divisional Changes.

Following the transfer of Mr. Sangar to Headquarters for special duties in August, 1930, Mr. Long took charge of No. 2 Division, England and Wales, and Dr. Steven was promoted from District Officer, Grade I, to Divisional Officer in charge of Division No. 5, England, in Mr. Long's place.

Mr. Hanson retired at the end of March, 1931, and his place has been filled by Mr. Frank Scott. Mr. James Fraser, promoted from District Officer, Grade I, has taken charge of Mr. Scott's old Division, N. Scotland.

Mr. Hanson is the first of our "veterans" to retire, and he does so after 37 years in the Public Services. He joined the Indian Forest Service in 1893 and remained in India until 1903, when he was invalided home. In 1904 he started a Woodman's School of Forestry in the Dean and continued in charge of it until March, 1916. It was doubtless his work in connection with this school which prompted him to write "Forestry for Woodmen" which is still regarded as one of our most useful text books. For fully a year after leaving Dean Forest, Mr. Hanson was engaged in the work of the Timber Supplies Department, he then resumed duties under the Office of Woods and remained with that Department until he was appointed Divisional Officer under the Forestry Commission, then the Interim Forest Authority, in June, 1919.

Forestry again achieved the distinction of receiving attention by a

Imperial Conference, 1930.

Committee of the Imperial Conference. Ten years ago it would have been accounted a remarkable step to have secured a hearing in so important an assembly, and it says much for the solidity of our profession that on this occasion it was accepted almost as a matter of course. The principal decisions arrived at by the Forestry Committee, and adopted by the Conference, included reference to the Imperial Forestry Insitute, Oxford, which it was considered should have adequate financial support so as to place it on a more secure footing. To allow the Institute to function properly it was estimated that an assured income of £19,000 per annum was required. Attention was drawn to the excellent progress which was

being made in forest products research in several parts of the Empire, and stress was laid on the importance of further development of forest policy in some of the Dominions.

Dean Forest Apprentices' School.

The School at Parkend has been considerably enlarged and now accommodates 40 apprentices. Advantage was taken of the reconstruction to improve the building generally. There are now two lecture rooms, reading and recreation rooms, a good dining room and kitchen, and more modern equipment as regards baths, drying-rooms, etc.

Contributions to the Journal.

The plan followed in the present issue has been to ask three Divisions (Messrs. Scott, Hopkinson and Steven) to provide their quota of contributions. For the next number three other Divisions will be selected, but intending contributors outside these Divisions who have interesting statements to communicate should not withhold them on that account.

Headquarters Office.

It should be noted that the new address of the Commission's Headquarters Office is 9, Savile Row, London, W.1. (*Telephone*—Regent 0524. *Telegrams*—Inforesta, Piccy, London.)

CLEARING OF FIRE RIDES.

By J. M. MURRAY.

Ploughing, screefing by hand, mowing, spraying with chemicals and burning have all been tried as methods of making fire rides effective. Each method has its own particular disability; ploughing is capable of limited application, screefing is too costly, mowing is not sufficiently secure, spraying with chemicals is not a lasting measure, while burning introduces the fire risk directly into the forest. Burning of fire rides can lead to accidents of a distressing type and, as the method can be cheap and effective, means to overcome the danger have been sought for. An obvious suggestion is to burn when the surrounding dead vegetation is too damp to burn readily.

In America the Hauck Burner is used for burning slash and for forest protection work such as fire line burning. The machine consists of a tank about the size of that provided with the Knapsack Sprayer, an air pump connected with the tank, a gauge to measure air pressure, a tube about 4 ft. long connected to the tank and at the end of this a large burner of the type provided in a plumber's blow-lamp. The Hauck Burner uses paraffin forced over the tube by air pressure and then volatilised by heating the spirals within the burner almost to a white heat. If the burner is working properly a colourless flame 22 ins. long is produced.

It was considered that this type of instrument might produce a flame hot enough to burn withered vegetation while it was damp. Certain difficulties arose about getting the Hauck Burner, and a similar type of burner made by the Primus Stove Company, and used for certain railway work, was tried. Subsequent experience has shown that this article is as useful as the Hauck Burner. The price in each case is the same.

In the first attempts to use the burner the grass was too wet and the cost in fuel and time was excessive. Later experience showed that by choosing mornings when the dead vegetation was moist, not wet, the results were most satisfactory. On some days the burning could be continued well into the forenoon. It was considered unnecessary to burn the whole width of a ride and the burner was employed in treating only 2 or 3 ft. on each side, leaving a strip in the middle which was burned when the weather was dry and there was no wind.

An attempt has been made to use the burner along with a water pack (Wajax). So far the experiment has been satisfactory. By this means the distance covered by the fire can be quickly controlled, and damp conditions can be produced artificially in the fallen vegetation. An attempt was made also to use a material employed in fire-proofing fabric screens, but while effective in moderately low concentrations the cost was too great to make the experiment likely to be useful in practice. The materials used were patented, but the main fire controlling constituent seemed to be chlorine. Investigations on these lines may discover some chemical which will be cheap, easily applied, moderately insoluble after drying and exposure to the air and render materials non-inflammable.

The type of vegetation dealt with influenced the degree of success in using the burner. It was most successful in grasses of the *Aira* and *Agrostis* types and in short heather, while it was least successful in *Molinia*. It seemed that the first-named types did not absorb into the dry vegetation the same amount of water that *Molinia* did. The midway stage was easier to reach either in wetting or drying. In addition, *Molinia* usually occurs at its maximum in areas of fairly high rainfall and on a water-retaining peat.

The rate of working varies very greatly. The maximum reached has been four miles of strip averaging 4 ft. in two days.

PRUNING OF OVER-SIZED DOUGLAS FIR AND OTHER CONIFERS.

By W. H. GUILLEBAUD.

In September, 1929, Silvicultural Circular No. 5 was issued to Divisional Officers with instructions to test the effect of shoot pruning of overgrown Douglas fir, Japanese larch and European larch, and to report at the end of the growing season.

Thirty-three reports have been received, namely, 22 for Douglas fir, 8 for Japanese larch and 3 for European larch. Many of the reports fail to state either the age or the size of the plants dealt with, but these appear to have varied in age from 2 + 2 to 3 + 4, and in size from 2 to 4 ft. or over. It is unfortunate that the method of pruning adopted is given only in certain cases, but it is apparent that this has not been uniform, *e.g.*, there have been differences in the severity of the pruning and in the position of the cut in the leader-pruned plants in relation to lateral buds or branch whorls, while in the branch-pruned plants branches have been cut back to varying distances from the main stem.

Douglas Fir.—Data based on actual counts are available for only 8 out of the 22 experiments carried out. The average figures for failures are :—leader-pruned, 13 per cent. (range 4–19 per cent.); branch-pruned, 11 per cent. (range 0–28 per cent.); unpruned, 15 per cent. (range, 10–28 per cent.). It is very doubtful if the differences between these averages are significant, but in individual experiments results have been obtained which do give definite indications. For example, at Scootmore with 3 + 4 plants, 4 ft. in height, the losses were :—leader-pruned, 28 per cent.; branch-pruned, 19 per cent.; control, 11 per cent. Here the evidence is against pruning. On the other hand, at Bourne and in the Forest of Dean the results were favourable to pruning.

Forest.	Leader-pruned Losses.	Branch-pruned Losses.	Control Losses.
	Per cent.	Per cent.	Per cent.
Bourne	24	4	28
Forest of Dean	5	5	15

As regards the remaining reports, it is often not clear whether the comparison made refer to failures only or also to general appearance, rate of growth, etc. Using all the reports it would appear that in 10 series of experiments there was no marked difference between the three methods of treatment, branch pruning gave the best result in 6 series, leader-pruning in 4 series, while only in one case (Scootmoore) did the control give the best result. Several of the reports mention the fact that the season was exceptionally favourable for planting, hence the relatively small losses in most areas. In two forests, however, Myherin and Radnor, losses were stated to be high, but there was no marked difference between any of the treatments.

As regards the response of the plants to the pruning, it was found, for example, at Eilanreach that Douglas fir, which were both side- and

leader-pruned, did not suffer so much from windsway. Where the leader was cut back to a strong side bud, normal leaders of from 6 in. to 10 in. were put on below the cut, but where this was not done the leading shoot was liable to die back to the next whorl of branches which then became a cluster of leaders. At Cynwyd the trees which had their leaders pruned increased their height growth more than the branch-pruned or control trees. At Myherin there was no difference. Mr. Hanson remarked that leader-pruning appears to have no advantages, as in a high proportion of cases multiple leaders are formed and it is not uncommon to find that the cut leader has started to die back. At Lyminge, Hemsted and Rhinefield growth was virtually the same in the pruned plots as in the controls. Most of the leader-pruned plants at Rhinefield were stated to be making new leaders. Mr. Young found that the behaviour of the leader-pruned plants was very varied, where the topping had been done close to a node there was a far greater tendency for one of the side shoots to take up the lead than where the cut was made, say—midway between the nodes. In some cases a side shoot had become quite perpendicular and it was difficult to realise that the stem had been topped. In the Forest of Dean, in addition to the two pruning methods a third treatment was introduced to test the theory that large plants could be safely used if sufficient care were given to the method of planting. The method used was that known in Germany as the Hugelloch; a mound of soil being formed in a pit and the plant roots spread radially over the surface of the mound, further soil being added to cover the roots and bring the level of the pit flush with the ground level. This method was actually the most successful both as regards losses and rate of growth. Losses only 2 per cent., as compared with 15 per cent. in the unpruned controls, growth $4\frac{1}{2}$ ins., against $3\frac{1}{2}$ ins. in the controls.

Japanese Larch.—Leader-pruning reduced losses at Cynwyd from 26 per cent. in the controls to 10 per cent.; this method gave also slightly the best results at Mortimer and Cannock. At Nevis, on the other hand, leader-pruning resulted in the formation of a large number of double leaders; branch-pruning was here the best of the three methods. No difference was reported in the remaining areas where Japanese larch was treated.

European Larch.—No difference was noted in two areas, but in the third (Cynwyd) pruning was beneficial, the failure being—leader-pruned, 6 per cent.; branch-pruned, 4 per cent.; control, 22 per cent.

Summary.

In spite of somewhat conflicting results, the evidence generally is favourable to pruning. In a number of cases losses have been definitely reduced and in only one area has harm apparently resulted. There does not seem to be much to choose between the two methods of pruning, but a good deal remains to be learned as to the best way of doing the leader-pruning, and more attention might be paid to this in future experiments. A further report on the plots in two or three years' time should give useful information.

REPORT ON LARCH RAISED FROM SUDETEN (SILESIAN) SEED.

By W. H. GUILLEBAUD.

Ten distinct lots of so-called Silesian larch seed have been sown in Commission nurseries, and reports dealing with all the lots have been received, with the exception of I.No. 26/55 (sown at Bagshot Nursery). Apart from I.No. 22/30, which was purchased from Gruenwald of Vienna and entered in our books as " reported Silesian," all the seed was supplied by Gebauer of Liebenthal, formerly in Prussian Silesia but now in Czecho-Slovakia. The seed apparently comes from the Sudeten, the range of mountains running south-east from the neighbourhood of Görlitz and forming the north-westerly extension of the Carpathians. Sudeten larch is perhaps a better name for the seed than Silesian larch.

The reports on the individual lots of Sudeten larch are summarised below :—

(1) I.No. 22/8. Eight reports (2 England and Wales and 6 Scotland), of which four refer only to nurseries. Growth in plantation : good (4). Form : fair (2) ; poor (2). Nursery germination and growth : good (1) ; bad (4).

(2) I.No. 22/30. Two reports on nursery stage only (1 England and Wales and 1 Scotland). Germination : good (1) ; poor (1) Growth : good (1).

(3) I.No. 23/8. Four reports (Scotland only). Growth in plantation : good (1) ; fair to poor (3). Form : good (1) ; fair (1) ; poor (1) ; bad (1).

(4) I.No. 24/17. Six reports (Scotland only). Growth in plantation : good (5) ; poor (1). Form : good (3) ; poor (1) ; bad (2).

(5) I.No. 25/28. Twelve reports (3 England and Wales, 9 Scotland, including 2 of nursery stage only). Growth in plantation : good (7) ; fair (2) ; poor (1). Form : good (5) ; fair (3) ; poor (1). In nurseries : one good, one poor.

(6) I.No. 27/35. Five reports (2 England and Wales, 3 Scotland), one of nursery stage only. Growth in plantation : good (4). Form : good (3) ; fair (1).

(7) I.No. 28/27. Eight reports (7 England and Wales, 1 Scotland), of these five refer to nursery stage only. Growth in plantation : good (3). Form : good (3). Growth in nurseries : good (6) ; fair (1) ; failed (1).

(8) I.No. 29/27. Twelve reports (3 England and Wales, 9 Scotland) all on nursery stage only. Growth and form good to very good in all cases. Germination poor to good.

(9) I.No. 30/27. Five reports (4 England and Wales, 1 Scotland) all on nursery stage. Germination and size satisfactory, except in one case where the soil conditions were unfavourable.

The data on germination are very incomplete, but this appears to be much on a level with that of Tyrolese or Swiss seed.

The reports do not throw much light on the form of the Sudeten larch in plantation as compared with other larch races, but considerable variations in form of branching and colour appear to exist. The following are some of the observations recorded in the reports. (1) Radnor Forest, 25/28. Shoots pale, with small buds, leaders straight and sturdy. Out of 14 larch races planted in P. 28 the Sudeten come third in rate of growth after two Scottish races. (2) Radnor Forest, 25/28. Tall strong plants, rather coarse with many side buds on the leaders. Sudeten the best out of 7 races planted in P. 29. (3) Slattadale, 23/8. Irregular in growth, stems slim and side branches weak, growth poor. (4) Inverinate, 24/17. Stem and branches exceptionally slim, branches long in comparison with height, growth inferior. (5) Eilanreach, 24/17. Plants inferior when planted but have made marked recovery. Most of stagheaded plants have now made leaders, and 25 per cent. of the trees have a very good form.

Summary.

The reports are generally favourable in respect of rate of growth and form as well as germination. The later consignments are especially well reported on and appear to have done better than other continental larch seed. A much more extended use of Sudeten seed would appear to be justified.

LAND ACQUISITION IN SCOTLAND.

By L. A. NEWTON.

By way of preface, I would say that the acquisition of land and its economic utilisation are questions of the first importance to all technical officers in the Commission. I would add that, while expressions of opinion on the policy employed for both purposes would be out of place in a public print, the submission of one's ideas on the subject may not be without interest to readers of a purely domestic Journal. I propose to confine my remarks to Scotland, for which country I have the figures and know the conditions.

At the present date (mid-February), if we take into consideration land for which acquisition has been completed, and if we allow for the planting commitments of the present season, the plantable land available for future seasons is slightly over 80,000 acres. By the end of the financial year other acquisitions will have been completed and the area in hand will be slightly larger. The Commission's commitments for the whole country for new planting for the current decade are, roughly speaking, 350,000 acres. Whatever be the proportion to be allotted to Scotland (and this can hardly be less than one-third) it is obvious that acquisitions of large areas will be necessary if the balance in hand is to be maintained, so as to secure an orderly sequence of plantations in each forest area.

Acquisitions of plantable land in Scotland in recent years have generally averaged somewhere near 17,000 acres. This is sufficient, in the meanwhile, to secure an annual planting of say 10,000 to 12,000 acres and still add something to the balance; but in the latter years of the decade larger plantings will be necessary, and, if ordered sequence is to be maintained, very substantially larger balances will be required.

Before the time of the Commission's formation, the prophets of those days, when estimating the plantable acreage of Scotland, spoke in numbers made up of seven figures. At the present time, estate after estate, comprising in all many square miles of "waste lands," as well as better farms, are thrown on to the market. Meanwhile, the annual average acquisition of plantable land is, comparatively speaking, a paltry 17,000 acres. The conclusion quite readily drawn is that either the prophets were utterly wrong or the Acquisition Officer is not doing his duty. I do not think the prophets were utterly wrong and also I do not agree to the latter alternative. The plantable land is there all right, but what is wrong with it is its distribution.

In Scotland very large estates are becoming more and more rare. The landowner, who of his own volition could convert 50,000 acres into a single deer forest, no longer exists. The tendency is all the other way, estates tend to become smaller and smaller. Many properties which are offered to the Commission contain between 1,000 and 8,000 acres. In these cases, if all the suitable planting land were set aside for that purpose, the result would too often be either to rob a deer forest or a

sheep farm of all wintering or to deprive small mixed farms of the whole of their outrun. In my report for the Forest Year ending 30th September, 1930, I find no fewer than 56 properties for which negotiations were broken off. Whatever the reason ascribed, the fundamental reason was always the same, viz., the area of plantable land was not sufficient to carry the high value of the surplus assets. For half of these properties the plantable acreage is given as 20,767 acres, for the other half the plantable acreage is not specified. Assuming it were about the same amount, then the total plantable acreage lost during that one year would be, in round figures, 40,000 acres. The casual traveller who traverses the valleys and glens of Scotland sees many a hillside which may appear admirably suited to timber growing, but which on inspection does not come up to expectations.

If these premises are correct—and I do not think they can be gainsaid—it is at this point that one must leave the safe entrenchments and sally forth into the battle area of Policy.

A glance at the rent-roll of the Commission's estates in Scotland reveals the fact that about twenty estates return a rent of over £200 per annum, fifteen return over £400 per annum, ten over £600 per annum, seven over £800 per annum, and four over £1,000 per annum. These rents are due mainly to shootings and agricultural leases. They are mentioned to show that the Commission both can and does purchase rent rolls. I would advocate an extension of this principle. Among the conditions of success would be the following :—

1. A sufficient block or aggregation of blocks of plantable land.
2. A willingness on the part of the pure forestry interests to give up a proportion of the plantable land in order to preserve a possible economic entity for an acquired farm or farms.
3. The sanction of the Treasury to enable the Commission to carry permanent rent rolls and not be under the necessity of realising so-called surplus assets under any sort of pressure.

The first and third of these conditions are, of course, essential. It is the second which might now be further considered. Imagine a private landowner who has a fairly large mixed estate and has also a strong bias towards afforestation. His tendency will be, while doing his utmost to extend his plantations, at the same time to preserve, as far as possible, workable farms, and with them his rents. He will also, as a large-minded man, try to devote each section of his estate to the purpose for which it is best suited. Such estates, both large and small, are offered to the Commission. The present practice in an acquisition report is to indicate the number of plantable acres and the number of arable acres. If the proportion of the latter is too large the estate may be, and frequently is, regarded as unsuitable for the Commission's purposes. Suppose, for example, that an estate is reported on as having 2,000 plantable acres and 600/800 arable acres, and suppose that there are several mixed farms which rely both upon plough land and outrun. The devotion of the whole 2,000 acres to plantations would reduce the bulk of the arable to a

small and very problematic value. If, however, it were decided to plant only on 1,000 acres and to maintain 1,000 acres of outrun to go with the arable land, the several farm boundaries if necessary being readjusted, the result to the Department purchasing the estate would be this: An area of 1,000 acres would be added to the Department's woodlands, and the rest of the purchase price would be represented in the rent-roll for the farms. As a rule the only alternative to a course such as is described is to give up all hope of acquiring the place, whereby 1,000 acres of new plantable ground is lost to the Commission.

To fulfil their programme, the Commission must acquire more land. The problem confronting all those officers interested in or responsible for acquisition is whether to try for it in large blocks including much land of speculative value, or in smaller areas, in which case some arrangement on the lines suggested in this paper seem to me to be necessary. The acquisition of selected areas highly suitable for forestry, but unencumbered with surplus assets, is becoming yearly more difficult. To put my proposals into effect would require a strengthening of the estate side of the Commission's activities and a complete liaison between the forestry and estate sides.

There remains the last resort of Compulsory Acquisition; but in what way can this help? The most ardent partisan of this method could hardly justify taking a section of an estate regardless of the effect of such action on the remainder. An unwilling seller would naturally require high compensation. The purchase ot the whole of a property by compulsion on the other hand, would have no advantages over such a purchase in the open market. The problems connected with the full utilisation of all the assets would still be present; and, the purchase having been compulsory, the searchlight of public criticism would be concentrated even more closely upon it.

COST AND ERECTION OF FIELD TELEPHONES.

By P. R. S. WILD.

Cost of laying 1 mile of telephone line, 2 wires, based on cost of erecting 1½ miles of line over a mountainous area, where haulage charges are high; cost per unit would, no doubt, be considerably cheaper on level ground.

Materials required.

	£	s.	d.
132 lbs., 16 gauge, hard drawn copper wire (66 lbs. per mile) at 1*s.* 2¾*d.* per lb., from Edison Swan Cables, Ltd., Lydbrook, Glos.	8	2	3
1 gross 2-in reel insulators, at 8*s.* 4*d.* per gross, from Edison Swan Electric Co., 25/27, Charles Street, Cardiff	0	8	4
1 gross 2½-in. screws, 28 lbs. 1-in. netting staples and 2 lbs. zinc washers, local purchase..	0	7	6
Few yards "lead in" insulated wire as required, local purchase, 2*d.* per ft., say	0	4	0
2D Mark III or other field telephone instruments, at 15*s.* each (Hqrs.)	1	10	0
4 pairs inert cell batteries (2 pairs as spares) at 1*s.* 6*d.* pair, size 582, from Messrs. T. W. Thompson, 1, South Street, Greenwich, London, or the makers, Siemens of Woolwich	0	6	0
40 Larch poles of required length at local valuations, say	2	10	0
½ cwt. barbed wire at 18*s.* per cwt.	0	9	0
½ cwt. No. 8 gauge plain fencing wire at 15*s.* per cwt.	0	7	6
Labour costs: erection of poles, fitting spiral barbed wire as lightning conductor and 3 staying wires to each pole, fixing insulators and telephone wires ..	6	10	0
Haulage of poles, based on local conditions, say ..	2	0	0
Total cost per mile	£22	14	7

Costs at Llanover worked out at £20 3*s.* 4*d.* per mile, over mountains, but this is owing to the fact that the value of the poles was not charged.

Method of Fixing up Field Telephone.—This can be done very simply by own labour and without the services of any electrician; all that is required is an intelligent man to fix the line, under competent supervision. Poles should be set up about 2 chains apart, holes being dug about 2 ft. 6 ins. deep for each pole, a length of barbed wire a few feet longer than the pole is cut off and twisted spirally round it from a point which will be below ground level at the butt and carried up to the tip and extended some 6 ins. above tip of pole as a lightning conductor. Three pieces of plain fencing wire, old material will do, are cut off and stapled to top of

pole to act as staying wires, and are pegged into ground when pole is up. This allows a light ladder to be set up against the pole for fixing insulators, and later for repair work.

After the line has been marked out by placing a peg where each hole is to be dug, and the poles have been hauled to their respective spots, the services of seven men under the forester will be required, two men to go ahead and dig holes, two to follow up and fit up the poles with barbed wire and staying wires and erect the poles, and they in turn to be followed up by the linesman and two assistants who work as follows. Primarily it may be mentioned that the wires must not be put up parallel, but should cross between each pole, as a guard against induction (as illustration).* At the starting point a board should be prepared to hold two insulators, and is fixed to the wall of house above window where "lead in" wire enters to the instrument. Having fixed this in position the linesman gives a coil of wire to each of his assistants and fastens the loose end of each coil round an insulator. The two men then walk back to the first pole unwinding their coils and cross over before reaching the first pole, carrying on till they halt some 20 yards beyond. The linesman puts up a light ladder to the erected pole and, carrying a planting bag full of insulators, screws, washers, pliers, screwdriver and gimlet, fixes insulators taking the top line first and placing the insulator nearly at the top of the pole on the side at which the top wire comes. The lower insulator is placed 16 in. below the first on opposite side of the pole, a washer is placed on each screw to prevent the porcelain being cracked when the insulator is finally tightened up. The linesman then fits the telephone wire on the insulators by taking a double turn of wire round the insulator and turning it in his hand until wire is tight, his assistants in front carry a strong pointed stick 3 ft. long and at his direction place the point of the stick in the ground, take a turn of wire round the top and, using the ground as a fulcrum, strain the wire to the required tension and hold fast till the linesman screws tight the insulators and screws the line with a short piece of copper wire twisted round line at one side of the insulator carried round under and twisted again round line at other side. It is said to make a better job if this is secured by a spot of solder, but it is quite impossible to carry a blow lamp and soldering outfit about on this job, especially when working from a ladder, and the above simple method has been quite effective at Llanover.

This process is repeated at each pole, the men crossing the wires as they go. The 16-gauge copper wire is very tough and will stand a big pull, though it will, of course, break if allowed to kink. It is very easily uncoiled by hand and does not easily become tangled. In turning corners four insulators are required on each pole, and the wire is fastened to its proper insulator on the pole when the turn is reached and then cut, a second insulator is placed on the side of the pole and the line commenced afresh from that point, the union being made with a short piece

* It is regretted that the illustrations (pen sketches) which accompanied the manuscript cannot here be reproduced. They are retained on the Commission's files at 9, Savile Row, London, and are therefore available for reference.—Ed.

of wire as before. The two wires should be kept at similar tension as far as possible throughout, and if the above system is carried out the line can be very quickly completed.

Instruments.—The lead-in wires are fastened to the copper wires on the insulator board on wall of house, and carried down through hole in window frame to the instrument, one wire being fixed on each terminal on side of instrument box, but before making this connexion the inert cells are put in, first being connected in series by a piece of copper wire, whilst two other pieces are fixed to the remaining clips and fixed to terminals in rear of instrument box. Directions for fitting the inert cells are printed on them. The phone is then in working order. Inert cell batteries give very good results and have a long life. Unfortunately, on the D III phones the bell is not loud, and where the phone is installed for fire alarms a supplementary electric bell, in the form of a door bell, can be added at a further cost of 6*s.* 10*d.* inclusive of wiring and battery. This can be fixed anywhere in the house and, on the phone being rung, this bell is set going and will make plenty of noise. To fix this bell, take an ordinary flash lamp battery and the required length of flex. Fix battery in left hand corner of front of box with a tin clip and two screws. Take off adjusting bar of bell knocker and file bright, also side of knocker which touches knocker bar. Replace bar, attaching one strand of end of bell wire to screw on knocker bar "A." Attach end of second strand to terminal of battery "B." from terminal "C" run one single wire, untwisted from a piece of wireless flex to bell knocker arm, which when in operation makes contact with knocker bar and completes the circuit. It is advisable to cut the bell wire near the box, unravel the binding, expose the ends of the wire and bend them over in the form of hooks, so that they may be connected or disconnected at will. They should be disconnected when thunder is about, as the lightning always strikes the bare copper wire, and although it does no damage to the phone, it sets the electric bell ringing, and it cannot be stopped till the bell knocker has been pushed back to its place.

Upkeep.—The D III type of phones do not readily get out of order and failure to communicate may generally be put down and traced to crossed wires, though this should not occur if properly put up. The only other thing that is likely to happen, given that the batteries are all right, is that one bell or the other fails to ring, and as these phones are very secondhand affairs this has already occurred at Llanover. If this happens the back of the box should be taken off and the revolving apparatus which generates the current taken out. This is in the form of a circular piece of steel, and it should be roughed up with a piece of sand paper or match box, replaced, and will be found once again in working order.

R.E.A.S. SUMMER MEETING, 1930: FORESTER'S REPORT.

By P. R. S. WILD.

The main business of the meeting comprised visits to three different estates, the greater part of each day being spent among the woods and plantations grown on various grades of soil.

The first day of the meeting was spent on the Midhurst Estate of Lord Cowdray, which consists of some 4,900 acres of woodlands in which, since 1910, a regular planting programme has been carried out, the results having evidently justified the labour and expense. Previous to the purchase of the estate by the late Lord Cowdray in 1910, the woodlands had been badly depleted by excessive fellings, the annual timber sales between the years 1875–1880 yielding £94,612, or an average of £15,768 per year, and very little had been done towards replanting. The present Lord Cowdray, after having planted the areas felled during the war, drew up in 1923 a working plan allowing for a regular annual planting programme of 60 acres, though records show that this has been exceeded by 12·6 acres annually, the total amount planted over the last eight years being 581 acres, the previous acreage planted between 1910 and 1922 being only 197. The first point of interest was a group of yews, 260 years old, reputed to be the tallest in Europe, averaging a height of 80 ft., the greatest quarter-girth of an individual tree being 20½ ins. Some of these trees are dying and suggestions were requested to determine the best means of reviving them. An application of blood to the roots as a resuscitative medium was suggested, but it is very doubtful if anything can be done to save the dying specimens of these beautiful yews, and probably too much sentiment is attached to them to cut down those that are failing in order to give an added lease of life to the more healthy trees.

From here the party moved on to inspect a 6-acre plantation of Douglas fir, planted in 1910, at 4 ft. × 4 ft. spacing. The plantation carries an average height of 50 ft. with a Q.G. of 4 ins. to 6 ins. It has been thinned six times, the gross receipts from this 6-acre plot being £195, on sale of the thinnings, which are at present cut and sold in the wood at 90*s.* per 100. This plantation has obviously paid its way and still will have one more thinning before it is left to mature, and while 4 ft. × 4 ft. spacing requires one more thinning than 5 ft. × 5 ft., yet on such fertile soil as this 4 ft. × 4 ft. spacing is apparently preferable as regards revenue. The estate finds no difficulty in disposing of Douglas fir and larch poles, the former probably being converted to scaffold poles by the purchaser. Leaving this area the walk continued past a promising P. 21 Douglas fir plantation, average height 16 ft. to 18 ft., arriving at a clearing in an 80-year Scots pine wood, where natural regeneration has proved to be a failure. Compared to planting it has cost four times as much, with disappointing results. Some of the naturally regenerated plants have taken eight years to attain a height of 2 ft. 6 ins. to 3 ft., and compare badly with a Scots pine plantation of exactly the same age planted in the ordinary way.

The next point of interest was Verdley Wood, an area of 388 acres, originally pure oak, which between 1914 and 1927 was so badly defoliated by the oakleaf roller moth that it was felled during this period, and is now replanted with some 200 acres of Douglas fir and the remainder with larch. Two areas of European larch planted in 1914 and 1915 were inspected here, growing on Grade 1 soil planted at 5 ft. spacing, the 1914 plantation having shown a marvellous growth of height and girth for its age, carrying a very uniform height of 50 ft. Sales of the last thinning realised 70*s*. per 100 on the ground. The latter part of the day was spent among the chestnut plantations and nurseries. Chestnut pale-making seems to be an important industry on the estate, which has an area of 1,000 acres of chestnut underwood. The *modus operandi* appears to be in planting an area with sweet chestnut at 3 ft. spacing, when in ten years' time it is sold in standing lots. It may be cut again in twelve years' time, giving a much greater yield, many shoots having grown from the original stump. A quicker return may be gained from the 12-year old shoots from the stools of a matured wood, felled and sold as timber, but as sweet chestnut does not find a ready market owing to its liability to form ring shakes during growth, and consequently falls to pieces during conversion in the sawmills, it would seem that cultivation of chestnut underwood is far more profitable than growing the tree for timber. Standing lots are sold to firms of chestnut-pale fencing makers, the underwood making about £14 per acre, though this price is subject to variation according to crop or demand. The wood when purchased by a firm is cut, converted to pales and bundles by their own men on a piece-work rate of 2 ft. pales 1*s*. 4*d*.; 3 ft., 1*s*. 9*d*. and 6 ft., 3*s*. 9*d*. per 100 in bundles of 25. The number of bundles being afterwards collected and conveyed to the mills to be wired together to form the finished product.

The nurseries showed wonderful results, the soil is of the best and has not yet had any manuring. The annual growth of seedlings and 2 + 2 plants is almost abnormal.

E. larch, 2-year seedlings, average 15 ins. to 17 ins.
E. larch, 2 + 2 transplants, average 2 ft. 6 ins.
J. larch, 2 + 2 transplants, average 3 ft.
Scots pine, 2 + 2 transplants, average 2 ft.
Chestnut, 2 + 2 transplants, average 2 ft. 6 ins. to 3 ft.

Even nurserymen were impressed by this prolific nursery.

The second day of the meeting was spent on chalky ground, where beech, Douglas fir and larch had been planted, on the West Dean Estate. Most of the coniferous plantations planted during the last 35 years contain a 25 to 50 per cent. mixture of hardwoods, usually beech, the intention being to cut out the larch and Douglas fir during the first 60 or 70 years' growth with a view to a final crop of beech, which owing to the chalky subsoil of the ground is the principal crop. Douglas fir appears to thrive here, and one plantation (1911–12) shows an average height of 50 ft., with an estimated Q.G. of 8 ins. to 9 ins. Although it is termed chalky ground yet there is some 2 ft. of good sandy soil above the chalk containing very little lime; it is probable that these flourishing

Douglas firs may begin to decline when their roots get down to the limestone. It is contended that there is very little lime in this soil, this is being backed up by an example of a fine Douglas fir of some 60 years' growth, growing on chalk which is cropped out to within 6 ins. of the surface of the ground.

The plantations throughout had a healthy appearance and compared very favourably with those seen the previous day. A 90-years'-old beech wood was inspected, some 2 or 3 acres of which had been felled during the last two years. These lots carried 120 trees to the acre, which yielded 3,600 cu. ft., realising just over 1*s.* per cu. ft., or £190 per acre. This shows a return of £2 2s. per acre per year since the time of planting, minus planting and weeding charges in its early stages. These figures should be convincing enough to show that really good returns are gained from beech on chalk soil.

The final day of the meeting was spent on the Herons Ghyll Estate, on soil ranging from sand to a mixture of white clay and sand which grows some excellent Jap. larch and European larch, while there are some very good Douglas fir on the sandy parts of the area.

A 50 per cent. mixture of beech, alternate row system, is introduced in most of the coniferous plantations, on account of the great manurial value of the leaves. A theory was advanced that group planting of beech superseded the method of alternate rows. Groups of 25 planted 40 to 50 yards apart have a chance of getting away together and, apart from this, the leaves are more evenly distributed over the ground, and ultimately, after thinning out is completed, there would be one big beech left from each group, or 10 to the acre.

Sitka spruce, Jap. and European larch planted since 1921 showed a wonderful growth. A P. 30 plantation of Jap. larch as 2 + 1 had an average height of 3 ft., showing what good results are being met with on this soil.

To sum up, one would say that although excellent plantations were seen, on excellent soil, the work of the Forestry Commission is not so far behind the exhibition work of these great estates. Their programmes are confined to smaller acreages and their plantations can be more carefully tended than in the case of the larger areas dealt with by the Commission. Comparing the Commission's 1921 to 1930 areas in South Wales with those of the same age in Sussex the Commission's woods on poorer soil seem to be as far ahead with Scots pine and Sitka spruce and perhaps a little behind with the larches. The writer will not commit himself by saying anything about Douglas fir, however. On the whole, our plantations compare favourably with anything of this period seen during the meeting, though it remains to be seen, whether we, with our much larger programme, can tend and thin our established plantations to attain the same results and yield the revenue that these estates are getting from their older woods.

EXCURSION OF THE ROYAL SCOTTISH FORESTRY SOCIETY, NORFOLK, 1930.

By A. H. POPERT.

The first visit was paid to the Earl of Leicester's estate at Holkham. After seeing the estate sawmill and carpenter's shop, the party walked through Scarborough Wood, which is a mature wood of mixed hardwoods, including some very fine ash growing on fairly shallow boulder till over the chalk with adequate water supply, which makes up for deficiency in rainfall. A small area was also visited on which *Thuya plicata* was regenerating naturally where it was protected from rabbits, which form a serious pest and effectually prevent any natural regeneration, except in the case of sycamore which grows like a weed and which they do not seem to touch. East Belt wood, which is part of the main belt, several miles long, passing round the estate, was next seen. Here similar conditions obtain, except that in places the chalk is very near the surface and the till absent, which militates against the good growth of oak, ash and chestnut which is so apparent on the boulder till. Both these woods of mixed hardwoods appear to have many mature trees in them which would be better removed, but æsthetic considerations prevent any method of regeneration except the selection system, and this is very difficult to execute owing to the rabbits. A wood of mature Corsican pine growing on almost bare chalk was also visited and the contrast between the Corsican and Scots pines noted.

The results of reclamation and afforestation of sand dunes along the sea coast were inspected. There does not appear to be any difficulty over the shifting sand, which is being deposited by the sea on this part of the coast, and the first plant to appear is the marram grass. The first seedlings of Corsican and maritime pines are few and far between and grow very slowly, but the process would be accelerated by removal of rabbits, which are very plentiful. The plantations on the dunes were first started in 1865 and were completed in 1890, and are composed of Scots, Corsican, maritime and Austrian pines planted 25 ft. apart; the marram grass died out as the canopy closed up.

One of the best examples of what will happen where rabbits are excluded was a small patch of mixed pines, aged from two or three years to 15 or 16 years, which had grown up and formed a dense thicket on a small neck of land surrounded by deep ditches which exclude rabbits. Considerable use is made of elder bushes which strike from stakes inserted in the sand as fixing agents for the sand on exposed points.

On the second day a visit was paid to Lord Hastings' estate at Melton Constable, on which there are considerable areas of young plantations of many species made during the years 1906 to 1923. The site of the plantations was a dense oak forest which was very heavily thinned so that there were only about six trees per acre in 1906. Japanese larch has been planted in some quantity, and some plots formed in 1926–27 are now 12 ft. high. The planting distance was 4 ft. × 4 ft., while Douglas fir

in adjacent plots were planted 6 ft. by 6 ft. The Douglas fir have been mixed with *Thuya* in some cases and is holding its own, probably owing to its freedom from *Chermes cooleyi*, of which very little was visible. Many of the plantations are mixtures in rows of oak, beech, ash and chestnut, pit-planted in rows 6 ft. apart.

In those plantations made about 1911, which have now reached the thinning stage, the problem of treatment to obtain an oak wood has arisen. The beech and chestnut have in most cases obtained so much mastery that it is highly doubtful if there will be more than a few oak in the final crop. In other cases conifer nurses have been mixed with the oak and various treatments are in process of being tried, including the removal of the nurses at an early age. Where spruce has been used as edging for the plantations. it has made extremely good growth, but is not so successful where mixed in plantations. The soil conditions here are favourable to growth—being boulder till covered in places with deep sand and gravel.

Hindolverton Wood, which was visited, is an area of considerable historic interest and 169 acres in extent. It has apparently been a wood of oak standards over hazel coppice since the time of Domesday Book, and still grows good oak. Records of the See of Norwich show that it has been maintained in almost its present character for 600 years at least, though there are now no trees in the wood over 125 years old. Four years ago the largest tree was estimated to contain 135 cu. ft., and the average volume for the oak standards was 40 cu. ft., and the density was about 20 trees per acre. An interesting point very noticeable in this wood is that oak defoliation was not bad last year and was much less in areas cleared of coppice, i.e. recent coupes, than in coupes where the hazel coppice is ready for cutting and larger in size.

The underwood is cut over in eight annual falls and the utilization is very complete. A coupe of 21 acres employs four skilled men from November till April and produces 60 dozen wattle hurdles, 700 bundles of pea sticks, 1,000 stakes, 250 poles, 7,000 tying bands, 600 fencing binders, 1,000 hammer handles, 32,000 prickets for thatching and 15,700 faggots which are used in the estate brickyard. This intensive utilization of the coppice is possible where a local demand exists for the produce and where freight costs are consequently low, but it is questionable as to whether it could be done in many parts of England, but as an example of what can be done with good hazel coppice it is exceedingly interesting.

Fulmodestone Wood, which belongs to the Earl of Leicester, was next visited. This wood is very interesting from an arboricultural point of view, and very fine examples of exotic conifers are growing there, which were introduced from 1870 to 1875. One of the finest trees was a *Tsuga Albertiana*, which is 74 years old, 90 ft. high and 26½ quarter-girth at breast height. Other fine specimens were Douglas fir, Sitka spruce Thuya, and *Taxodium distichum*.

The third day was spent in a visit to Thetford Forest and Ryston Arboretum. Considerable regret was felt that longer time could not be allotted to the former, as successful afforestation on such a large scale

was of great interest. Visits were paid to the large nursery at Mundford and to the rejuvenated village of Santon Downham, in which converted buildings, saw mill, creosoting and seed extraction plants were examined. Fears as to possible calamities in such extensive areas of Scots pine were expressed, particularly in regard to the possibility of attack from nun moth, but apart from some small damage by *Tortrix buoliana* nothing is to be found at present and it is to be hoped that the difference in climatic conditions between Germany and East Anglia will prevent any invasion by insects. The visitors were very interested in fire precautions, particularly in the ploughed strips and in the small fire beaters of brushwood kept at intervals along roadsides.

On leaving Thetford, the party proceeded to Ryston, where Col. Pratt has established in three fields an extensive arboretum of broad-leaved trees. Educational value of this arboretum is rather lacking owing to the absence of any labels, but good comparisons are afforded of the relative growths of isolated specimens of different varieties of the same tree. This estate is well known for the cultivation on commercial lines of cricket bat willows, which are planted out as three years sets 10 to 12 ft. high from a nursery. These are placed in hedge rows and felled in about 12 years' time, when they have reached a diameter of 9 or 10 ins. A very high price is obtained for the butt lengths.

An example of a small mixed wood of conifers was seen on this estate which afforded a very marked contrast to the well-thinned plantations visited so far, as it had reached a height of 30 ft., had been closely planted and had not been thinned at all, with the result that wind and storm conditions had bent over many of the trees and most of the wood was in a very bad condition and had got beyond all hope of recovery.

The last day of the tour was spent at Weasenham, the property of Major Richard Coke. It is an extremely good example of the results that can be obtained by careful management on a small scale, an all-round profit of £1 per acre per annum being obtained from a wood of 141 acres, the staff employed being a man and two boys. The system employed by the owner and his father has been more arboricultural than silvicultural on the whole, and the results are very interesting, as the wood contains fine examples of many exotic conifers. Growing conditions for trees, with the exception of late frosts, which appear to be general throughout the district, are excellent. In many parts of Weasenham Wood, where gaps have occurred, they have become automatically filled by natural regeneration of larch, Scots pine, sycamore and other species, in places where the rabbits have been excluded. In cleared strips felled during or since the war, much use has been made of Scots pine as a nurse for larch, and adequate protection from frost has been obtained ; where there is no protection, severe frost damage has resulted. Tender species have been introduced successfully under a thin canopy of mature Scots pine.

The soil conditions are variable and in places there is a distinct hard pan at a depth of 10 to 20 ins., which disintegrates quickly on exposure to the atmosphere. There is a shallow gravel layer over the boulder till, which probably accounts for the good growth of the more exacting species. Where the chalk comes close to the surface the growth is not so good.

FIXATION OF SHIFTING SAND.

By G. W. Hollis.

The term " fixation " is not a common one in the Forestry Commission progress reports, and to those unconcerned it suggests very little. This sub-head, which comes under " Preparation of Ground," means a great deal at Pembrey and to other similar shifting-sand areas. Approximately one-third of our annual expenditure goes to this work, and for the greater part of the year some class of work is being carried on in connexion with the fixation of sand.

On vast stretches of shifting sands, the first and probably the most difficult step towards afforestation is to " fix " or stop the movement of the sand. After nearly three years' work, I feel fairly safe in venturing a few remarks on the procedure and the progress made at Pembrey. There are many species of grass that grow to some degree or other along our shores; but the most common is the marram or sea-matweed (*Psamma arenaria*). This is a very coarse grass that grows in tufts and spreads mainly by long underground rhizomes. One chief peculiarity of this grass is that it thrives best when it is continually being covered by fresh sand and that it loses its vigour when fresh sand is not forthcoming. It is on this species of sea-grass that we rely mainly to aid us in fixation.

Marram may be planted throughout the year, but results show clearly that planting done from October to May does far better than that done when the sand is generally hot. One year differs from another according to the temperature and degree of moisture maintained during the summer months. The procedure of planting marram is :—

(1) To pull tufts of grass from places thickly covered.
(2) Plant by means of Schlich's spade on the shifting stretches of sand.

I find the most economical gang for this work is : one man holing with Schlich's spade, 2 ft. 6 ins. × 2 ft. 6 ins. apart, with two boys planting behind him; one man pulling the tufts, with a strong lad carrying to the planting area if any considerable distance. So long as the sand is moist and not drifting much, the holes made will remain open sufficiently long for the boys to plant. Planting as described costs approximately 30*s*. per acre, circumstances being favourable. Good grass planted in this way, even when successful, will grow very little the first year, but providing it is not blown out or completely buried by drifting sand before the next growing season commences, it will begin to send out rhizomes, and at the end of the third growing season successful marram plantings will have thickened up and the tufts originally planted will have spread until almost all the intermittent spaces are more or less covered. It will be understood that as the marram leaf-blades lengthen and bend over, the sand is so protected that the force of the wind cannot strike direct on to it and therefore it remains in a more staple form, making it possible for

dwarf grasses, mosses and other herbaceous plants to take hold and grow beneath the marram.

At this stage, three years after first tackling the shifting sand, it is safe to introduce the species of tree to be planted. According to evidence obtainable from experimental plantings on the Margam sand dunes and at Pembrey made 20 or 30 years ago, it is easy to see that the merits of the Corsican pine outweigh those of the maritime species, with this knowledge to hand we are planting 95 per cent. Corsican pine and experimenting with *Pinus contorta*.

Reverting to the problems of fixation; in this short account of the fixing of shifting sand from the time of planting the marram to that of the trees, no allowance is made for reverses which invariably have to be contended with. For instance, when marram is planted on the slope facing the prevailing wind, it usually becomes bared of sand to such a degree that replanting is inevitable, while those plantings on the leeward side get such an accumulation of sand that the planted tufts are completely buried, and therefore replanting again is necessary.

After experience gained, I am of the opinion that to plant marram without further aid to fixation, in exposed areas at least, is absolutely futile. The ideal help to marram planting would be an unlimited supply of " broust " (lop and top), and as each area is planted with marram a good covering of " broust " could be applied, thus reducing the possibility of an exposed area being completely bared of sand and of the opposite slope being excessively covered. As we have comparatively little " broust " available at Pembrey, we have experimented with reed, rough grass or any other coarse vegetation obtainable. This is preferably cut when the seed is about ripe and should be carted to the area as early as possible to avoid loss of seed. Material such as this has been used with great success, and not only does it bind the sand temporarily, but millions of seeds germinate and grow, forming quite a turfy layer under the marram. Haulage is expensive, but results to be seen from experiments made in 1929 prove that it is worth while.

The first marram plantings were made here in April, 1928, and we intend to plant the best of these areas with Corsican pine 2 + 1 this season. An area of about 250 acres of naturally fixed sand has been planted up to P. 30 with Corsican pine and, apart from some damage by rabbits, is doing very satisfactorily.

REPORT ON INSPECTION OF AFFORESTATION GRANT SCHEMES.

By D. F. STILEMAN.

The inspection of areas planted under grant schemes was carried out by me from the middle of March to July last year in parts of South Wales, the South-West of England, the Midlands, Yorkshire, the North-West Counties and the Home Counties. Planting had been carried out under a great variety of soil and climatic conditions, and the results were on the whole most promising. It is encouraging to note that landowners are in many cases planting up waste areas which are unfit for any other purpose, in addition to the replanting of old woodlands. Owners of estates appear to take a great interest in the formation of the young plantations, and in some cases, especially among the smaller landowners, personally supervise the planting and weeding operations.

It is apparent from my inspections that care has been taken in selecting species suitable to the factors of the locality. In only a few instances I noticed that the species were obviously unsuitable, e.g.—oak, European larch, in a black sour soil in a swampy area. In another case an area on chalk downs with only a few inches of top soil had been ploughed up and the plants, Scots pine and Norway spruce, planted in the furrows on pure chalk, no use having been made of the top soil. In several cases areas containing old standards with a dense canopy had been underplanted with Scots pine and Norway spruce, and such areas naturally had to be excluded from the total areas available for a grant.

The plants used, generally speaking, were of good quality and of a suitable size. In the majority of cases they had been obtained from nurserymen, but in some of the larger estates private nurseries were maintained, the usual practice being to purchase 1-year seedlings and line them out in the nursery. On some estates a few extra thousand plants were ordered and lined out actually within the area planted to allow for beating up in subsequent years. In at least 30 per cent. of the areas planted up with conifers, and for which only a conifer grant was claimed, a small proportion of hardwoods, chiefly beech, ash and sycamore, were planted.

On the whole the planting was well executed, properly spaced and in regular lines. "Pitting" was the most common method of planting, "notching" was employed in only a very few instances. Invariably, the planting was done by workmen on daily wages. The firming of plants subsequent to planting was largely undertaken. The weeding of newly-formed plantations was generally well attended to. In one instance the ground in between the rows was intensively cultivated, and judging from an area planted in the previous year and treated in a similar manner, the result was exceptionally good.

It was most noticeable throughout the areas I inspected that drainage, wherever necessary, had been well attended to. In most cases the plantations had been properly fenced with rabbit-proof wire. In only four

instances was I unable to certify that the planting had been properly carried out, and in these cases the plants had been very severely damaged by rabbits or deer.

The maintenance of plantations was, generally speaking, good ; but in about 30 per cent. of the schemes inspected, it was impossible to certify that the whole of the plantations had been properly maintained and beaten up. Failures were only in a very few instances caused by lack of weeding. Blanks in many cases could be accounted for by planting in bad frost hollows, and also by failing to maintain the fencing, with consequent damage by rabbits. On some large estates the forester was unable to attend adequately to the maintenance of the plantations owing to reduction of staff and large extent of operations under his charge. In only three or four cases were the planted areas totally neglected, and in such cases the owners were called upon to refund the grant.

In some instances owners or their agents appeared to be genuinely unaware that their plantations were due to be finally inspected, with the consequence that beating up had been deferred. In order to obviate this I recommend that a notice be sent to all grantees in the autumn of the year prior to a final inspection being made, informing them of the intended inspection and warning them of the consequences if the areas are not properly maintained.

The question of the adequacy of the grant for planting and clearing scrub is a matter for consideration. The total cost of planting and fencing comparatively small areas by private owners is, according to their statements, at least £15 to £20 per acre, and in addition to this, maintenance is a very considerable item. Although the present scale of grants is undoubtedly a small encouragement, I am doubtful whether it is sufficient in most cases to induce owners to plant up areas with which they would not otherwise deal. If the grants were enhanced the probability is that many more of the smaller land owners and farmers as well as large estate owners and corporations would consider the question of planting waste land and old woodlands. With regard to scrub clearing, many owners complained that the minimum area fixed was too large. If the minimum area were to be reduced to 10 acres or even less, the probability is that larger areas of waste woodland would be replanted.

In many of the grant scheme files relating to final inspections, no map or tracing of the area planted is attached. It would be of considerable help to inspecting officers if such maps were invariably included in the files.

THE TREATMENT OF ALDER AND BIRCH IN THE NURSERY.

Increasing use of alder and birch species as nurse trees on poor and exposed sites, on account of their wind-resistant and soil-improving qualities, and their capacity for rapid growth in youth, will involve the growing of these species on a fairly large scale in the nursery. To obtain the best results the technique must be varied considerably from that normally used for coniferous species and for large seeded broad-leaved trees.

The following recommendations are based on the results of experiments carried out by the Research Branch.

Storage.

Alder.—The seed should be extracted from the cones, mixed with an equal bulk of clean, coarse sand, and stored in a box in a well-drained open pit until the spring.

Birch.—With this species storage is an important matter as the seed do not retain their vitality very long. After collection the catkins should be set out to dry and allowed to fall to pieces. The combined seeds and scales should then be mixed with sand as in the case of alder and stored in the same way.

Treatment of Sand.

It is not easy to procure sand sufficiently free from the finer silt particles to be suitable for mixing with the seed. It is suggested that when obtaining sand from a contractor or merchant, instructions should be given for one or two washings to be applied to rid the sand of the finer particles. Before using it the sand should be dried and kept turned for a few days under cover to ensure that it is clean, i.e., free from fungi.

Season of Sowing (both species).

In spring, during March or April. Sow early to avoid June droughts.

Rate of Sowing.

Alder.—Assuming normal impurity and a germination per cent. of 30, sow at the rate of 14 to 18 ozs., (apart from sand) per 100 sq. ft. of bed.

Birch.—Assuming normal impurity and a germination per cent. of 25, sow at the rate of 12 to 16 ozs. (apart from sand) per 100. sq. ft. of bed.

Method of Sowing (both species).

The broadcast method is recommended, but special precautions in preparing the beds are necessary.

If possible. the soil should be on the moist side and must not be infertile. A fair admixture of mould or organic matter is important. If the nursery soil is lacking in this a good mould should be specially imported and mixed with the top 3 ins. of seed bed soil. The most suitable dressing is humus from an alder (or birch as the case may be)

stand as this will provide the natural root fungi (*mycorrhiza*). Manuring at the rate of $\frac{1}{2}$ lb. Ammonium phosphate per 100 sq. ft. of seed bed, has a very marked effect on the growth. The manure should be scattered over the beds after preparation but before the final raking.

The soil in the beds should not be made too loose, but should be firmed before sowing. The surface should be left rather rough after raking and should be well watered from a watering can immediately before sowing.

The seed and sand mixture after drying sufficiently to enable it to be handled should be scattered broadcast over the beds and not rolled or pressed down in any way. If any seeds show after sowing, sand should be lightly sprinkled over them but there should be no further covering.

If the seed supplied for sowing is in its natural state it should first be mixed with its own bulk of coarse sand before sowing.

Mr. Young has been successful, in the Forest of Dean, in raising alder by sinking the seed beds 9 ins. to 1 ft. below the soil level. Good subsoil drainage is essential where this method is employed.

Tending Seed Beds (both species).

The beds must be kept moist after sowing and should be watered whenever the surface dries, until germination begins. The coarse sand covering prevents caking, to which the seedlings are very susceptible, but in order to reduce this risk still further, the beds may be covered with a light layer of broom, or gorse or other branches until germination is fairly advanced.

Birds are very fond of the newly-sprouted seedlings and if branches are not placed over the beds, lath or wire screens may be necessary.

Watering should be carried out during dry spells after germination, and shading against sun may be necessary in some districts in hot weather. In watering, the container should have a fine rose and should be held close to the seed beds to avoid splashing up of soil around the small plants. When germination is well begun, the branches or screens should be gradually removed.

Protection (both species).

If beds are left for two years they must be protected in the usual fashion against frost-lift, to which the small seedlings are very susceptible.

Lining-out.

If the beds have been manured with Ammonium phosphate the seedlings will usually be large enough to line out at the end of the first year, which is the best practice, especially with alder. A spacing of 3 ins. in the line is desirable.

NOTES ON FIRE PROTECTION IN THE PROVINCE OF QUEBEC.

By A. D. Hopkinson.

The Province of Quebec contains over 130,000,000 acres of forest, the timber of which is valued at more than £200,000,000, and the gross receipts accruing to the Government from Crown Forests amount to about £1,000,000 per annum. The interrelation of these figures may seem curious to those accustomed to European forestry, but they reveal the very great importance of the forest wealth of Quebec, not only to the Province, but also to the Dominion of Canada and the Empire. It follows that the question of the protection of such a valuable asset from fire is a matter of considerable moment and one which, as a matter of fact, now receives both from the Government and the limit-holders great consideration.

The responsibility for fire protection in the State forests of Quebec is divided between the Forest Service and the limit-holders through their Fire Protection Associations. The origin of this peculiar dual control, is probably to be found in the former inefficiency or inadequacy of the protection afforded by the State. This, doubtless, drove the limit-holders to organise associations for the purpose of creating their own fire protection services. Thus we now find that in certain areas the Forest Service is responsible for the protection of the woods and in other areas this duty is relegated by the consent and approval of the Government to private initiative. I had no opportunity during my recent tour of the Quebec forests of investigating the Forest Service protection organisation as all the areas visited were protected by the limit-holders concerned, but judging from what I heard, the limit-holders, seemed to prefer their own organisation to that of the State.

The Forest Service in Quebec has been divided into two separate parts since 1924. One deals solely with protection and the other with the remaining duties. Each has at its head an officer who is directly responsible only to the Minister of Lands. That this is a sound form of organisation it is difficult to believe, and its origin is probably due to personal considerations.

The Staff of the Forest Protection Service consists of 1 Chief, 1 Assistant Chief, 75 Inspectors, 422 Fire Rangers and 1,301 Auxiliary Wardens. The Protection Associations employ 165 Inspectors, 1,115 Fire Rangers and 389 Auxiliary Wardens. These figures relate to the year 1927 and have probably increased since. They show that between three and four thousand men are wholly or partially employed in fire protection.

In the course of my tour of the forests in the Lake St. John region I came in contact solely with the " Price Brothers Forest Protection Association " and my further observations relate only to this organisation. I must state without further delay that I was very favourably impressed with what I saw of the working of this Association. It employed in 1929 :—16 Inspectors, 98 Rangers, 67 Sub-Inspectors and Rangers, making a total of 181. In addition, there is the Manager, Mr. R. H. Nisbet, and the three Divisional Managers. I am indebted to two of the

latter, Messrs. Smith and Jago, for much of the information obtained, and I am glad to acknowledge the courtesy and kindness received from these three gentlemen and from numerous other members of the organisation.

The Price Bros. Association protects an area of nearly nine million acres. The total outlay in 1929 was approximately £17,652, or 4½*d.* per acre. The activities of the Association are numerous and varied and the following notes represent only that part of its work which I had the opportunity to investigate.

Control of the Public.—During the period of fire hazard, namely, April to November, all persons entering the limits must have a permit authorising them to travel through the country. The object of this is to control to some extent the movements of persons entering the limits and to give the fire rangers a chance of inspecting camps of berry-pickers, fishermen, hunters, etc., to see that the fire regulations are not neglected.

Cigarette smoking is not allowed in the woods during the summer and all cigarettes have to be handed over to the fire warden stationed on the trail or road going in. Settlers who are clearing land for agriculture are required to have permits before they can burn their brushwood and these are only given in suitable weather. Contravention of these regulations is liable to entail a heavy penalty. Often to ensure safety in this operation the fire rangers will assist at the burning or take over the work completely, as this is one of the most fruitful sources of fire.

Warning to Public.—Many thousands of notices, both graphic and written, are posted throughout the limits, and I was surprised to find these in most remote places wherever there was the least chance of persons travelling as well as in the more obvious positions. These notices are supplied by the Forest Service, which produces new designs every year. They are printed on a particular type of thick paper-like material with a highly enamelled surface and are very weatherproof, lasting for four or five years without appreciable deterioration.

Fire Towers and Telephones.—Considerable use is made of fire towers and these are now generally constructed of L section galvanised steel. They are very light and supplied in handy sections which one man can carry, and vary in height from 40 to 80 ft. They are all equipped with telephones giving communication to the Chief Rangers' officers, who are in turn in telephonic communication with the Divisional Managers. The Association controls about 1,600 miles of telephone line. It can be no light task to keep this mileage of line in order when it is considered that for the most part it is running through forest often very remote from any linesmen.

No. 9 galvanised iron wire is used for the line and this is preferred to copper. It is carried on ring insulators which are attached to trees by a staple and No. 11 gauge wire. Care is taken not to drive the staple too far home. The wire is hung very slackly in order to allow it to be borne to the ground by a falling tree rather than snap. I believe there is sufficient slack for a tree to fall over the wire every five hundred yards without breaking it or pulling down the insulators. Even after

that the wire would probably not break, but the insulators would come away from the supporting trees. The latter are not chosen in a direct line but slightly zigzagged in order that the tension of the wire will tend to keep the insulators clear of the bark of the tree. The main object appears to be to keep the wire from breaking at all costs and, apparently, good communication can be obtained with the line in contact with vegetation and the ground, provided the weather is dry.

Roads.—Experience has proved the necessity of getting men, equipment and stores quickly to the scene of a fire and for this purpose roads have proved more useful than any other means. Consequently, every effort is made to open out roads fit for light motor lorries as far as finances will permit. These are supplemented by trails to facilitate the quick passage of men. Many of the logging camps even those situated on rivers are now served with roads, which not only facilitate the transport of provisions and forage, but very greatly increase the mobility of the men.

Meteorological Observations.—Great importance is attached to proper meteorological records and a number of well-equipped stations are maintained during the danger period. The principal records kept are temperature, wet and dry bulb thermometers, barometric pressure and percentage of atmospheric moisture. The latter is either worked out by tables from the wet and dry bulb readings or taken direct from a "hydrograph," an instrument working on the same lines as the familiar barograph.

The meteorological data are summarised in the Divisional Offices and telegraphed daily to the Federal Meteorological Bureau at Toronto, and forecasts as to weather are sent back. A very careful watch is kept on the atmospheric humidity as this has been found to be one of the surest indications of the degree of danger.

A further instrument has now been adopted, the so-called "duff basket." This is a wire tray about 12 ins. × 18 ins., which is placed on the ground and filled with the natural litter of the forest. It is weighed twice daily in order to ascertain the amount of moisture present in the surface material and has proved to be a useful adjunct to the other instruments.

Equipment.—This includes motor vehicles, motor-boats, canoes, tents, field cooking appliances, rations, etc., as well as the actual fire-fighting implements. Amongst the latter are :—2 steam pumps, 34 portable fire pumps, 45,000 ft. of hose and 81 canvas knapsack sprayers. In addition, large stocks of axes, spades, shovels and other implements are maintained, but I did not notice anything comparable to our fire beaters. This is probably due to the very different conditions prevailing.

It is noteworthy, however, how much reliance is placed on portable pumps. These have now been brought to a high state of efficiency by Messrs. Watson Jack & Co., Ltd., of Montreal and their use is general throughout Canada. They vary from two H.P., weighing 45 lbs., to five H.P., weighing 104 lbs., and are adapted for transport either on pack horses or on the backs of men.

Fire pumps are utilised in two ways. The water may be played direct on to the fire or utilised for filling the canvas knapsack sprayers. The use of bifurcating connexions to spread the supply to several points is common for either form of utilisation. It would appear that in suitable places fire pumps would be useful in this country. Aeroplanes are mainly employed for areas which are difficult to watch from towers and are hired under contract together with their pilots. They are not so extensively used in Quebec as, for example, in Ontario.

Office equipment includes charts which record the meteorological data supplied daily by the observers and maps showing the position of the observation towers. Each such position is the centre of a 6-in. circular scale of 360 degrees and has a thread fixed to the centre. By this means when the bearing of a fire is given from two towers and the threads placed along the appropriate angles, their point of intersection is the location of the fire.

MOOR PLOUGHING.

By A. H. H. Ross.

Over the greater part of the flat or gently sloping heather moorlands of North-Eastern Yorkshire there occurs a moor pan. This pan is the result of the leaching out of the surface layers of soil and varies considerably in depth. It is generally found that the shallower the peat the nearer to the surface is the pan.

The geological formations, with which we are more directly concerned, are the Middle and Lower Calcareous Grits of the Middle Oolite.

On examining a typical section of this moorland soil one finds, below a surface layer of decomposed heather peat of perhaps 3 ins. thick, a layer of greyish brown sandy loam or sandy clay, heavily leached. This may be 4 or 5 ins. thick and more or less mixed with stones. Immediately underneath it is the pan, a narrow, dark-coloured layer possibly one-third of an inch thick. The upper part is of a peaty nature and consists of a mat of root extremities, all apparently struggling in vain to find a way down through the lower part, which consists of a thin layer, brittle and hard, almost black or very dark brown and to all intents and purposes an effective barrier to any root development in the lower soil levels. Under the pan one finds an abrupt change. The soil is now of a bright colour, only very slightly discoloured near the pan. Below this no discolouration appears.

It will be seen from the above description that if trees are to be grown successfully, especially on the shallow pan areas, something must be done to provide a sufficient depth of soil for their proper root development. Then again, apart from considerations of the quality of the timber to be produced, there is, on these, very exposed uplands, the urgent necessity of encouraging the tree to become windfirm. Until recently, the general practice has been to carry out subsoiling with specially designed pick-mattocks having exceptionally long picks. With these a hole was made for each tree sufficiently deep to pierce the pan, the criterion of effective work being that some of the bright yellow subsoil must appear on the surface at each hole. This work was either done in advance or at the time of planting, preferably the former, for in this way the actual planting was accelerated, an important item when planting remote areas during the short winter days. Advance subsoiling in the summer previous to planting had an additional advantage in that the soil in each hole had a chance to weather before the plant was put in.

One serious disadvantage, however, became apparent. In soils of such close texture rain water takes a long time to seep away even where the pan has been pierced, and after a continued spell of wet weather these holes remained full of liquid mud often throughout the winter, save for such times as they were frozen, providing about the worst possible medium in which to plant trees, one of the chief drawbacks being the impossibility of firming the plants and the consequent damage by wind.

This method of subsoiling, even if otherwise satisfactory, does not meet one important requirement. The surface of much of the moor peat is covered with an algal slime which seems to prevent the free soaking away of surface water, e.g. rain water, into the soil. As the moor is covered with small and shallow depressions it follows that small pools and puddles tend to remain for many days or even weeks after rain or snow, at times when a lack of dry winds or sunshine allows of practically no evaporation. Trees planted in such places have but a poor chance of thriving, standing as they do for long periods in water or ice with the algal slime closing in on them and wrapping itself tightly around each stem. It would be interesting to know exactly what effect this slime has on the growth of the plant and it is hoped to determine this experimentally by keeping plants in certain rows clear of slime and comparing the growth with that of untreated plants.

To summarise the special requirements necessary to overcome adverse factors which must be contended with in planting this type of moorland, we find it is necessary :—

(1) To break the moorpan whenever it is at all shallow.
(2) To mix and aerate the closely packed soil.
(3) To drain off the surface water ; and
(4) To overcome the slime difficulty.

The only method of meeting all these requirements in one operation is by ploughing. This is by no means a new idea. In the Allerston district it was quite an accepted practice on certain estates about sixty years ago. Oxen provided the power and the resulting timber crops are said to have fully justified the expense of the undertaking. Actual ploughing was not always done. The main object was pan breaking with a subsoil tine.

In 1921, the Commission began ploughing and subsoiling at Allerston, preparatory to planting. The areas dealt with had a hard pan and a certain amount of stone. A wheel tractor and a light single furrow plough equipped with a subsoil tine were employed. A very shallow and narrow furrow was turned and the subsoil tine seldom penetrated to any depth, being almost invariably thrown out of the ground whenver it encountered anything hard, which happened most of the time. In 1929 and 1930, ploughing was again embarked upon on a fairly large scale. In 1929, light single-furrow ploughs were used and power supplied by Fordson and International Tractors, both these being of the " wheel " type. No subsoil tines were fitted as it was considered that on the fairly shallow pan areas of Wykeham Low Moor the furrow would be deep enough to break the pan.

The ploughing was done in strips of three furrows, the strips being 5 ft. apart centre to centre. Where the soil was comparatively free from stone reasonably good results were obtained, the pan being broken and a certain amount of the subsoil being turned up over about 50 per cent. of the length of the strips. Where, however, the ground became stonier, the depth, which had been a more or less satisfactory 6 to 8 ins., dwindled to an entirely insufficient 3 or 4 ins.

On Allerston Low Moor where one of the stoniest pieces was encountered, the pan over a good many acres of the worst part was never once touched. Moreover, the wear and tear on tractors and implements was extreme, and by degrees the moor became littered with broken pieces of machinery and derelict tractor wheels. A Rushton Wheel Tractor and a light 3-furrow plough were tried. On easy ground with free sandy soils this worked well, but on the stonier areas there was no improvement.

Early in 1930, the Commission having decided that the required results could only be obtained by the use of a much-improved and heavier outfit, and that the work should be done departmentally and not on contract as hitherto, purchased, after suitable tests, a " Catterpillar Twenty" Tractor, which, as the name implies, is of the track-laying type, developing 20 h.p. at its governed engine speed. They also purchased two double-furrow " Deep Furrowtrac " Ransome ploughs, two single-furrow " Unitrae " Ransome ploughs, and a specially built single-furrow Ransome plough carrying a light subsoil tine set so as to run in the furrow bottom just behind the plough body. All these ploughs are of the mould board type. A disc plough had been given a trial but was found to be incapable of getting down deep enough into stony soils, hence its use was at once ruled out. In addition, a Killefer Subsoiler was acquired. This consists of a strong carriage on two large wheels, carrying a robust vertical blade, attached to the bottom of which is a steel chisel point. This point is designed to work at anything up to a maximum depth of some 20 in., deep enough, therefore, to penetrate any pan which is likely to give trouble.

A discussion on all the points of interest and importance in connexion with the use of these implements would fill much more space than is here available. We are chiefly concerned only with such matters as have a special bearing upon the silvicultural aspect of the ploughing operations and must ignore for the most part the many mechanical problems which have arisen, except in so far as they affect the attainment of the results at which we are aiming.

A whole crop of mechanical difficulties appeared as soon as operations had fairly commenced. They still appear, but not so frequently and one by one they are overcome. Very soon we shall be able to say that with our present tackle the operation is out of the experimental stage, mechanically. From the first the beams of the double-furrow ploughs, designed as they were for ordinary agricultural work, kept on bending under the unwonted strain and had to be replaced. Now the makers have turned out a new plough with specially reinforced beams that are standing up to the work well. Also, partly in order to get over this difficulty, an Oliver double-furrow plough was acquired. This is of much lighter construction than the Ransome, but has heat-treated beams which have not as yet shown any tendency to bend. Standard points and blades for the Killefer subsoiler wore out rapidly, but are now specially made for us in Sheffield of Hadfield's manganese steel and give little trouble.

The chief trouble with the double-furrow ploughs affecting the quality of the work lay in the fact that they were all designed for normal,

i.e. complete, ploughing. The furrowside wheel in complete ploughing runs in the furrow, whereas in the strip ploughing or " fairing " carried out by the Commission, this wheel has to run on the unploughed land. Therefore, when the plough is set at its maximum depth the wheel is running perhaps 10 ins. higher than it should, with the consequence that the plough travels on an uneven keel, the landside furrow being deep and the furrowside furrow shallow. With the Oliver plough this trouble has now been overcome by extending the furrowside wheel axle so as to allow this wheel to run in the landside furrow of the adjacent strip. Slightly greater depth has also been obtained in both furrows by cutting away a triangular piece at the rear end if each share. This results in greater penetration especially on stony ground or ground with a very strong pan, over the top of which the long flat shares tended to skate. The Ransome double-furrow plough to which the fitting of a longer furrowside wheel axle presented difficulties has now been improved by fitting to the landside crank a special attachment provided by the makers. This helps the plough to run level, giving approximately an equal maximum depth on both furrows.

The tractor itself has so far run with unfailing dependability and has needed only minor repairs or replacements. The power developed is ample for the work to be done, in fact so great a drawbar pull can be exerted that for some time much loss of time was incurred through wooden safety plugs shearing and having to be replaced. Now the work is being carried out with a safety hitch fitted between tractor and plough, set to release at a drawbar pull of about 3 tons. On normal soils the hitch does not release often and recoupling does not in the aggregate take up much time. On stony soils where the hitch frequently releases it is found advisable to subsoil first and so loosen up the soil to some extent. This prior operation has the effect of reducing the drawbar pull on the plough by about 1 ton. The cost of subsoiling and ploughing is rather more than double the cost of ploughing only. On the easier soils it would be possible to run the tractor at a greater speed by using second gear, but with the types of ploughs at present in operation it is found that the quality of the work deteriorates as the speed increases. Increased speed seems to entail a decreased degree of penetration and a much more scattered and tougher furrow slice, involving more difficult planting.

So much for mechanical problems. There yet remain to be decided many doubtful points affecting the growth of the tree. I shall conclude by enumerating some of these problems in the form of a series of questions :—

(1) Having in view the cost of the operation is it possible to decide what types of soil it is economically sound to plough ? It is conceivable that certain areas at present classed as " unplantable " might be made " plantable." Other areas classed as " plantable " but which are very poor might have their productive capacity greatly increased. Still other " plantable " areas, e.g., deep pan, might, however, be so little improved as to render the operation quite unprofitable. Then again, ought the presence of pan to be the criterion by which the necessity of ploughing

or subsoiling is judged ? It may be that some pan-free but very impervious soils require working just as much as, if not more than, some of the better quality pan-bearing soils.

(2) Is it advisable to bring some of the unweathered subsoil up to the surface and, if so, how much ? Is this subsoil of more or less immediate value to the early growth of the tree ? If this is not so, would it not be better simply to stir it up with the subsoiler and limit the work of the plough proper to the leached horizons. If this were done, it might be possible to subsoil and plough in one operation, instead of two as at present.

(3) If the pan and subsoil are touched by the subsoiler only and not by the plough how long is the disturbing effect going to last ? Will the subsoil reconsolidate itself into its former impervious state and the pan start to reform before the tree has had time to establish a normal root system ?

(4) Is the practice of single-furrow ploughing sound, since if the tree is planted on the ridge between the furrows it will be directly over unbroken ground ? If no lateral weathering action occurs from the walls of the furrows on each side, the tree will be forced to produce an arch-shaped root system. It is just possible that if this were likely to be the case the direction of the furrows might with advantage bear some relation to the direction of the prevailing wind. Incidentally, double-furrow ploughing costs little if anything more than single-furrow ploughing, though a greater depth is available with the single-furrow plough.

(5) In double-furrow ploughing might not power be economised by ploughing the landside (rear) furrow both shallower and narrower than the furrow-side furrow ? It has been suggested that by ploughing a narrower rear furrow the front furrow would accommodate the rear furrowslice more easily. Consolidation of the furrowslice would thereby be accelerated and planting be made easier. If the pan is to be broken by only one furrow it is more important that this should be done by the front one directly over which the tree is to be planted. The advisability of this procedure would be dependent upon the answer to question (2).

(6) What are the best methods of planting on various types of ploughing ?

The foregoing problems are only a few out of the many arising in connection with an operation which may well prove a decisive factor in the afforestation of moorland areas.

STOCK JOBS.

By D. Reid.

The provision of work during foul-weather-stoppage of normal routine is a problem which is more significant than may appear. When a harassed forester is faced with many days of stormy weather, and the knowledge that his costs are performing altitude records, the reality of this minor problem is forced upon him. To those in charge of areas where trees in the pole stage abound, foul-weather work is seldom difficult to find, stock-tasks usually being available, if there has been proper foresight on the forester's part. These few remarks, therefore, are applied to areas comprising wild heathland with only plantations of the youngest class and practically no roads, workshop or shelter for the men. As the Forestry Commission now hold many square miles of such land, the following ideas which are being tried on a typical area in north Yorkshire, may just possibly contain the germ which would help a colleague to meet a difficulty.

We have found in this bleak district that the usual bad-weather task of repairing and cleaning tools, plant bags, etc., is better reserved for times when there is deep snow, or such heavy and persistent rain that "shelter-and-snatch-work" cannot be continued. On most areas, road-tracks are the most pressing need, and fortunately the opportunity of making these is limited only by snow, and availability of rough shelter, the latter being necessary for the "bobbing in and out" process. It therefore behoves one to choose one's road-lengths in advance, keeping in view (1) handiness to the normal work, such as planting and draining, and (2) shelter near enough to avoid a soaking. Thus the squadman knows in advance just where to go, workable time is not lost, and the men are not quite so miserably cold as through enforced inaction.

On this particular area, however, our principal stand-by is intended to function somewhat as follows. Firstly, please bear with a brief account of our system of forming compartments. The flat and featureless topography of this area, affords scope for a very formal, almost geometrical, layout of rides and paths, and this has very ingeniously been taken advantage of (not by me) to make nearly every compartment of the same size, and in a series of contiguous oblongs; thus it will be seen that it is possible to transform any of these rides into a road or a fireline which will continue the full length, or breadth, of the area, to meet almost any requirement. Lengthways through the middle of the whole area is a chain-wide fireline, and therein lies our chief hope for stock tasks. At the crossing of this fireline by each major ride, a simple depôt is being formed, consisting of (1) a dump of fire-beaters, (2) a plant dump, and (3) a shelter. Thus, throughout the most central and accessible part of the area, are located the most necessary things. Finally, it is our ambition to complete an effective track along the middle of the fireline along its whole length, to serve as a road for carting plants and everything else. In due time also, this track as we consolidate it piecemeal into a road, will become the tushing (or snigging) road. It is not

often that a job cannot be found on this fireline-road ; the plant dumps must be dug ; the shelters have to be built with zinc, stones, or turfs ; fire beaters need to be cut, trimmed, and wire-bound ; and the sections of road made stage by stage as the plantations advance. Meanwhile, if the track is kept repaired, that, in addition to the burning along the sides, will form a fireline which really will break a fire.

The collecting and preparation of fire beaters, is a task which, in common with the overhauling of tools, etc., is better reserved for when the ground is snow covered, or deeply frozen. Arrangements can usually be made with neighbouring owners and tenants to clean out their unwanted birch-copse for the purpose.

Anent the plant dumps, the system in vogue here, is to allow each woodman to utilize those nearest his own home as allotments. By doing this, the dumps are kept free from rubbish, are in good tilth for the next planting season, and where a shelter exists also, there is much more inducement for him to cultivate them. What is more important, a very considerable amount of incidental patrolling is done by each man at diverse times and places, particularly at the riskiest periods, namely, weekends ; and this is encouraged by the desire to see his potato patch.

APPLICANTS FOR F.W. HOLDINGS.

By D. C. D Ryder.

6.30 p.m. Door bell. Caller (for the 5th time): " Has Mr. . . . come in yet ? "—" Yes, what is it ? "

Caller : " I hear there are some small holdings being built on Government forestry at . . . my wife and I feel we should like to better ourselves and we wonder if there is any chance of our having one."

6.40 p.m. Mr. . . . : " Now that I have explained the details of the F.W.H. scheme and having your name and address I think that is all, thank you. I cannot hold out much hope of your acceptance as you are the 85th on the list and there are only two vacancies at present. Good night."

With a large number of new holdings to fill, and plenty of time to choose from among the numerous applicants, it seemed probable that few would turn out unsatisfactory; this optimistic view was not justified, however; as subsequent events proved, the choice was not so easy as first appeared, and a short discourse on the men who have proved satisfactory in this district, their qualifications and the methods they have adopted on their holdings may not be out of place. The reasons for applicants wishing to have a holding vary considerably, and upon them depends largely the success of the applicant when installed. Some who wish to get away from the coal mines for the sake of their health or that of their family, have been recommended to the Forestry Commission by the local doctor or the " Lady of the Manor " who takes a kindly interest in the individual. Some wish to better their position, being tired of the uncertainty of work in the pits and the high rents of colliery houses, others simply imagine they foresee an easy time with a low house rent, a small piece of land and some poultry, and a "cushy" time generally under the " Government." It is important to find what the motive is for application and, above all, if the applicant thoroughly understands the necessity for hard work in all weathers and really intends to cultivate his holding to its full capacity. The District Officer, to ascertain the reasons, has recourse to a limited number of avenues of enquiry, but finally a guess has to be made as to the unknown motive. At the interview, which has always been insisted on, the appearance of the individual often proves to be misleading, though it is necessary; the wife of the applicant often puts in an appearance also, and perhaps this is of use, though often she is entirely prejudicial to the chances of the candidate in the eyes of the District Officer, by her pushful attitude. In this connexion it may be said that an interview by the Forester as controller of labour as well as by the District Officer, is desirable. It is better both for the applicant and the Forestry Commission to turn an applicant down at the start if he does not appear to be satisfactory in all respects.

References at first were accepted at their face value, but it has proved that doctors, the Church and some employers will perjure their souls to give a helping hand to a " lame dog " or to rid themselves of a useless

servant. The ruling which has proved satisfactory is to require the candidate to produce at least two references with originals and copies from present and previous employers, together with a reference from his landlord. This gives some indication as to capacity for work and the probability of freedom from debt. The question of debt is not an inconsiderable one, and more than one man has been forced to give up on account of his incapacity to meet both past and present liabilities on the wages received while working for the Forestry Commission. This raises a further important point, that of having some capital to start the holding with, many men did not appreciate this, and some of the two-year tenants have already given up and returned to the pits, as the combined house and land rents and rates are considerable before the land begins to bring in some return. A sum of £2 to £3 per acre seems to be the minimum on which a man can make a start. A few men have been helped to tide over the difficult starting period by loans from private landlords or societies. There can be no doubt as to the importance of the small capital and thus of the helpfulness of a private loan, but the desirability of financial aid, unless in kind rather than money, by the Forestry Commission is a more doubtful policy which is not suggested.

A few other points to be considered in making a choice of tenants may here be discussed with advantage. When a vacancy occurs it has been the practice hitherto first to offer the holding to men who are already employees of the Forestry Commission. Such men have proved satisfactory, though only in a few instances have regular forestry workmen been anxious to take up the holdings. Next came the problem of whether to choose from men already working or those out of work, and it has been customary to choose from among men in work at the time of application. The applicants were mostly recruited from the collier or farm worker class, with a few other trades represented. As a rule preference was given to the collier as there was a political urgency for their employment. This policy has not been justified, the farm worker having shown himself to be, not only the better workman for the cultural operations of the Commission, but also the better husbandman of his own land. Certain applicants have applied for neighbouring holdings in order that they could work the land together, this has proved most satisfactory and should be encouraged on the larger forests, and the sharing of such expenses as outbuildings, horse labour, and implements has been of enormous benefit to the men concerned.

I have already spoken of the unfortunate impression made by some of the wives of the applicants at the interview, and it is as well to mention here how large is the influence of the wife on the success or otherwise of the holder. A slovenly and ill-kept home has a marked effect on the work of the holder outside and an unthrifty wife obviously prejudices his chance of finding his rent at the proper date. Whereas a clever poultry woman can prove herself a financial asset. Large families seem generally to be a disadvantage in forest workers' holdings as in other walks of life, and more especially where young children have long distances to walk to school. Older families have the advantage (to the Commission)

of providing cheap labour for general work, this type of labour, however, is sometimes more nuisance than it is worth.

As to conditions of employment and terms of the agreement, the agreement insisted upon for the forest workers' holdings is certainly not advantageous to the tenants, and there is no doubt that the uncertainty of tenure prejudices certain men against putting money into their land, gives a sense of insecurity which is most undesirable and prevents the better class of tenant from applying for the holdings. On the other hand, the necessity of reserving the right to dismiss unsatisfactory workmen justifies the agreement and makes control easier for the Forester. In spite of this clause tenants are a little apt to rest on the security of the tenancy when demanding higher piece work rates during the planting season and relying on the forgetfulness of authority of the date at which notice to quit may be received. Even one subversive and discontented character in a gang may lead the rest in revolt, which, when the men are tenants and are bound to be given work, is not so easy to deal with as when a " sack-the-lot " policy is available. It is true that 14 days' notice may be given in certain cases of extreme misbehaviour, but such cases are carefully avoided by the men. Such troubles, however, seldom occur, and successful and contented holders can and are being settled on the land. Great care and foresight is needed in choosing applicants, and the Commission is profiting by its experience and, in the course of a number of changes, the right man is found and accepted as a holder.

DIVISIONAL DIVERSIONS.

By E. R. Lewis.

There is about Whitehall an air of immediate contact with national events—it is the historic setting of the country's pageantry whether in times of national joy or mourning, and, similarly, to those members of the Forestry Commission staff who carry out their duties there each day, must come, I think, a sense of intimate proximity to the Commission's affairs inducing perhaps an atmosphere of distance in their regard of the Divisions. Quite a number of them have never seen any of the Divisional Offices or, for that matter, any of the Commission's operations, and some of these, so much in the hub of things, must at one time or another, have had a feeling of curiosity as to the service conditions of their colleagues in the Divisions. Experiencing both sides as I have done, I feel prompted to set down some points of difference.

Divisional Office 5 was, until quite recently, at Santon Downham Village. The nearby town of Thetford is situated some 5 or 6 miles distant, reached by road traversing Thetford Warren, a rather fine piece of Breckland scenery. Four of us in the Office came each day from Thetford on our several mechanical mounts, mine was an old Douglas motor-cycle, upon which many previous owners had left their mark and *vice versa*. This amazing machine was never devoid of thrills, there was always a delightful uncertainty about it. One felt that anything might break at any moment. However, such worries were usually dispelled in the charm of the view that unfolded on summer mornings. The young plantations made a vivid splash of colour across the landscape and, as one sped along, the sandy bracken-covered warren seemed to stretch away over the cloud-topped hill to the edge of beyond. In reality, the road led away down to Santon Downham in its hollow by the river, and over all stood the little church on the hill with its quiet acre and old lichen-covered stones. Here was the office in part of a picturesque old house whose site is marked in Domesday. From my office window I could see a daffodil-covered bank, the pathway leading to the woods, and could hear the song of the birds and the hum of the saw from the mill by the river. Vastly different from stately Whitehall with the hurrying crowds from the Underground and the roar of the traffic.

The days were not without incident there. Very often I was alone to receive callers and if these took the form of persons with a grievance the experience was often rather trying. It is not easy to forget the sudden appearance one day of a man of very generous proportions, who in features closely resembled Mr. Louis Wolfheim, the complete pugilist, in fact. He had a curiously intent look, but did not speak, and slowly he came towards me with what seemed an awful deliberation. I became uneasy, and fingered an ebony round-ruler nervously. "*Dulce et decorum est pro Patria mori.*" The anti-climax came, he enquired diffidently if there were any vacancies in the office. I was genuinely relieved to answer in the negative ; like Cassius, " such men are dangerous." Then there was

the dog lady—do not mistake me—she kept a large number of dogs, no one knew quite how many, in her cottage. When calling at the office to pay rent, it was her custom to bring part of her canine string also. These were as to three of the first part, attached to a post outside the office door, whereupon they commenced a loud and continuous barking and revolved slowly round the post, until brought up all standing on their shortened leashes. The interview would then be suspended for a while until the owner had adjusted matters, returning to await a repetition of the performance in the opposite direction. The three or four dogs of the second part, who were privileged to accompany their mistress into the office, were released on arrival to go their several ways, and they always did.

I must mention also the gentleman of the Press. How carefree and happy he seemed that snowy morning almost a year ago—with what gusto he snapped his camera shutter in all directions. An unsuspecting District Officer bent to examine a plant, he appeared next day in a certain London Daily over the words " Lonely Forest Worker—he is 9 miles from his nearest workmate." It was well at that moment that he was nearly 90 miles from the gay camera man. A father and his sons were grouped at their cottage door, they appeared also in greater prominence as " exminers settled on the land." This family were aborigines and their subsequent sufferings from the tender enquiries of fellow-workers as to conditions in the mining industry were acute. This calls to mind the camera-man who visited Santon Downham to make a film of the operations ; I learnt afterwards that he had for some years been with the MacSennet Company of Los Angeles. Hollywood had nothing on Santon Downham that morning ! The onlooker felt that the future of the film industry in this country was assured. The film was subsequently exhibited in Thetford and the workpeople visited the theatre *en masse* to see themselves " on the pictures." It may have been subconscious influence of Mr. MacSennet's inimitable comedies or merely just a technical fault in the apparatus, but the movements of all concerned were speeded up to quite a feverish degree. I will draw a veil over the reception accorded to the exhibition, one stalwart seated near me, wiping away his tears of mirth, remarked " Blimey ! they must be on piece-work !"

Dry weather at Santon Downham brought fear of fires, an ever-present danger in that district on account of the large area crossed by the railway. Chemical extinguishers were kept at the office and so soon as a column of smoke became visible, the Estate Officer and myself would load them into his side-car, and dash to the scene to stem the outbreak if possible until the men arrived with beaters. On one occasion the tell-tale smoke was seen, and it was found not possible to get the motor-bike across country ; we paused irresolute at the river bank, below us the Vicar's punt lay at its moorings. Let the Church assist the State, was our thought, as remarked on a previous and more important occasion. We embarked our extinguishers and jumped in, pushing off. The deep-rooted instincts of a maritime people possessed us, we gave way with a will. In the urgency of the moment we overlooked the extremely

large holes in our vessel's side, the overloading produced a leak that could not be disregarded, more especially by my companion, who was actually sitting in water. We commenced to revolve and then to sink, but at length, after desperate efforts, we managed to beach the wreck just opposite the fire. Our only comfort lay in that the saturated condition of our nether garments rendered us immune from the scorching we should otherwise have had in traversing the burning undergrowth.

Apropos of fire extinguishers, mention must be made of the water bag. This instrument, as you perhaps know, consists of a canvas sack which is strapped to the wearer's back after being filled with water, which is subsequently ejected by a syringe. Two ricks stood quite close to the office last summer, and imagine my consternation one afternoon to see large tongues of flame leaping from the top of them. By a curious coincidence there were in the office at the time two callers who had come to interest the Divisional Officer in the new type of extinguisher marketed by their Firm. The alarm was raised, the visitors were brushed aside, and each one of us ran to the outbreak. My eye caught the water-bag, gleaming in splendid newness in a corner, I snatched it up and ran to the village pump and filled it to the brim. I did not know that the affair was not watertight until its fabric had become saturated, this fact I discovered after I had undergone a similar process; also I did not realise that when full of water it was quite impossible to lift the bag without assistance. Nothing daunted, I attached it to my back in a prone position and then rose and staggered to the rick. By this time a dense smoke covered the scene. At the moment of my arrival the Estate Officer had carried out a smart flanking movement and opened fire with his chemical machine from my opposite front. A loud scream from the smoke-covered rick top denoted that he had ranged on an unfortunate workman who had climbed to the top to more readily approach the blaze. The workman retired in bad order to my side, to be met with a deluge of water from the waterbag; the exchange of remarks cannot be set forth here. However, we worked for two hours, a bucket chain was formed, and eventually the flames subsided. Retiring to the shade to enjoy a well-deserved rest, we observed our two visitors, who had been overlooked in the excitement, exhibiting signs of violent emotion. On seeing the fire they had dashed to their car for their apparatus, giving thanks for what was to them a heaven-sent opportunity of demonstrating the efficiency and superiority of their goods, they flung open the dickey to discover they had left their machines at home!

More could be written in similar vein, but the confinement of such incidents, drawn from a period of over two years, to the small space of this article, may tend to mislead the reader as to exactly how diverting the Divisional Office can or cannot be; those there can best supply the answer, but that is another story.

BUILDING OPERATIONS: THETFORD CHASE.

By J. Broach.

Apart from forming forests, extracting seed, seed sowing, planting and tending trees, other most interesting operations are carried through in conjunction with the production of forests for the future uses of the State. One of these is termed the Estate Department, which is responsible for the providing, amongst other responsibilities, of suitable dwellings for the forest worker. When a new acquisition comes to hand a considerable flutter of excitement runs through the office, plans and maps are scrutinised very carefully, buildings, dwelling houses and land are surveyed, buildings suitable for conversions are noted, sites are chosen for new houses or bungalows. All this has to work in with the small holding scheme.

In this forest the work of converting and building new dwellings is mainly done by direct labour. A well-stocked store is run from which everything required to form these dwellings is issued; the usual run of procedure is to find a water supply in the first place, a task which is usually done by estate employees, but when a special deep well is required an expert well digger is called in to do the job. We have various systems of finding water, i.e., for conversions there is usually a supply nearby which can be utilised, such as tapping a main and leading a pipe in, or using a well supply at hand and sometimes sinking or driving an Abyssinian tube. This last is a very interesting piece of work. A special set of gear is required, consisting of shear legs with a grooved pulley wheel, 18 ins. or so, a stout rope, a dump or weight approximately 100 lbs., with a guide rod attached. Along with the tubes, which can be any length, we use them 4 ft. long, threaded at both ends to make a butt joint with the special socket used for this purpose, a point about 3 ft. long is also required which is perforated. These tubes and points are 1½ ins. diam. The position being selected the start is made by driving the point into the ground as far as possible with a mallet, the shear legs are then erected over where the tube is being driven, pulley wheel and dump attached, which must be perfectly perpendicular to drive the tube straight into the ground. Should it deviate the least degree, the job has to be restarted. The working of the dump weight now starts on the addition of a length of tube being fixed to the point, the guide rod is inserted in the tube and the see-saw motion of pulling the weight up and letting it drop its full weight on the end of the tube; this is continued with lengths of tube added as it disappears into the ground until, say, up to 30 ft. of tube has been used, when tests are made to see if water has been tapped; if so, the pump is attached and pumping begins, and must be carried on continuously, sometimes for several hours; this is to draw up the sediment loosened in the formation of a cavity or reservoir at the bottom of the tube. When water is found in chalk a great deal of pumping is required before the water comes up clear, it will come up like whitewash for a time, but will clear eventually and a good quality of water found. If

in sand, a large deposit has to be pumped out in order to form a reliable cavity for the supply of water, if not, the perforated point will get silted up through which no water can be drawn, so therefore a failure, and the tubes have to be drawn up, which is often a most difficult operation.

The amount of work on the driving of these tubes varies greatly; on free open easy driving ground it is easily accomplished by three men, but on stony flint and chalk it is very often a hard task for six men to keep the dump going. On free going, water has been found in a few hours' time, but on hard going it sometimes takes a few days. We have had tubes turn like an elbow when several feet down in the ground owing to striking large flints. When this happens the operation is a failure and tubes cannot be drawn. When the water supply is assured, building begins, cement and rubble for the foundation on which to build the brick work are obtained, we find the 11-in. cavity wall very satisfactory in this district, so this style of construction is generally adhered to; so on goes the work, ultimately the roof of timber and asbestos slates is finished, the inside fixings and decorations carried out, these operations come under local supervision with occasional visits of inspection by other officers. By this time it has become known that a dwelling or two will soon be ready to let and several enquiries as to conditions of tenure and applications for tenancy are received. Applicants are interviewed and finally one is selected to become a small holder and forest worker.

The bricks used in all or most of the new bungalows in this forest were salvaged from Downham Hall, which stood in a central position in the forest. The hall fared badly during the Great War, and did not emerge very happily from it. It was vacated in the war period owing to military restrictions and was taken over by the military for camping and instructional purposes, and finally occupied by a Canadian Forestry Corps, whose menial duties were attended to by German prisoners; this added destruction to the hall and depletion to the beautiful and well-wooded surroundings. The hall on being taken over by the Forestry Commission was offered to be let, but no suitable tenant or company could be found and finally it was decided to have it demolished. This was done by direct labour, the lead salvaged paid amply for all demolition expenses, the bricks were mainly used for new bungalows; slates, doors, windows, etc., were used as far as possible on conversions; while the timbers were used in erecting out-buildings for the small holders. Thus, the Old Downham Hall is well represented in this forest by the various neat squat and comfortable forest workers' bungalows dotted about in the most convenient places for the well-being of the forest.

SOME PROBLEMS OF NURSERY PRACTICE.

By T. E. Anderson.

Of the many problems that beset the forester none, I think, calls for such a degree of special treatment as those which arise in nursery practice. It might be contended that nursery operations are carried on with but little difference from those of, say, 20 years ago. This may be true in a broad sense, but I venture to suggest that at the present time nursery technique is far in advance of those days, the all-important matter, cost of production, has probably been responsible for this to some extent. Initial low cost is often a misnomer, there being a vast difference between cost of production of plants, and the cost of first-class plants only, the production of which should be the aim of every forester, even if this entails some increase in expenditure due to thinner sowing. Inferior plants invariably mean a higher percentage of losses on planting out than is the case if first-class plants are used.

How to gain this much-desired result is a question that is being continually ventilated. I can only set out my own experience in so far as seed beds are concerned, which may to some extent differ from others, but there are many points which are common to all. We have here at Clipstone 33 acres of nurseries, 8 acres of which are devoted to seed beds, the chief species raised being Corsican pine, European larch, Scots pine, Japanese larch, and various hardwoods; the spruces and Douglas fir are not suitable for the district. The soil is of the New Red Sandstone. It has been continually fed with farmyard manure, humus and, when possible, soiling crops; here arises a question of some importance, whether it is advisable continually to treat nursery ground used for the growth of transplants with farmyard manure. How far the excessive frost damage which we suffer from at Clipstone is due to this I am not in a position to state, but this, however, I can say, that in my long experience of Corsican pine, frosting has never occurred to anything like the extent we can see here. Horticulturists maintain that too much nitrogenous manure tends to cause an excessive flow of sap, and this large water content in the plant renders it much more liable to frost; to counteract this effect potash is added to the nitrogen, this hardens off the plant, but how far this thesis can be applied to forest trees is an interesting question. The fact must not be overlooked that on these sands as on others, changes of temperature are rapid, but a peculiarity of this is, that in hollows where one would expect frost the plants are usually doing well. On the subject of manuring, the area available for seed beds should be more heavily manured than for transplants, this would encourage a good growth in the seedling stage.

Seed and Seed Beds.—About the formation of seed beds there is little difference of opinion, beds 4 ft. to 3 ft. 6 ins. wide are the general rule, the width between may vary, but 15 ins. should be ample, 18 ins. being a waste of ground which often cannot easily be spared. With regard to the preparation of beds for seed too much time and consequently money can easily be expended on this part of the work; if the soil is fairly light

it is not necessary to break it up into a very fine state 6 or 7 ins. deep, provided a fine tilth is secured, 2 ins. deep is sufficient to enable seed to be sown and covered, germination will be as good or better than if time and trouble were taken to pulverize the soil to greater depth.

Treatment of Seed.—The minimum, maximum and optimum times for the soaking of seed previous to sowing have been laid down. While it is necessary to soak nearly all coniferous seed before sowing, great care has to be taken if large quantities are being dealt with, for instance, if you have larch in soak 4 or 5 days and then get a spell of bad weather the seed will probably pre-germinate. Not altogether a bad thing, you will say, in the case of larch, but it is a dangerous practice and much damage may result. I favour one day's soaking for the following: larch, Scots pine and Corsican pine. Douglas fir and Sitka spruce I will not refer to as these require longer soaking. After soaking, the usual practice is to treat the seed with red lead, 1 lb. of red lead to 9 or 10 lbs. of seed is roughly the amount used.

Sowing.—On the density of sowing various figures have from time to time been given, but what one has to bear in mind always, is the production of first-class plants, and not merely numbers. It has been stated that thin sowing while attaining the result of better plants adds to the cost of production by increasing the area, and consequently the weeding costs, that is a natural corollary; but the extra cost entailed in this is more than compensated for by the increase of grade I plants produced, which is the object we all aim at. The density at which seed is sown in this nursery for the chief species used is, for 1 lb. of seed, Corsican pine, broadcast 165 sq. ft., drill 210 sq. ft.; Scots pine, broadcast 260 sq. ft., drill 350 sq. ft.; larches, broadcast 410 sq. ft., drill 600 sq. ft.; these densities are liable to slight variations according to the germination figures.

The art of sowing can only be acquired by practice. In broadcast beds it is most important to spread the seed evenly, and to give the beds the proper covering. This cannot be too strongly emphasized, for once your seed is covered it only makes matters worse to interfere with it, only your most reliable men should be entrusted with this job. The ordinary garden rake has been found to be the best tool for this purpose, as it does not offer any inducement to a large quantity of soil being pulled on to the bed at once, it also has the effect of spreading the soil evenly. Corsican pine will take up to $\frac{1}{2}$ in. of covering without any ill effect, but not more; with the larches it is fatal to give more than $\frac{1}{4}$ in. of covering. I found that by covering larch $\frac{1}{8}$ in., or as light as possible, and going over the beds with buckets of sand after they were rolled, to cover any exposed seed, is a better method than trying to cover them at one operation with any tool. The cost of preparing beds and sowing seed last season was 8*s.* 1*d.* per 100 sq. yds. at Clipstone.

Drill v. *Broadcast.*—Hardly any two persons have similar views about the benefit or otherwise derived from these two methods; of the larches I can only say it is an open question, the chief benefit from drill sowing is in weeding, and the fact that in nurseries which are liable to

cake, the hoe can be used between drills, this also conserves the moisture during drought. In the case of Corsican pine and Scots pine I think drill sowing is best, not only for the benefits mentioned above, but chiefly for the fact that as the seedlings stand two years they can be undercut when one year old. This operation is a highly controversial one. Many argue that by undercutting no new roots are produced, and others take the opposite view. Mr. Blake in his investigations on the matter at Oxford maintains that by undercutting Corsican pine no new roots are produced. While it is not easy to disagree with specialists I can state that it has been found by experience at Clipstone that undercutting does definitely improve the root system, control plots have been carefully kept and the results checked ; from this it has been apparent that even if new roots are not produced, which is not admitted, the mass of secondary and tertiary rootlets certainly make it worth while, foresters are familiar with the " carrot "-like root of Corsican pine when left in the beds for two years, and the practically impossible task of lining these out satisfactorily, it was to prevent this effect that undercutting was introduced, and the results found so beneficial.

The Corsican pine lined out at Clipstone last season resulted in a loss of 10 per cent., against one lot from another nursery which was obviously not undercut of 46 per cent., after making allowance for losses due to transport there appears to be a case made out for undercutting.

Weeding.—When such a prolific growth of weeds has to be dealt with as is the case at Clipstone, especially spurrey and to a lesser degree other annuals, it is a matter of some concern not only from the financial point, but also from the damage which results in pulling out seedlings, no matter how carefully it is done. The blow-lamp was introduced in 1927 and at once found favour ; of course, much depends on the kind of weeds to be dealt with, different nurseries will, no doubt, have different weeds ; but I will endeavour to show from actual costs that, so far as Clipstone is concerned, it is an unqualified success.

In 1926, weeding beds cost for the whole season 22*s.* 7*d.* per 100 sq. yds., this was all done by hand previous to the introduction of the blow-lamp ; last year all beds were burnt over, and, although the season was not an unfavourable one for the growth of weeds, the cost of weeding beds, including paraffin for the blow-lamp, was 12*s.* 9*d.* per 100 sq. yds. ; from these figures it is apparent that a considerable amount of money is saved by the use of the lamp and, in addition, there is the unknown gain in seedlings due to the abolition of the first hand-weeding. A further point is that it allows your men to attend to the lines, which would otherwise have to be left until the beds had received attention. There appears to be some doubt regarding the time it is necessary for the flame to play on any given area, but this is really a very simple matter, as any one using the lamp can see the flame scorching off the weeds, any intelligent man can quite soon get used to working it.

It has not been the intention in the foregoing to deal comprehensively with every phase of seed and seed beds, but to touch on a few of the important points which arise in everyday nursery practice.

THE ÆSTHETIC ASPECT OF AFFORESTATION.

By F. Oliver.

Forests are not always easy to establish, but once formed, their period of life is a long one and they can be looked on as permanent features of the country side. A man who is born in a glen where a young plantation exists grows up with the trees, and to him they are as much a part of the landscape as the hillside on which they stand. The State forester may or may not have a poetic strain in his make-up ; but his work, by which is primarily meant re-afforestation, must of necessity be carried out on strictly utilitarian lines. Poetry is not a plant that flourishes in the bitter blast of progress reports and monthly accounts. Methods first and foremost must be practical ; they must also be modern and at least conform to the latest approved practice. This means that to a large extent they must be standardized.

The last point brings in the great British Public, typified by the man in the street. He knows that there is a Forestry Commission, that its function is to plant trees, and he has a more or less distorted idea, according to the particular newspaper which he reads, of how it is discharging its duties. But the " man in the street " is now a traveller. When summer comes he enters his car or motor 'bus and " sees the country, " along with hosts of his fellows, and he then forms his own opinion of what the Forestry Commission is doing.

But the forester is a servant of the State. He is engaged in forming forests for the ultimate benefit of the nation and of the aforesaid " man in the street." The latter, as represented by the holiday maker or tourist, cares very little for the economic side of forestry, but cares a great deal for what appeals to his sense of beauty, however inarticulate. The average forester hears his views with tolerance rather than respect, nevertheless, they deserve some consideration, the more so as they deal with an aspect of silviculture which perhaps is somewhat neglected in State forestry.

There is no reason to suppose that the annual holiday invasion of country districts will lessen. On the contrary, it is likely to increase and to lengthen its season every year. For the next 60 years very little material return in the way of receipts from fellings can be given the taxpayer as a return for his money, but he can receive very real dividends on it by our giving some immediate thought to the appearance which any plantation now in course of formation will ultimately present. This opens up a large subject, and only a few suggestions, and these with special reference to the Highlands, can be made here. The Commission has on several occasions been criticized for vandalism, not always undeservedly. Some of the instances complained of were largely unavoidable ; for example, the derelict spectacle of large areas of dead birch, killed by girdling to avoid the heavy cost of felling and clearing. But the effect produced by long stretches of dark conifers, divided into regular blocks by rides at equal intervals, can be a very cheerless one.

Where the forester sees a thriving forest, our "man in the street" may see the beginning of a new and unpleasing feature of the landscape, and

he is going to talk and write about it, which, as far as the Forestry Commission is concerned, will be poor propaganda.

The forester, however, has the remedy in his own hands, and when he realizes that some attention to the æsthetic side need not be incompatible with good silviculture, many measures will occur to him by which the rather sombre effect of massed conifers can be relieved, with benefit both to the forest and the "man in the street." The remarks here refer to forests in the Scottish Highlands, but the principles are generally applicable, assuming their desirability. There are at the forester's disposal three species which in themselves can do much towards what is required. These are the silver birch, the larch (both European and Japanese), and the beech.

Take a 500-acre block of pure Scots pine or spruce on a dripping autumn day. It is not in the least a cheering sight. But scatter through it a few clumps of birch or some small groups of larch in their autumn colours, and the entire wood becomes transformed. Every one must have noticed the peculiar " lighting up " effect that birches and larches have on a landscape, not only in the fall of the year, but even in the dark winter days. In dealing with birch scrub areas by girdling it is a simple matter to leave a few small groups untreated in a 100-acre block. Such a group need not be more than one-tenth of an acre in extent, and would be selected, keeping in mind its visibility, the age, type and virility of the trees, and any nursing or shelter-belt effect it might have. Further, where a basin of " bad " peat is to be planted, there is much to be argued in favour of conserving any existing birches in or around the peat for their leaf fall and shelter against frost.

In going through plantations formed by the Commission from 1920 to the present year, it is very striking to note the advance made in the proper selection of species for different site conditions. This is largely the result of bitter experience and one now seldom sees spruces or pines carried through stretches of hostile territory. On an area of varying site factors, such as is represented in the majority of Highland or hillside forests, the correct suiting of species to the ground will in itself go a long way to the provision of a forest of pleasing appearance, both to the forester's and the layman's eye.

A practice, rather Teutonic in its inflexibility, was that of delineating ridesides by carrying a single row of one species on each side throughout the length of the ride. This is now largely discontinued. Regularity in ride and compartment lay-out is difficult to avoid, in view of its simplicity and convenience and the resulting ease of survey. The regular effect, however, largely disappears with approaching maturity. But the practice sometimes seen, of planting with one species up to a rideside, and beginning abruptly on the other side with a different one, is seldom justifiable by change in soil conditions, and is undesirable from the amenity standpoint.

Beech is not a timber tree in the north. Silviculturally, however, its use can be justified. Many of the newly acquired forests consist of land that is in a condition of deterioration. In some cases peat formation

is going on actively. On many north-east coast forests soil leaching is in progress. This is reflected in the vegetation. In addition to planting the ground it is important that the soil condition be not only conserved, but also, as far as possible, improved. For this purpose beech is very valuable for its heavy leaf-fall, rich in humus. In the majority of situations where it could reasonably be used for this purpose, no great height-growth can be looked for, nor is it essential. The common method of using beech is to introduce it at beating-up time, or to plant it along with the crop on some regular plan and spacing. A later idea, which ought to be more effective, is to collect the individual plants into small groups. Here again, mathematical regularity should be avoided. Presumably, to make the most of the beech humus, such clumps should be planted on slight eminences, where the wind will give better distribution of the leaves. This is another instance where good silviculture agrees with æsthetics, as such small colonies of beech undoubtedly lend attraction to the view of a forest.

Much can also be done in the way of fire protection. Recent unfortunate experiences showed that railway companies, besides offering an important outlet for mature timber, constitute, by their very nature, a serious fire menace to young plantations. The natural result of these experiences was a crusade against railway fires, which included the laying out of new firebelts and traces and the improvement of existing ones, and was extended to cover other danger centres such as main roads. The species used are intended to serve the dual purpose of sparkscreens and of keeping the ground beneath them bare of inflammable growth. In the north, beech and Japanese larch, in varying mixture, have been largely used. Every one has his own opinion of the suitability of fire-protective species, but the slow growth of beech is a distinct disadvantage. The period of greatest fire hazards in the life of a wood is in the early years, and a quick-growing species is therefore indicated. Thus in some ground Douglas fir is very suitable. Another possible species is Japanese larch at a close spacing. Experience at Culloden showed that Japanese larch about 5 feet high, recovered almost entirely after being apparently killed by fire. Its rapid growth in youth and its fairly heavy leaf-fall are also in its favour. Fast-growing poplars can also be used. In preparing such danger zones for planting, it is advisable to spare young natural birch or other existing " weed species " for their protective value.

Where afforestation is taking place on both sides of a public road, only lack of imagination or the desire to utilize every yard of ground, can justify the planting of heavy foliaged conifers right up to the roadside. It is easy to visualize the appearance of such a road twenty years later, not to mention the breaking of road authority regulations as to the minimum distance at which fencing or planting may be done. The space parallel to the road for a distance of at least 20 ft. can be used as a firebelt and planted with species less likely to render the road a dark tunnel on a winter afternoon. Certain species, larches for example, do not shut in the road in this manner. Thuya also makes a capital roadside tree,

but should be planted there as an ornamental, not a commercial, tree, and far enough back from the road to let its fine appearance be appreciated.

Roadside planting has been taken up actively by Forestry Societies, by the Roads Beautifying Association, and by many municipal bodies; which goes to show the growing need for consideration of this side of forestry. As things are at present, the State forester's sense of humour must be tickled when he is approached by county councillors or city fathers confidently seeking advice on how to render their roads beautiful by planting.

These are a few of the more obvious lines that suggest themselves, and one does not see that they are at all in opposition to the canons of good forestry. The planting of rhododendrons on firelines and the judicious use of shrubs and flowering tree species is not strictly a branch of silviculture and is, in any case, limited here by soil and climate, but a little inexpensive work on these lines would be well worth while. One other method seems to offer possibilities and is distinctly interesting. That is the " new method of planting " recently described by Dr. Anderson, which deals with the group planting of certain species so that they will approximate more nearly to conditions in their natural habitat. It should represent a saving in preparation and upkeep costs and, theoretically at least, an improvement in the resultant nature stand. The fire hazard will in some cases be longer sustained than in ordinary plantations, but from the amenity point of view, group planting should be welcomed.

Finally, there are few fairer sights than a Highland glen in its natural state, at any season of the year. One cannot hope to afforest such glens without destroying much of their attraction, but one can at least clothe them with forests not devoid of charms of their own.

ON TAKING OVER THE DUTIES OF DISTRICT OFFICER.

By H. Beresford-Peirse.

A District Officer, newly appointed from one of the Universities, finds himself beginning the practice of forestry equipped, to all intents and purposes, only with a general knowledge of the theory of his profession —general, of necessity, because of the number and variety of subjects he has studied. It was one step to fit together, during his training, all these different subjects into a comprehensible form in his mind; to realise, for instance, the bearing pathology might have on silviculture, or the effect of economic theories on the practice of forestry. Another step is to realise, when beginning work, the value of theory as applied to practical conditions. It is one thing to know the general requirements as to climate and soil conditions of species of tree commonly used in England and Scotland; it is another to grasp to what extent the specialised conditions of any one locality afford requirements for tree growth, and to decide what species are best adapted to these conditions.

Choice of species is essentially the most important part of a District Officer's work. He will be given the general policy to follow by his Divisional Officer, but it will rest with him to decide on the ground the details of distribution of species over the areas under his supervision. In this he will receive greater or less assistance from the foresters under him according to their experience and local knowledge, but the responsibility will be his. To carry out this important work, a District Officer comes by no means well equipped. During his training a study of actual conditions of forestry could only be given a limited amount of time, and not all the practical experience that he acquired had any direct bearing on the conditions he would meet in his own work. Tours through continental forests and a study of forestry as practised abroad have an undoubted value in giving a wider outlook to the subject, but they cannot act as substitutes for practical knowledge of home conditions. The courses of forestry at Universities, however, have to cater for men going to all parts of the Empire and it is not practicable, even if it were desirable, that they should meet the specialised needs of men who are making forestry in this country their profession. A broad and thorough grounding in the subject is provided: District Officers are not to be turned out ready made. Even if the practical side of University training were extended the difficulty would not be overcome and a District Officer who is at once given charge of several forests will lack the experience that he should have. He will have to pick up practical knowledge in the course of his normal work, and this knowledge will be confined merely to the locality in which he finds himself.

This difficulty of practical experience might be largely overcome if the first year, at any rate, of the probationary period were looked upon mainly as a time during which a new District Officer might acquire as wide a knowledge as possible of conditions of forestry in this country— as a sort of complement to his University training. At the same time

he might be made useful as an assistant where extra help was needed for a time, and later on sent to take over routine work of another officer on leave. A period spent in a divisional office would also be of great assistance, besides giving an idea of the clerical work necessary when in charge of a district, a knowledge of the running of divisional headquarters is of considerable help later on. To assist another officer in preparing an acquisition report or in collecting data for a working plan before such work devolves entirely on the new District Officer himself, is of further assistance and affords experience of new localities. In this light the probationary period may appear as an advantage merely to the District Officer, but by making him better able to carry out, unaided, the work in a district, the probation period thus used would also ensure better work being done eventually for his employers. The routine work and clerical work that a District Officer has to do is fairly quickly picked up, but it is the practical experience and knowledge of conditions and methods other than those in his own locality of which he feels the need, and which are at present difficult to acquire.

The life of a District Officer probably comes up to the expectations that were formed of it. Besides an interest in trees and the way they are grown, perhaps the idea of an open-air life away from an office and a town is what mainly attracts a man to a career in forestry. A District Officer finds himself out of doors in his plantations or on new ground most days of the week and if he rather often comes home with a wet skin he will be none the worse for that. Then there are the endless opportunities for watching birds and studying their habits, and for all kinds of botanising, which fit in with the work and give it an added interest. In short, if he is badly paid, a District Officer has other compensations, not measurable in terms of money, which may make his work also his hobby.

NOTES AND QUERIES.

SEQUOIA SEMPERVIRENS IN CALIFORNIA.

The following is an extract from a letter received from Professor F. S. Baker of California University :—

" Good redwood seed is indeed hard to get, and you can almost say that no such thing exists, for even the best of it has very poor germination. Taking it over a period of years, the results here show from 5 to 20 per cent. of the seeds germinated, and it is not unusual to have some lots of seed show absolutely no germination. I have not received fall catalogue from seed collectors in this region yet, but if the same collectors gather this seed this year who have done so in the past, you can probably get good seed from The Pacific Lumber Company, Scotia, California ; The Long Bell Lumber Company, Longview, Washington ; and from Mr. J. W. Preston, Chico, California. I think the second source would probably be the most satisfactory to deal with.

" I have a few small lots recently collected that are now undergoing germination tests and if any of them turn out to be good I will send you a small amount, say one-fourth pound of the best seed. The seed deteriorates rapidly and cannot very well be held over a year.

" In this region, and I think the same would apply to England, the culture of redwood in the nursery is very similar to other conifers, the chief difference perhaps being that shade is very beneficial during the first year. Great care has to be taken to prevent damping-off, which is frequently very serious in May or June after rainy periods. I would recommend using a soil with a strong tendency towards sand, as moisture conditions are more easily controlled there. Of course, sow the seed very thickly, as the germination percentage is bound to be low. I think you will find the trees should be transplanted after one year in the seed bed and can be out-planted at the end of the second year. In the redwood region they customarily raise them only one year in the seed bed and plant in the field early in the first winter, but I do not think you will have as rapid growth in the nursery as they have in the redwood region of California, and that, therefore, the trees will be of a better size to handle at the end of the second year."

SEQUOIA SEMPERVIRENS IN NEW ZEALAND.

The following is a letter received from Mr. E. Phillips Turner, Director of the New Zealand State Forest Service :—

" This Service has been planting *Sequoia sempervirens* in New Zealand for some years now and although the nursery and plantation practice is more or less standardised, the results obtained vary within wide limits.

" Most of the seed used here is imported from California, but small quantities are collected locally each year, mostly from specimen trees. All imported seed is at least 12 months old when sown. Sowing takes

place during October and November, and as the Californian seed crop ripens during September and October, the seed cannot be collected and shipped to New Zealand in time for sowing the same year. The present method of handling seedstocks is as follows: The seed is shipped to New Zealand in cool storage (38° to 42° F.) as soon as it is collected, arriving here about December. It is then fumigated with bisulphide of carbon and placed in cool storage until required for sowing the following October. This method is proving satisfactory and the seed is not deleteriously affected by 9 months cool storage.

"The fumigation referred to above is a routine operation carried out on all imported tree seed in order to prevent the accidental introduction of seed-infesting insects. Bisulphide of carbon is the reagent used and the dose administered to redwood seed is 1 oz. of fumigant per 100 lbs. of seed, the exposure being 48 hours. Experiments carried out in 1928 to determine the effect of various fumigants on the germinative capacity of seed gave the following results for redwood:—

Fumigant:	Germination: Laboratory. Per cent.	Germination: Nursery. Per lb. of seed.
Control	12·5	2,688
Mercuric chloride	15·5	3,904
Sulphurous acid..	15·0	3,392
Potassium permanganate ..	22·5	2,944
Carbon bisulphide	26·0	4,480

"The above indicates a rise in germination due to fumigation, but in practice this has not been borne out. The whole question of fumigation is under consideration at present and it is hoped to obtain more conclusive data in the near future.

"Redwood seed is extremely variable in germination, and although the number of seeds per pound is about 120,000, the number of trees resulting from a pound of seed may vary from nil to about 20,000, the latter figure being a maximum obtained only in rare cases. Laboratory germination tests carried out by this Service have given results varying from nil to 32·5 per cent., while the average nursery production is about 5,000 trees per pound of seed. Germination tests carried out on seed collected locally from trees of different ages gave the highest germination for seed from trees 40 years old, 24 per cent. Fifty-year-old trees yielded seed of 13·5 per cent. germination, while the seed from trees 50–60 years old varied from 2·5 per cent. to nil. This experiment was carried out during one year only and is, therefore, not conclusive.

"Observations extending over a number of years have shown that while there is generally a tendency toward a three-year seed-cycle in New Zealand-grown redwoods, certain well-known specimen trees consistently yield fertile seed year after year. The reverse is also the case, and other trees are known which have never borne fertile seed. This quality of seed-fecundity and fertility is but little understood and is evidently inherent in the species, at least under New Zealand conditions.

"In sowing the seed, the usual practice is to cover to a depth of

$\frac{1}{8}$ in. to $\frac{1}{4}$ in. with sieved sand. Experiments carried out to determine the most suitable type of covering have proved that the best results are obtained by the use of coarse sand which will pass through $\frac{1}{4}$-in. but not through $\frac{1}{8}$-in. sieve. This covering is better than either fine sand or fine soil. Shelter, in the form of 10 ozs. hessian supported on wire-netting frames placed over the seed beds, is provided for the young plants. Scrim of this weight has been found better for the purpose than 18-oz. scrim which casts a heavier shade and makes for the production of weak, spindly seedlings. Laths, spaced 1-in. apart, have been tried for sheltering seed beds, and while they tend to produce good sturdy seedlings, they are not so generally suitable as 10-oz. scrim. After being in the seed beds for one year the seedlings are lined out, their average height then being 2 to 3 ins. They remain in rows for some 9 months and are then finally planted out in the plantation, the average height being 7 to 12 ins.

" Redwood is successfully grown in New Zealand only at the stations where higher average temperatures prevail. Rotorua, with average maximum and minimum temperatures of 65 and 45 deg. F., and an annual rainfall of 50 to 70 ins., is the optimum site in the North Island, while Nelson, with average maximum and minimum temperatures of 65 and 46 deg. F. and a mean annual rainfall of 37 ins., is the only suitable part of the South Island for the production of this tree.

" Commercial growers of the species now claim quicker results from planting of one-year and two-year or even one-year and three-year plants, the aim being to raise in the nursery a plant with a well-developed " collar," i.e., a marked thickening above the ground line due apparently to masses of dormant buds. The claim is that after planting, the plant receives no check, whereas younger plants, if put out as described above, frequently stagnate for two or even three years in the plantation before commencing to grow.

" Whilst one is not yet prepared to dogmatise on this question, the indications are that the contention of the commercial growers is correct, save for seedlings underplanted in a fairly dense canopy."

COMPARISON BETEEEN NURSERY AND FOREST-GROWN BEECH SEEDLINGS.

The lifting and using of self-sown forest seedlings will never become a general practice in forestry, but the following few notes based on an experiment I tried in 1928 may not be without interest.

The last good beech mast year in Scotland was 1926. I gathered a quantity and sowed some in the nursery in the spring of 1927, but owing to mice and bird damage the quantity of seedlings realised was rather less than anticipated. The same year in the old woods there were literally thousands of surplus beech seedlings. I lifted a few thousand of these in the autumn of 1927, and lined them out in the nursery in the spring of 1928. They were fairly good average seedlings. The nursery ones were also lined out in the spring of 1928 ; they were a little larger and with perhaps a slightly better root system than the forest-grown ones.

They did quite well, about 95 per cent. of them lived and at the end of the 1929 season they averaged 12 to 16 ins. high. On the other hand, the forest ones were rather disappointing, only about 50 per cent. of them lived, they turned out to be on the whole delicate third-rate plants, and only the best of them were 10 to 12 ins. high. They could not be compared with the nursery ones for size and vitality. It would appear that to obtain a stock of satisfactory transplants, although one may have some hundreds of thousands of surplus beech seedlings in the forest after a good mast year, that it would be much more profitable to gather the seed and sow in the nursery.

I have also tried a similar experiment in lining out one- or two-year self-sown seedlings of oak, sycamore, common ash, mountain ash, birch, alder and holly. All of these did very well with the exception of oak, which did not give quite such satisfactory results.

S. H. A. Paterson.

Despatch of Plants *per* Goods Train.

It is perhaps not generally known amongst foresters, that if "Vacuum-Connected Wagons" are ordered, these are attached to express goods trains and, according to the railway authorities, delivery is thereby considerably expedited.

G. W. Hollis.

Draining and Preparation of Turfs.

The benefits derived from turf planting are quite well known generally, previous articles having dealt pretty fully with the subject. There is room, I think, for a few words on the methods of draining, and preparation of turfs for planting. My general custom before cutting turfing drains is to clean out the existing ones on the area. One usually finds that the majority of these old drains are placed in the most effective positions, catching the maximum amount of water. and ideally adapted for the main drainage system. This is not uncommon when one realizes that some of the sheep farmers have farmed these areas for the best part of a life time, and from long experience knew just where to place a drain to the best advantage. Some parts, of course, may not be drained at all, especially where feed has been scanty. This, however, can be weighed up, new drains laid out and drained by the men cleaning out the old drains.

It may not come amiss at this point to describe the equipment in general use for draining. The tools consist of the sheep-draining rutter, made for the right and left foot for cutting the drain, a double-edged rutter for cross-cutting the turfs, a hack or hill drawing drag for pulling out the turfs, with the addition of a good stout line 3 or 4 chains long for laying out new drains. The line should be marked with some distinguishing mark or tag giving the exact measurement between turfing

drains centre to centre, 18 ft. or 20 ft. as the case may be, evenly spaced drains result if this is done. The flat file is used for sharpening the rutter, and if it is to be kept in good condition, ought to be kept dry. A good idea for this is to obtain a piece of old cycle tubing, tie one end, slip the file inside, making something not unlike a bayonet scabbard.

Turfing drains are usually cut 18 ins. wide at the top tapering to 6 or 7 ins. at the bottom, 8½ to 9 ins. deep, and supply 4 rows of turfs 18 ins. wide, 15 ins. long, the distance between drains depending on the spacing between turfs. The work is best accomplished by two men working together, the line is laid out in the direction the drain is going to run, one man using a left foot rutter the other a right, each cutting 9 ins. from the line. The result is a good straight even-width drain with clean-cut edges. If both men use the same footed rutter, one has to commence at the top of the drain and his mate at the bottom, very often making a ragged waving drain, sometimes 18 ins. wide and more often 12 ins.

The drain cut, one man takes the cross-cutting rutter and cross-cuts the turfs, the other man the back and places the turfs in their proper positions, usually two turfs to one side and two to the other side of the drain, spaced as per planting distance, keeping the row nearest the drain at least 1 ft. from the drain side. The next drain cut, the same operation takes place, two turfs placed to the top and two to the bottom, four turfs between drains and so on. This is the quickest method, less walking being entailed by the man laying out the turfs.

To put the method described into operation I commence with the compartment boundaries and roads, making a drain on each side, the turfs being placed two to one side two to the other until the whole compartment is enclosed. A much better idea can then be formed as to what is to be cut, and later on portioned out to the men. The ground having been parcelled out it is a matter of opinion whether a drain should be put in to divide one gang's work from another (pegs and private marks can be moved, but drains are stationary) if so decided care ought to be exercised that an accumulation of turfs does not occur. If the turfing drains are going to run into the side drain where the turfs were placed two on one side, two on the other, such an accumulation would occur. The way out of the difficulty is to run another drain parallel to the ride drain, but placing three rows of turfs to the inside and one to the outside the drain will then run through one row of turfs. The cross drain would be laid out three rows of turfs to the inside of the square, one row to the outside and the drain commence from the third row. It is most important to cut the sides of the drain deep, a little extra time spent on this is amply repaid, both to the men and to the finished appearance of the drain. The turfs come out easier, less material remains in the bottom to be thrown out later when bottoming and a neat square turf results. I have often had men complain of hard going and in many cases have traced the cause to this source.

The prices per chain for cleaning out old drains varies with the locality, 1*s.* to 1*s.* 2*d.* being paid at North Tyne. For new drains, including cutting, bottoming and placing the turfs, 1*s.* 3*d.* is the standard rate, and

quite good money can be made, the men averaging £2 10*s.* per week. In conclusion, may I remark that I prefer turfs cut at least some months before planting. The peat becomes more friable, or broken up, roots have a much better chance of ramifying and the nutrient salts become solvent.

Turfs, where clay predominates, are certainly better if cut early; cut late they are so hard that a good day's planting is enough to take the skin off the fingers, besides there is danger unless the turfs are broken up of jamming the roots of the plant too tight.

J. T. ANDERSON.

AN IDEAL FOREST WORKER'S HOLDING.

Now that the Forestry Commission have entered their twelfth year of progress there are several hundreds of forest workers' holdings.

The first point is selecting suitable tenants, men who have knowledge of the care of stock, take a pride in their holdings and upkeep, and are interested in the work the Commission provide for them. The land should be chiefly grass, as to cultivate would be expensive, suitably fenced, the best area being kept for mowing and the rest for grazing. A large garden for growing vegetables, also a small paddock near the buildings, would be very useful to turn stock out in winter time for exercise and water, water should be laid to every holding both in the yard and at least one field. The buildings should be compact and situated a short distance from the house, have a southerly aspect, and should include a cow byre to hold two cows, built up to the standard, not a loose box cow house, a stable for one horse, two calf pens, and two pig-styes, all the aforesaid buildings to be properly drained into a collecting tank, which should be made a few yards from the buildings, and a store house or barn of a good big type to hold bedding and a certain amount of fodder, a poultry house of modern construction to hold 50 fowls.

The house and buildings, of course, should be built near to a good hard road. The house should comprise a living-room and three bedrooms, the living-room should be equipped with an " L " boiler and plate, a large dairy built to comply with the milk and dairy order, and a wash-house of a good big type to act as coal and wood store as well.

A tenant with the work the Commission provide and the foregoing house and buildings and 10 acres of good land stocked to its full should be able to pay £18 or £20 per annum and prosper.

H. FRANK.

HEATHER BURNING.

Each year I have a certain amount of heather to burn before the planting season and have found that this is a difficult operation, especially where the heather is very old, as a great deal of heat is given off during burning. During the season 1929–30 I had to burn an area of 200 acres

of heather of the rankest type, and I knew that to set this on fire all at once would lead to serious trouble and cause unnecessary beating out. To avoid this I adopted the following method, which proved successful.

In the first place the area was drained with main drains only, the side drains to be cut after the heather was burnt. The main drains varied from 3 to 6 chains apart and were 22 ins. wide by 12 ins. deep, running approximately north and south. Taking the advantage of a west wind and very dry weather in October, a start was made on the east side by burning a boundary strip 1 chain wide, along a wall side. When this was done the fire proper was commenced on the first drain towards the west and allowed to travel east, and so on till the whole area was burnt. The only beating out that was necessary was on the north and south sides, and this was easily done as the fire was well away and giving off very little heat; all was done by three men, one setting fire and two beating out.

By this method a very clean burn can be obtained where the heather is dry, as a good body of flame can be had by setting fire along the drain side, and there is no back-fire to contend with. Whereas by the cutting method, fire beating and a staff of men are continually required to keep proper control.

C. McNab.

Foresters' Meetings.

The idea of holding Foresters' meetings, suggested in last year's "Journal," is an excellent one, and should be kept in mind. Meetings could take place at convenient centres, one in each district in the meantime, and Divisional meetings held later on if the scheme develops favourably. The interchange of opinions and experience of methods of working, and of problems connected with forestry operations would be valuable. Papers could be read, each followed by discussion; younger foresters in particular would benefit, and their number is increasing. Added efficiency would result and enthusiasm would be stimulated. Let us hope that the idea will materialize!

H. H. Waller.

Pine Beetle on Corsican Pine Seedlings.

An unusual attack of *Myelophilus piniperda* was observed on two-year-old Corsican pine in Clipstone Nursery last autumn. Leading shoots of the plants were seen to be turning brown during September, and on investigation it was found that the shoots were tunnelled and very easily broken off the plant. Although the attack was not serious quite a number of seedlings were affected; the beetles had emerged and disappeared. There are several older pine plantations in the vicinity which are infested with this beetle, but none nearer than three-quarters of a mile. In addition, we have some three-and four-year-old plantations adjoining the

nursery, but none of these appears to have been attacked. In the nursery it was probably a second brood which was the cause of the trouble, and, owing to the quite unexpected visitation no trapping was possible. A careful watch will, however, be kept in future.

T. E. ANDERSON.

CLIPSTONE FOREST.

Clipstone Forest, situated in the northern part of Nottinghamshire, is in the centre of the historical Sherwood Forest made famous by the exploits of the outlaw Robin Hood and his merry men. Many of the old oaks are still standing more or less in a dilapidated condition, and some of them are visited by thousands of people every year. Chief of these is the Major Oak, and legend tells us it was under this giant oak that Robin Hood and Maid Marion were wedded. It is still alive and flourishing, and is reputed to be the oldest oak in Great Britain, the age being stated to be 1,500 years. How the age has been ascertained I do not profess to know, but the tree has a girth of about 24 ft., and twelve persons can easily get inside the trunk, which is hollow.

Then there is the oak known as Robin Hood's larder, where that worthy was supposed to store his venison after the chase; this tree has unfortunately been considerably damaged by fire. Another large oak is known as the Greendale Oak, in Welbeck Park, the seat of the Duke of Portland. It is stated that in 1724 the then Duke made a wager with a fellow nobleman that he possessed a tree through which he could drive a carriage and pair. The wager being accepted, he proceeded to hew an opening through the tree 10 ft. high by 6 ft. wide, and eventually won the wager. This tree is still standing, but the gap has considerably diminished since that date through growth, and the tree, owing no doubt to this operation, is now falling into decay.

An interesting point in connexion with these old trees is that they are mostly sessile oaks.

T. E. A.

YOUNG PLANTATIONS AT SHERWOOD.

In one plantation about 30 years old, and 60 acres in extent, principally Scots and Corsican pines with a sprinkling of European larch, the growth last season was above the average. The Scots pine have suffered badly from *Tortrix*, in some cases the stems resembling the handle of a walking stick, while the Corsican pine have suffered little or no damage from this, the stems being straight and clean. In another plantation, 6 or 8 years old, of about 6 acres, with a mixture of Scots pine, Japanese larch and Sitka spruce, the growth has been better still. In many cases the Japanese larch and Sitka spruce are putting on shoots of about 3 ft., a growth which is strong and vigorous. The soil in all these plantations

is light and sandy and not very deep, in many places no more than 6 ins. in depth with a pure-sand subsoil. Smoke damage in this area is practically unknown as, although there are plenty of collieries, etc., not far distant, none is in the immediate vicinity.

R. BEWICK.

USE OF CARBIDE IN NURSERIES.

I have tried carbide on young cauliflower and similar plants which were attacked by grubs and have proved it to be very effective. In some cases the plants were beginning to die, but after using the carbide, they recovered and grew to an excellent size. The method I adopted was to drill a hole with a stick slantwise under the plant, and drop in a piece of carbide, and then close the hole. No water is necessary as the moisture in the soil is enough to cause gas to form. The gas permeates the soil and kills any grubs with which it comes in contact. If water were added gas would form more quickly and there would be less time for it to do its work. A method which could be adopted in forest nurseries would be to drill holes about a foot apart each way, and drop in pieces of carbide about half the size of a walnut. Carbide can be bought for about 16*s.* to 20*s.* per cwt., or even less for larger quantities. It can also be bought in various sizes. One hundredweight should be sufficient for 2 or 3 acres.

R. B.

STAKING DOUGLAS FIR.

Young plants of Douglas fir very often suffer from being wind-blown, expecially on exposed ridges. This necessitates staking, the common method being to drive a stake (often done through the tree roots, causing unseen damage) and to tie the stem to it by means of sacking, binder twine and grass, to act as packing to prevent chafing of the bark. A more satisfactory method is to drive the stake in at a short distance from the stem, take two fairly stout but flexible branches and, without severing them from the living tree, cross them and tie them behind the stake with a small length of binder twine. The position of the stake depends on the direction of the prevailing wind, and should be so placed that the branches have a pull on the main stem.

When the roots of the tree have established their position the branches which will bear signs of their past treatment can be cut away. This method has proved very effective in holding the tree secure without undue damage.

C. P. CARR.

THE FORESTER'S FRIEND.

The following note describes a modification of the ordinary slasher which is most useful on account of its adaptability.

Taking a slasher 3 ft. long, a leather loop is fastened through the handle about 6 ins. from the top, which is rounded for convenience. The blade is slightly altered, the point being beaten out to form a blunt edge 2 ins. wide, vertical to the cutting edge of the slasher. The corners of this are rounded off and the blade can then be used as a grubber, and is very useful when sampling seed beds in the nursery. A local blacksmith is the best man to do the above work, and he should also fix a round stud on the back of the blade at the point where it opens out to form a socket for the handle. This gives the cutting blade ample clearance. The stud is fixed by drilling a hole in the blade and passing a rivet through it and the stem of the stud. The stud I have is similar to a bifurcated rivet, the diameter of the head being 1 in. One can easily be made from a flat-headed bolt of suitable size. With the help of a hacksaw the stem is cut ¾ in. from the head and is slotted to fit over the back edge of the blade. It is then drilled so that it may be rivetted to the blade.

This attachment is very useful when renewing staples in fences. The length may be marked off every 6 ins., which makes it handy for getting the height of transplants and counting in the nursery.

Altogether its uses are quite numerous and it proves a good friend.

C. P. C.

Comparison of Growth of Corsican Pine, Maritime Pine and *Pinus insignis* at Dunwich Forest.

As regards height growth the Corsican pine is ahead of the other two pines, but *Pinus insignis* has the largest girth of the three. The maritime pine has not made the growth which the other two have, nearly all of this species in the belt seem to have been damaged by wind.

All three species are 46 years of age. The height-growth is approximately as follows : Corsican pine, 65 ft. ; *Pinus insignis*, 55 ft. ; maritime pine, 50 ft., and the girths at breast height are 78 in., 108 in. and 60 in., respectively.

The soil is light and sandy and the aspect north-westerly. The belt, situated on a hill, is about a mile from the sea, which is on the N.E. side. it is exposed on all sides, except the east, from which it is sheltered by a group of trees.

H. R. Halsey.

Protection against Fire, Rabbits and Moles.

Forest protection on the different areas on which I have had experience is one of the most important as well as one of the most persistent worries that a forester in charge has to contend with.

Fire is probably the chief danger, it is one which is present where railways run through any area, and also where there are thoughtless tourists seeking a pleasant time in some isolated nook. The last thing that the Forestry Commission would desire is to debar people from

pulling off the main road and sitting down with their families to enjoy their lunch, provided they use the fire rides. Half of our town visitors, however, seem to say to themselves—" Here is a lovely quiet place, no one to interfere with the children, we can light our spirit lamps and boil the kettle." There lies the danger unknown to the visitors. Probably one of the children upsets the lamp, and dry grass alongside gets on fire. When this happens the Commission is very lucky if a considerable part of the area is not burnt out. Another danger is smoking cigarettes; it is quite common for the patrol and the warrener to collect a fair variety of half-burnt cigarettes after one of these visits, mixed with bottles of all descriptions. If it was not for the present system of patrol during dry weather much destruction might result. I have no wish to be pessimistic, and it is clear that those belonging to former generations planted trees and managed to produce mature timber without serious injury from fire, but there were no motors in those days and it is these vehicles which now convey to country districts great numbers of town-dwellers from the congested centres.

As regards rabbits, it is clear that in common with other animals these creatures try to get their food in the best way they can, and they naturally seek it where it is most plentiful. Much of the land acquired by the Forestry Commission consists of areas which have been the home of the rabbit for generations, and as their feeding area has been diminished their only means of obtaining a living is by trespass. Surrounding each planted area is a large extent of ground where rabbits are numerous, and although fences are erected the hungry creatures try to get in; even wire-netting of $1\frac{1}{4}$-in. mesh is not small enough to prevent a tiny rabbit squeezing through, then along comes the mother-rabbit in search of her offspring, finds it impossible to get through the netting, starts to climb the fence, and very often succeeds. Others take the fence at a running jump, so, altogether, the warrener and his dogs have a hot and endless job.

The mole is another animal which has become a very serious menace on newly afforested areas owing to trees up to three years planted being killed or damaged. In Norfolk and Suffolk most of the land being poor and sandy, moles do not easily find, in large quantities, the earth-worms for which they are searching and have to travel long distances to obtain sufficient food. To gain what it requires the mole will follow forest-plough furrows to a surprising distance and do a good deal of harm, especially to small trees—say from 3 to 6 ins. high. Its burrows, which are about $2\frac{1}{2}$ ins. diameter, cause drying of the roots of the small plants, and this is particularly damaging in late spring. In addition, the mole hills cause trouble; these, being usually 6 or 7 ins. high, are sufficient to smother individual small trees. The only thing to be done in such a case is to clear away the soil by hand and firm the plants at the same time, an expensive but necessary operation.

T. HENDRIE.

Notes on Rendlesham Forest.

As regards the growth of the commoner species, Corsican pine last year made better and more regular growth than Scots pine. There was very little *Tortrix* damage and much less loss from saw-fly caterpillars. Larch did not do well, having been badly frosted during late spring and early summer. Douglas fir suffered from the same cause, but they are now getting away above the damaging frost zone. Maritime pine continued to develop many leading shoots per tree, and this has had the effect of reducing the rate of height growth, but all the trees appear healthy and vigorous. An area planted a few years ago with graded Scots pine seedlings, one year old, has done well, little difference being noticeable now between the seedlings and transplants on adjoining land. Sitka spruce occupying a small area produced abnormal leading shoots last season and many of them a second growth during autumn. The plants hung fire for several years and were annually frosted in late spring until they became acclimatised.

The weather in the early part of the growing season was marked by hot and dry days and low night temperature, a difference of 50 degrees between day and night temperature being not infrequent. The rainfall for the twelve months ending September, 1930, amounted to 37 ins. against an average of 27 ins. for the last three years.

C. Hankins.

REVIEWS AND ABSTRACTS.

INVESTIGATIONS INTO THE INFLUENCE OF THE ORIGIN OF SCOTS PINE SEED.

By PROFESSOR WIEDEMANN, Eberswalde.

(*Zeitschrift für Forst und Jagdwesen, July and December*, 1930.)

In 1907, on the proposal of Professor Schwappach, an international experiment was started to investigate the growth of Scots pine of different origins. Twelve lots of seed were collected, the origins including Scotland, Belgium, France, Germany, Sweden, Russia, Bulgaria and Hungary. Portions of each lot were distributed over as many forest research stations as would undertake the experiment. The object was partly to see how the different lots compared under given conditions, and partly to ascertain how the same seed would develop in different climatic regions.

Wiedeman reports first in detail on the series of plots at Chorin, near Eberswalde, and then describes the results of plot series in other countries. The third section of the paper refers to supplementary investigations on the provenance of Scots pine. Section 4 is a discussion of the results given in Sections 1 to 3, and Section 5 contains the Summary and Conclusions.

The broad result of the international experiment is to show that the best races in almost all the different sites in which plots were established are the Belgian race (from Campine) and the East Prussian race. The Scottish race comes about the middle of the series, while the poorest is that from southern France. In many of the series, plants from two lots of Hungarian seed were used, one lot coming from an "*élite*" stand of best type and the other from a so-called "cripple" stand. It is remarkable that there should be no appreciable difference in the form or development of the trees from these two lots, thus indicating that the dwarfed and crippled growth of the poorer mother stand was due to some non-genetic factor.

In the Rhein-Pfalz and in Hesse, Belgian pine has outstripped in height-growth the native pine race. The Scottish race was planted in two areas in Hesse, and there are also plots in Switzerland. At Kelsterberg, in Hesse, it was somewhat inferior in growth to the native race, but owing to its complete immunity from *Lophodermium* is very densely stocked. (This immunity from leaf-cast has been the salient feature of the Scottish race in the international experiment, and appears to be a definite characteristic.) At Schiffenburg, in Hesse, the Scottish and Belgian races head the list in rate of growth and in appearance. Planted in Switzerland at 1,300 ft. elevation, the Scottish race was poor at the age of 6 years, while at the greater elevation of 2,600 ft. it was very good.

Two interesting series of pine plots were planted in Schleswig-Holstein in 1911. In this cool, rainly climate the north Swedish races died out almost completely, Central German races have also failed. The best race in both areas is that from the climatically similar region of South Sweden; also, remarkably enough, the East Prussian race from Memel,

a district on the same latitude, it is true, but far to the eastward, and with a very different climate. The East Prussian race thus shows here, as elsewhere, its adaptability to extreme ranges of climatic conditions.

An important series of experiments in Russia, using pine seed from different parts of the country, confirmed, on the whole, the results in the rest of Europe. They showed that it was possible to use pine from widely separated localities without bad consequences resulting, the permissible range being about 4 degrees of latitude and 10 degrees of longitude—but that failures resulted where the difference in climatic conditions was too extreme. When using seed from a northern latitude in the south, slow but healthy growth resulted, while in the opposite case (south to north or east to west) the result was great susceptibility to disease and check in growth after good early development.

Wiedemann summaries the general results as follows :—

(1) There is a large number of local races of Scots pine in Central Europe which have inherited characteristics affecting form and rate of growth as well as susceptibility to certain dangers.

(2) Within the very wide natural range of the pine in Europe there are obviously such climatic extremes that the extension of races which have formed under one set of conditions to widely differing conditions is fraught with very grave dangers. For central European conditions, races which must be excluded are the Scandinavian, the south-eastern European, the southern French and the high Alpine. In Germany itself, extreme conditions occur, e.g., coastal, high elevation mountain and exceptionally dry areas, which must be treated as special zones, seed from which should not be used elsewhere.

(3) The conclusions of Engler and others as to the great adaptability of many pine races have been fully confirmed. Extreme localities apart, a large number of the races used have maintained unchanged their natural characters of form and growth, when planted under a very wide range of conditions. Within these limits the decision as to the suitability of a given race for cultivation depends at least as much on the natural characteristics of the race in its native habitat as upon the actual distance separating the origin from the site of cultivation.

(4) Just as in agriculture, certain "*élite*" races of corn, potatoes or cattle do well under very different conditions and are often superior to the local native races, so in the cultivation of Scots pine the use of certain particularly good foreign races in place of the native races may be amply justified. Such "*élite*" races will be distinguished by good stem form, rapid growth, great resistance to leaf-cast, and insensitivity to change in climatic conditions. The Belgian pine, first and foremost, and to a lesser extent the East Prussian pine, have shown themselves to be "*élite*" races in the above sense, capable of being cultivated over a wide climatic range, although discretion must be used to avoid extreme differences from the native habitat. An essential condition, of course, is that seed should be collected from "*élite*" stands of these good races. In this connexion it is important to note that the Belgian pine itself is

no native race. According to Quairière this race has been formed as a result of the introduction, 150 to 200 years ago, of seed from South Belgium, South Germany, Kurland, etc. Some property of the local habitat has led to the rapid elimination of trees with inferior characteristics and to the survival only of trees with those characters which justify the forester in terming the race "*élite.*" Unfortunately there is no evidence to show to what extent the Belgian pine stands as a whole belong to this desirable strain.

Wiedemann concludes that it is highly probable that there are other "*élite*" races in Scots pine in Europe and that the discovery of these is an important task for forest science. Further, the areas with special extreme climates must be defined, mapped, and the most suitable race in each case worked out. In the meantime, caution should be the watch-word in practice; where the local pine race is satisfactory the forester should be content. Where this is not the case he is justified in seeking elsewhere, working on the principles outlined in this paper.

W. H. GUILLEBAUD.

THE REGENERATION OF MIXED STANDS OF SCOTS PINE AND BEECH.

By PROFESSOR DR. SCHWAPPACH.

(*Zeitschrift für Forst und Jadgwesen, July and August,* 1930.)

Professor Schwappach describes some of the difficulties experienced in regenerating mixed stands of Scots pine and beech on fertile sandy soils in North-East Germany, selecting for the purpose a forest, Görlsdorf, with which he has had many years' experience. The chief characteristic of the soil in this forest is the rapidity with which weeds, especially the coarse grass *Calamagrostis*, occupy the soil after the crop has been removed. It should be mentioned that the beech is always sub-dominant in the crop, with the best trees 12 to 15 ft. shorter than the Scots pine. Other adverse factors are the presence of a heavy stand of game, the extreme light demanding character of the Scots pine in this area, which is intolerant of all but the lightest shade, and the exactly opposite requirements of the beech, which suffers from frost and drought in early youth. The following is an account of some of the methods employed to secure regeneration—which is desired to consist of two-thirds pine and one-third beech—and the principal causes of failure.

(1) Clear felling in the form of Kulissen strips 50 to 60 yards in width, with intervening strips of standing forest 100 to 120 yards wide. In order to combat the weed growth potatoes were grown for one or two years before planting. The result: destruction of the natural beech in the cultivated strips as a result of the cultivation. Beech subsequently

introduced were destroyed by game or suppressed by the pine. The resulting plantations were very costly and consisted of pure pine.

(2) The next attempt was to establish a crop of beech under the shelter wood compartment system, planting through the beech with pine at a later stage. A heavy thinning was made just after a full mast year. Result: the small beech seedlings were almost completely destroyed as a result of damage accompanying the felling and extraction of the trees.

(3) It was then recognised that it was necessary to give the beech time to become established before opening up the crop sufficiently to introduce the pine (all attempts to induce the pine to regenerate naturally had failed, hence the pine was always introduced by planting), at the same time the beech must not be allowed to become too strong or they would suppress the pines. In places where groups of beech advance-growth occurred all the pine were cut out in a single felling and beech left to serve as mother-trees to seed the area and provide shelter. Pine was introduced by spot sowings. Result: very unsatisfactory. It took many years before the crowns of the suddenly freed beech developed sufficiently to bear seed, and many died. The pine sowings suffered from the shade of the beech and required excessive beating up. Eventually a pure pine plantation resulted.

(4) These failures led Schwappach to introduce the strip system regenerating in narrow strips from north to south, but first preparing the way by gradually opening up the canopy and so freeing the beech crowns sufficiently to enable them to become seed bearers. The stages of this method, which is said to work satisfactorily, are as follows:—

(1) Moderately heavy thinning during the last 20 to 30 years of the life of the stand resulting eventually in the appearance of a certain amount of beech seedlings.

(2) A regeneration felling in the form of a strip 130 ft. wide, removing the larger pine and part of the heavier crowned beech.

N.B.—Successive strips are narrower, not more than 80 ft. in width.

(3) A secondary felling in 3 to 5 years, again removing the largest trees.

(4) Introduction of pine when the beech is 12 to 15 in. high and the stand has been reduced to about 600 cu. ft. per acre. The pine is either planted as one-year seedlings on raised strips 4 ft. apart or sown on the strips. Part of the ground between the plant lines is kept worked mechanically, but avoiding the better beech groups.

(5) Removal of the timber in the second or third winter after the pine is brought in.

(6) Continued working of the soil on each side of the conifer rows to keep down grass and other weed growth.

It may be observed that as the regeneration areas have to be enclosed against deer, and the pine seedlings are planted to the number of about 7,000 per acre, the above must be a pretty expensive form of forestry.

W. H. G.

QUALITY OF TIMBER AND THE DEVELOPMENT OF SCOTS PINE IN YOUTH.

By OLDBERG and KUHN.

(*Zeitschrift für Forst und Jagdwesen, September*, 1930.)

The paper describes an investigation on the factors affecting the production of high quality milling timber of Scots pine. It is based on the view that it is more profitable to grow pine timber of the best quality than to strive after greater volume production. The starting point is the assumption that there is a direct relation between breadth of annual ring and timber quality. It is shown that in old timber the relation holds good, not only as between annual ring and timber quality, but also as between timber quality and the method of establishment of the stand. The ultimate quality of the timber (for the finest purposes) is determined when the stem has a butt diameter of only 10 to 12 cm. (4 to 5 ins.). First quality timber can only be obtained if the average ring breadth within that diameter does not exceed 0·12 in. (= 8 to 9 rings per in.), and it was proved that this holds good irrespective of soil quality in so far as the better quality sands and sandy loams are concerned. High quality timber cannot, however, be obtained on heavy loams or clays. The poorer soils will also yield first-class timber, but too long rotations are required.

The best conditions for the production of high quality timber are provided by long-continued development under a shelter wood during youth combined with uniform height-growth of the individual trees. On bare ground broadcast sowing produces the best timber. In view of the fact that broadcast sowing is seldom practicable the spacing on establishment must be reduced as much as possible. With plant rows 4 ft. 6 ins. apart the spacing in the rows should be not less than 16 ins., and better, 12 ins.

First thinnings should be delayed as long as possible, wolf trees should be beheaded, not felled. If necessary pruning must be resorted to, especially when the plantation is irregular or gappy.

W. H. G.

FOREST SOIL RESEARCH IN RELATION TO FORESTRY, WITH PARTICULAR REFERENCE TO THE NORTH-EAST.

By PROFESSOR I. G. ROMELL, CORNELL UNIVERSITY.

(*American Journal of Forestry, October*, 1930.)

This is an interesting study of the lines along which research should proceed in the North-eastern States. After stressing the essential differences between forest soils and agricultural soils, pointing out, incidentally, the far greater diversity of the former, the writer develops his main thesis, which is that before real progress can be made certain

typological classifications must be made. For the practical application of laboratory knowledge it must be tied up with some easily recognised characteristics of different natural conditions, so that foresters can use the information in the field, without carrying a laboratory about; hence the need of types, of which three series appear to be required: (*a*) Mineral soils; (*b*) Humus types; and (*c*) Forest types. With regard to (*b*), Romell considers that the humus cover represents the central and most promising object of forest soil research; practically the only way of influencing soil productivity by silvicultural means is through the humus cover. He considers that it is absolutely necessary for further progress to elaborate a good scheme of classification of the humus forms. This may perhaps be achieved by further developing P. E. Müller's classical scheme, as Hesselman has done for the Swedish raw humus and associated forms. The importance of Müller's humus types in Denmark is, no doubt, largely due to the fact that Denmark lies in a transition zone between the brown earths, with mull, and the zone of true podsols, with more or less pronounced raw humus. It is reasonable to assume that in such a region silviculture can do more to improve or to deteriorate the soil than in the heart of a climatic zone. New York State is like Denmark in this respect and, therefore, it is probable that good silviculture and a good classification of humus types will be more important there than further to the south or west. The establishment also of floristically characterised, ecological forest types is badly needed; but in New York State, as in Denmark, it will, no doubt, be particularly important to make a distinction between "fundamental" types and "conditional" types, the former being determined by the site, the latter mainly by the silvicultural treatment.

It may be remarked that recently there has been a general overhaul of forest research organisations in the United States and that the pendulum has swung violently over to the side of pure research. Romell's article is interesting as showing that what may be termed the observational or experimental school has still some prominent adherents. There can be little doubt that their point of view needs to be stressed.

W. H. G.

CAN NATURAL REGENERATION BE ASSISTED BY CHEMICALS.

(*Skogen*, 15*th November*, 1929.)

The article describes some experiments carried out in 1928 and 1929 by a Norwegian forester, Professor J. G. Böhmer, on the use of Sodium chlorate and other chemicals for destroying weed growth and so promoting natural regeneration. In the first of these experiments Sodium chlorate solution was sprayed in spring on a dense growth of bilberry under a spruce stand which was under regeneration; the result was the complete killing down of the bilberry within 14 days of treatment, and no further vegetation appeared that year. In the autumn there was a good crop of

cones on the spruce and a satisfactory regeneration on the ground in the following spring. The seedlings developed quite normally, showing no signs of poisoning. A count in September showed an average of 10·2 strong well-developed seedlings per square meter in the treated plot, as compared with 2·8 per square meter of small weakly seedlings in the control area. Another trial showed that bracken sprayed with Sodium chlorate was destroyed the first summer but sprouted again next year; gradually to wither away.

In the early trials as much as 270 lbs. of Sodium chlorate were used per acre, but it was found later that much smaller quantities, viz. 27 and even 18 lbs. per acre, were effective. Sodium chlorate was the most satisfactory of the chemicals used and the best time of application is from early summer to midsummer. The strength of the spray liquid and the amount used per unit area of ground is not stated, but it is recommended that the spray should not be applied closer than 10 to 12 ft. from any tree which it is desired to preserve. The cost of the chlorate is given as about 10*d.* per pound.

Professor Böhmer suggests that the method is also worth considering as an alternative to screefing, prior to planting or sowing, on soils covered with a heavy growth of vegetation.

W. H. G.

AFFORESTATION MECHANISED.

(*Skogen, January 15th*, 1931.)

A company has been formed in Norway to promote the sale of a machine which is to revolutionise (?) the process of afforestation. The raw materials with which the machine works are: (*a*) Soil of suitable composition and moisture content; (*b*) seed of either pines or spruce; and (*c*) paraffin wax. The machine proceeds to form soil briquettes, each contains two or three seeds embedded therein. The briquette is then coated with a layer of paraffin wax which keeps it together and prevents undue loss of moisture. The finished briquettes are automatically deposited in packing cases for transport. The briquettes are stated to cost about 17*s.* per 1,000, and are to be turned out by the machine at the rate of 16,000 per day.

The company is credited with the intention of introducing the method first into England before approaching other countries. It may be added that two prominent Norwegian foresters have given the idea their technical blessing.

W. H. G.

SITKA SPRUCE.

By Anton Smitt.

(*Translated from the Norwegian by* W. H. G.)

Sitka spruce is believed to have been discovered by Archibald Menzies in Pouget Sound in 1793. It is the largest of all the American spruce

species, attaining heights of up to 295 to 330 ft., breast-height girths up to 8 to 10 ft., and ages of 800 to 850 years. When it occurs close to the sea it is often heavily branched and moss-covered, but in sheltered positions it has a straight, clean and very fine form. It likes a mild coastal climate with a large rainfall and does not extend, therefore, far from the coast. For example, it does not extend over the coast range in British Columbia or the Cascades in Washington. It has its greatest distribution from north to south, occurring from Caspar in the north of California to the north-east of Kodiak Island and the west side of the Cook Inlet in Alaska. It does not occur at great elevations above sea level, and, curiously enough, grows higher up in British Columbia and in the south of Alaska than it does in Washington and Oregon. In the Cascades it occurs up to 3,300 ft. and in British Columbia up to 5,000 ft. It is a characteristic tree of the lowlands and so is best developed in river valleys and on gentle slopes, especially where there is a good layer of humus. It likes a fresh to moist soil and is not affected by flooding during the spring. On the best sites it can dominate all other trees as, for example, *Thuya plicata*, *Tsuga heterophylla*, and Douglas fir. It is a particularly good timber tree, even though the Americans may not as yet attach great importance to it, owing, perhaps, to the abundance of Douglas fir.

Distribution.—In California, Sitka spruce is confined to a relatively small area in the north-west corner of the State and the small flood valleys descending to the sea. In Oregon it occurs south of the Columbia River, but has here no importance. In British Columbia it grows to appreciably greater elevations up to 5,000 ft., as, for example, in the Taku Pass. It occurs on the west side of the coast range and is especially abundant on the Islands. On the west side of Vancouver Island, where perhaps the finest Sitka spruce stand is to be found, it does not occur above about 1,000 to 1,300 ft. elevation. It extends to the edge of the sea on the smallest islets as long as there is sufficient soil to carry its roots. In south-east Alaska it forms 25 per cent. of the forests and is, without doubt, the most important tree and the one attaining the largest dimensions. Here it occurs more or less universally, as a rule mixed with other trees such as *Thuya plicata*, *Tsuga heterophylla* and *Chamaecyparis nootkatensis ;* it is also found in pure groups of about a quarter of an acre in area. On the west side of Cook Inlet it forms the only coniferous tree.

It is suggested, that the reason why Sitka spruce occurs at higher elevations in British Columbia and Alaska than it does in Washington and Oregon, may be due to the fact that it is such a definitely coastal tree that it is unable to survive so far from the sea in the hills in the southern part of its natural range.

Soil and Climate Requirements.—Sitka spruce makes relatively large requirements on the soil. It requires a rich humus-containing and moist soil for its best development. Morainic soil, humus-rich sand soil, scree and weathered rock soils appear to be good sites. The chief essential is that there should be sufficient moisture, given that it can often show quite satisfactory growth on otherwise poor sites. It is not merely soil moisture

but also air moisture which is required, and it appears to thrive especially well in the small valleys where fogs are particularly frequent. However, it can also have too much moisture, especially if that be acid or cold, and it is apparent that Sitka spruce, like other trees, tends to prefer south slopes the further north it goes in its natural range.

Especially in the first four to five years of its life it is very liable to suffer from late frosts in the spring and early frosts in autumn. Its seedling is very small and much more weakly than that of Norway spruce. It is possible that this liability to frost damage is one of the main factors which keep it so near the coast. Along the coast of Alaska and British Columbia dangerous frosts seldom occur after the 15th April or before the 15th September, thus giving it a long vegetative period.

Where Sitka spruce grows it is practically always free from snow, but the rainfall can be very heavy, up to 120 ins., and the relative humidity is also especially high. The tree is very wind-firm, occurring right to the edge of the sea, but it likes shelter from the cold north wind which blows usually in spring.

Light Requirements, etc.—Sitka spruce stands more shade than Douglas fir and approaches more closely to our spruce in that respect. On the other hand, it requires a fair amount of light in the first 3 to 4 years, but later on is as shade-bearing as the common spruce. The root system is very superficial, but on the dryer soils it is often more deep rooting. On the better sites the stems are symmetrical and taper slowly. Yet I am inclined to believe that in the younger ages the common spruce has the better form. The branches are small and at first are horizontal, but later hang downwards. In close stands it begins to clean itself of branches at 50 to 70 years of age and in old age is a very clean-stemmed tree. On exposed sites and near the coast the stems are short and very much branched. In such cases the branches often cover the tree right down to the ground level. Branch depression takes place slowly and is not complete. Naturally, the density of the stand is an important factor. A close-grown stand on Goose Island, a little island surrounded by the sea on all sides, consisted for the most part of clean and very fine stems of 80 years of age. In another stand of about 100 years of age, open grown in mixture with *Thuya plicata* and *Tsuga heterophylla* in Alert Bay, which has a typical coastal climate but is fully sheltered, the Sitka spruce stood with branches from 5 to 6 ins. in thickness, covering the stem right to the foot of the tree. The bark remains thin throughout the whole life of the tree and does not exceed $\frac{1}{2}$ in. in thickness even in quite old trees.

Sitka spruce regenerates itself freely when the humus layer is not too thick or tight. The seed germinates readily on fallen moss-covered stems, resembling in this respect *Tsuga heterophylla*. The full seed years occur at intervals of 3 to 4 years and the seed has, as a rule, a germination of about 70 to 80 per cent.

Timber.—The wood is soft with white sapwood and reddish heartwood. It is easily cleft, flexible, holds nails well and is not brittle. On the other hand it shrinks somewhat badly, but this can be obviated by proper

seasoning. It takes paint and polish well, is only slightly resinous and not very durable. During the War the timber was largely used for aeroplanes, but apart from that, Sitka spruce, in spite of its many good qualities, is little sought after in the southern part of its natural range. On the other hand, in the north, where the Douglas fir disappears, Sitka spruce becomes an important tree of commerce and in Alaska is by far the most important timber. The chief use in these parts of the country is for sealed boxes, but latterly it is also being largely used for the manufacture of cellulose. For general purposes the timber is scarcely as good as the common spruce, but with its more rapid growth it will, in all probability, be superior as a source of wood pulp and cellulose. The timber of open-growing and very rapidly growing trees often contains loose knots.

Production.—In West American silviculture Sitka spruce has hitherto not taken the place which it deserves. The principal cause is not only that other conifers occur in large quantities and, to some extent, produce timber of better quality, but also that the Sitka spruce occurs only in small pure stands. The cellulose manufacture is still in its infancy and the sawmills seek chiefly after Douglas fir and *Thuya plicata*. My impression is that Sitka spruce can hold its own in the forest with Douglas fir and possibly even, under exceptionally favourable conditions, can dominate it. None of the other species which I have investigated can compare in growth with either Sitka spruce or Douglas fir.

As above mentioned Sitka spruce usually occurs in mixture with *Tsuga* and *Thuya*. A good example was seen in the neighbourhood of Thorne Bay, north of Ketchikan, Alaska. The stand was 52 years old and the trees had the following dimensions :—

	Average Quarter-Girth. Ins.	Maximum Quarter-Girth. Ins.	Height. Ft.
Sitka spruce	7¾	12½	72
Tsuga heterophylla ..	5½	10¾	66
Thuya plicata	5	11½	59

A group of young Sitka spruce in Charta Bay, Alaska, had at 29 years of age an average height of about 52 ft. and a quarter-girth of 5 ins.

In an old mature stand of Sitka spruce, Hemlock and Red cedar in Mud Bay, Alaska, the Sitka attained a height of about 165 ft. with a quarter-girth of 23¼ ins. and volume of approximately 7,700 cu. ft. quarter-girth per acre. (Sitka volume only.)

In another somewhat better sheltered young group of Sitka spruce the trees showed an average annual height increment of about 20 ins. Poorer growth was, however, seen ; for example, a 57-year-old stand not far from Ketchikan, with a height of 59 ft. and an average annual growth of 4 rings to the inch in the fastest-growing tree.

In Alaska leading shoots of an average length of 16 to 18 ins. in young forests were not infrequent. In more southern regions as, for example, Washington, the growth was naturally greater, and at the same age in

good localities leading shoots of 3·3 ft. and annual rings of 0·4 to 0·8 in. in width were common.

Diseases and Injuries.—In old age, Sitka spruce is at times heavily attacked by *Trametes pini* and apparently also by root rot, but in 70-to 80-year-old forests I saw no signs of any such damage. Schwappach reports from Germany that where *Picea excelsa* is often badly attacked by *Hysterium macrosporum*, Sitka spruce is wholly immune.

On account of its superficial root system the tree is evidently very liable to wind-fall, but all the same it was astonishing how little evidence of wind-fall I came across. I consider that Sitka spruce will be much less subject to the effect of exposure than common spruce or Scots pine. In this respect it is much more like the white spruce.

Summary.—I consider that in Douglas fir and Sitka spruce we have two of the most important forest trees for trial in our country. Of these I consider Douglas fir to be the more valuable as it has the better timber, while Sitka spruce is the tree *par excellence* for wood pulp and cellulose. Sitka spruce is likely to be of special value for the west coast of Norway, and as a coast tree it has many advantages over Douglas fir. It is hardier, less exacting and prefers greater atmospheric moisture.

"FORSTWISSENSCHAFTLICHES CENTRALBLATT," 1930.

During the past year the above Journal has dealt with a wide range of subjects and has become much more readable. A special number was issued in April to celebrate the seventieth birthday of one of the editors, Dr. Max Endres, and this includes a large number of short articles by many well-known foresters. A feature of the *Centralblatt* which has been continued this year is the publication of further articles dealing with forestry in other countries, amongst which are included, Australia, China and Brazil. A number of important articles on entomology by Escherich and others have also appeared.

The following are summaries of some of the articles which have been published :—

PART 3.

Plant Diseases and International Commerce.

(By DR. KURT HAUPTFLEISCH.)

This article gives a list of the more important pests and diseases of economic plants in Europe and mentions the various regulations that have been put into force in the different countries in the hope of controlling them—regulations and orders such as our "Destructive Insects and Pests Order." Only three forest diseases are mentioned—the Dutch elm disease, the blister rust of the Weymouth pine and the canker of the sweet chestnut. The first is still fresh in our minds and Great Britain is one of the countries which has dealt with the importation of elms.

The blister rust of the Weymouth pine is one of the diseases that has been spread by traders. It did not originally occur in the native habitat of the pine, the Eastern States of North America, but is, on the other hand, a native of Europe, where it probably lived on *Pinus cembra*. It attacked the Weymouth pine after its introduction to Europe and became epidemic, and from Europe it was spread on infected nursery stock to the Eastern United States, where it has become one of the most serious of diseases. Later it was spread to the Western States of North America, not directly from the east, but as a result of a fresh infection from Europe.

The chestnut disease in the United States, which is caused by the fungus *Endothia parasitica*, is of obscure origin, but it is thought to have been introduced on plants from Japan. It is, without doubt, the most serious disease that has ever appeared in a forest and the damage it has caused in America is enormous.

The author emphasises the need for strict measures of control in dealing with imports of plants as, if these are neglected, the consequences may be serious.

Parts 7 and 8.

The Bavarian Thinning Investigations in Pine Stands.

(By L. Fabricius.)

An account of the sample plot investigations that were carried on by Endres between 1896 and 1924 is given by Fabricius. Five sets of comparative thinning plots, four sets where B grade and C grade thinnings were carried out, and one set of three plots, where an A grade treatment was also included. This type of thinning, it is stated, is of little importance for pine, as the rapid dying off of the small trees makes it in a short time very similar to a B grade. The plots are now from 56 to 72 years of age and have been measured at intervals of five years, since 1900, except during the war.

There is no clear indication as to the effect of thinning on height growth. In most cases the relative position remains unaltered. Thus, where the B grade plot had originally a greater mean height than the C grade it is usually found that, after 30 years of treatment, it still maintains the lead. (This tendency is noticeable also in Great Britain.)

The diagrams, giving the numbers of stems in each plot at different ages, show that the differences in stocking have been well maintained. They also show that in almost all cases the number of stems is now falling faster in the light thinning plots than in those heavily thinned.

The most interesting point brought out by this article is the apparent failure of heavy thinnings to improve the production of the stands. The author points out that this is quite contrary to the accepted theory and offers two explanations. The first is that heavy thinning may have an unfavourable effect on the soil by increasing the evaporation, and the second is that, although the soil conditions may actually be improved, the remaining trees may not be able to avail themselves of this. If a tree is cut from an old wood, it leaves behind a vacant,

unproductive space which is not penetrated and utilised by the roots of surrounding trees for some time and before this has taken place other trees may have been felled and further areas made temporarily unproductive. With a young stand, of course, the vacant spaces are rapidly filled up by the roots and this points to the need for heavy thinnings in early youth.

PART 9.

Soil Cultivation in the Forest.

(By H. H. HILF.)

This article deals technically with forest soil cultivation. The author commences by discussing typical soil types, typical soil coverings and obstacles in the soil with respect to their effect on the various implements that may be used. For the different types of soil he finds agricultural practice to be a sufficient guide. As for the soil covering, most soils have a covering of living plants and the treatment must vary according to the character of the species represented. Moss, heather, lichen, etc., are not usually difficult to treat, as they are shallow rooted and at the worst only clog up the tackle.

The berry-bearing shrubs form a difficult problem, especially *Vaccinium Vitis-idoea*, which forms a thin but very tough layer, and *V. Myrtillus* with its frequently luxuriant growth. Characteristic of these plants are the runners which spread through the humus without being rooted in the mineral soil. Many cultivating instruments are found to stick in this growth and they may require an enormous tractive power to break up the soil covering. The best method of overcoming this is a direct vertical cut from above in order to break the tough runners.

Grass coverings are of two kinds, tussocky and sward-forming. Both kinds are fixed in the soil by numerous fine roots and can only be broken up by undercutting. The tussocky grasses—*Aira*, *Molinia*, etc., have no side connexions, whereas the others, though not so firmly rooted, have side runners and require therefore both a horizontal and a vertical cut.

The aerial portions of the plants are also a difficulty, the berry-bearing shrubs and the dry stems of grasses often preventing the introduction of a cutting implement.

Among the obstacles, the following are mentioned: brushwood and bark on the surface of the soil; roots and stumps in the soil; stones in the soil.

The author gives details of various types of ploughs and cultivators.

PART 20.

The "Alnetum incanae" on the Drave in Carinthia.

(By E. AICHINGER and R. SIEGRIFT.)

This is an account of an ecological study of the grey alder on the River Drave in Carinthia. The conclusions are of some interest and it is found that the "Alnetum incanae" is of a quite homogeneous structure.

The following combination of species is characteristic and shows how the association is made up :—*Alnus incana, Prunus Padus, Berberis vulgaris, Rubus caesius, Brachypodium silvaticum, Aegopodium Podagraria, Malachium aquaticum, Galium mollugo-dumetorum, Festuca gigantea, Agropyrum caninum, Geum urbanum, Circaea lutetiana, Thalictrum exalatum, Lithospermum officinale, Deschampsia caespitosa, Agrostis alba, Ranunculus reptans, Glechoma hederacea, Lamium maculatum, Viola Riviniana, Veronica chamaedrys, Prunella vulgaris, Ajuga reptans, Geranium Robertianum, Struthiopteris germanica, Urtica dioica, Stachys silvatica, Salvia glutinosa, Mnium undulatum.* There is a tendency when conditions are better, towards the development of a mixture with spruce.

The soil in the " Alnetum incanae " has an air capacity of 8-14 per cent. which, with the soil moisture conditions that are found, constitutes optimum conditions for the growth of the vegetation.

If, as a result of diminished soil water content, the " Alnetum " changes by degrees into mixed forest, the air capacity of the soil rises and, in undisturbed places, may reach a figure of 23 per cent. With these conditions we have the first stage towards mixed forest and this is characterised by groups of the following species :—*Paris, Majanthemum, Asarum* and *Adoxa.*

The Influence of underplanted Beech and Spruce on the Soil Conditions and the Production and Growth of Scots Pine.

(By E. Kmonitzel.)

This is a long and important paper from the Research Institute in Giessen, giving an account of an investigation carried out in the Hessian province of Starkenburg. The greater part of the area lies over fluvio-glacial sands from the River Main, but there are also deposits of ancient blown sand and of loess. Upper Pliocene deposits of sands, clays and boulders also occur, the clays being dense and impenetrable. The average rainfall over a period of 28 years (1901-28) was 25·7 ins., and the annual figures varied between a minimum of 14·9 ins. in 1921 and a maximum in 1922 of 32·3 ins. The wettest month of the year is August and the driest March. The rainfall is thus favourable to the development of Scots pine which is the principal species. In most of the woods the vegetation belongs to the Moss type (*Hypnum*) and it is only on wetter areas over the clay that Grass-types occur.

The pine woods which were investigated ranged from 67 to 102 years of age, the beech underplantings from 21 to 40 years, and the spruce from 20 to about 40 years. The research falls into two parts, a soil investigation and an investigation of the growth of the species. The former was carried out in an exceedingly thorough manner and dealt with the physical structure, moisture content, chemical composition and biological characteristics (nitrification, etc.). The second part dealt with the height growth, diameter growth, breadth of annual rings, bark percentage

and heartwood of the pine and the growth of the underwoods of beech and spruce.

Among the author's conclusions are the following :—

The physical structure of the soil in the stands with the oldest beech underplanting has been improved.

In underplanted stands, the moisture content of the soil is always smaller than in pure stands.

The uppermost layer of the soil has a higher content of bases in the stands underplanted with beech.

The content of humus in the soil is higher in underplanted stands.

The total nitrogen expressed as a percentage of the organic matter present gave higher figures with underplanting, the nitrogen content being especially high in the stands where spruce was introduced.

With a beech undercrop, the available nitrogen is more abundant than in pure stands.

Nitrite formation was not observed in any case.

No beneficial effect on the diameter growth of the pine could be traced to the beech undercrop. The effect of the dry year (1921) on the growth of the pine was not modified by the growth of the underplanting.

In the stands underplanted with beech, a deterioration in form has begun. The cause of this is not to be found in any breaking of the canopy as this has not taken place to a greater degree than in the pure stands. (The deterioration in form refers to the fact that in the underplanted pine the annual rings are now narrower than those in the pure stands.)

In his summing up, the author gives as the results of his study, on the one hand, the encroachment of the beech and spruce on the water supply and the falling off in increment of the pine, and on the other hand, the improvement of the soil conditions as a result of underplanting. The effect on the increment of the pine he puts down to the competition for water which is the most important growth factor in the sandy soils which were investigated. On heavy soils, on the other hand, the water supply would not be of decisive importance. In this connexion it is considered to be a matter of importance, in the district where the investigations were carried out, not to have the undercrop too dense, and to thin out the dense underwoods so as to reduce the competition with the principal crop and to promote the development of the underplanted trees themselves.

J. Macdonald.

LIST OF TECHNICAL STAFF.

Officers of Divisional, District and Analogous Scales.

Since the last issue of the *Journal*, changes have occurred as follows :—

Headquarters.

(Address now 9, Savile Row, London, W.1.)

Mr. O. J. Sangar, transferred from Division 2 and appointed Assistant to Technical Commissioner.

At Imperial Forestry Institute, Oxford.

Dr. M. L. Anderson, Research Officer, England and Wales (transferred from Scotland).

Travelling Officer.

Mr. J. A. B. Macdonald, appointed District Officer (Sample Plots).

England and Wales.

Address of Assistant Commissioner's office is now 55, Whitehall, London, S.W.1.

Address of No. 4 Divisional office is now 55, Whitehall, London, S.W.1.

Address of No. 5 Divisional office is now 17, Queen Street, Peterborough.

Mr. C. O. Hanson, Divisional Officer, Division 3, retired.

Mr. A. P. Long, Divisional Officer, transferred to Division 2 from Division 5.

Mr. F. Scott, Divisional Officer, transferred to Division 3 from Northern Division, Scotland.

Dr. H. M. Steven, appointed Divisional Officer, Division 5 (transferred from Imperial Forestry Institute, Oxford).

Mr. F. G. O. Pearson, appointed District Officer on probation, Dean Forest.

Mr. R. E. Fossey, appointed District Officer on probation, Division 4.

Mr. A. C. Dicker, appointed Estate Officer on probation, Division 1.

Mr. W. S. Fletcher—Utilisation Officer—Post abolished.

Scotland.

Mr. J. Fraser appointed Divisional Officer, Northern Division (transferred from S.W. Division).

Mr. J. Macdonald, Research Officer, Scotland (transferred from Sample Plots).

Mr. J. P. M. Whyte, District Officer, S.W. Division (transferred from No. 4 Division, England and Wales).

FORESTERS.

Transfers—

Name.	*Grade.*	*To.*	*From.*
R. Butter ..	I	Vaughan (Div. 2) ..	Haldon (Div. 3).
D. Jones	II	Hafod Fawr ..	Vaughan (Div. 2).
C. R. Wellington	II	Dyfnant	Kerry (Div. 2).
Jack Williams ..	II	Haldon (Div. 3)	Vaughan (Div. 2).
L. Edwards ..	II	Caio	Margam (Div. 3).
D. N. Williams ..	II	Parkend School .. (Dean Forest Div.)	Exmoor (Div. 3).
H. C. Dyer	I	Salcey (Div. 4) ..	Tintern (Dean Forest Div.).
G. Mackenzie ..	II	Glenmore (N.E. Div.)	Slatterdale (N. Div.).
J. M. Kennedy ..	II	Blackcraig	Glenmore (N.E. Div.).
A. Weir ..	II	Brechfa (Div. 3), previously called Glangwili.	
T. Lewis	I	Tintern—Dean Forest Div. (previously Div. 3).	

Appointments—

Name.	*Grade.*	*To.*
J. Crighton	II	Exmoor (Div. 3).
W. J. Hale	I	Dartmoor (Div. 3).
J. Roberts	II	Tintern—South (Dean Forest Div.).
G. Light	II	Tintern—North (Dean Forest Div.).
W. Kent	II	Micheldever (Div. 4).
J. D. McDonald ..	II	Inverliever (S.W. Div.).
A. M. MacKenzie ..	II	(Research and Experiment.)
T. Watson	II	Bennan (S.W. Div.).

Resignations, Retirements, etc.—

T. Jones, Div. 4.
J. Kidd, Div. 5.
H. Mitchell, N. Div.
C. Hankins, Div. 5.

REGISTER OF IDENTIFICATION NUMBERS.

FOREST YEAR, 1930.

The order of arrangement is as follows :—

Serial number (preceded by the last two numbers of the forest year in which supplies were received) ; quantity ; species ; crop year ; origin ; vendor ; purity per cent. ; germination and fresh seed per cent.

30/1 2½ lbs. ; *Pinus pinaster ;* crop year unknown ; France (Landes de Gascogne) ; gift from French Forestry Service.

30/2 4 lbs. ; *Cedrus atlantica ;* crop year unknown ; France (Provence) ; gift from French Forestry Service.

30/3 4½ lbs. ; *Pinus sylvestria* var. *lapponica ;* 1929 ; Sweden (Dalecarlia) ; Skogsvårdsstyrelsen, Falun.

30/4 2 lbs. ; *Cedrus atlantica ;* crop year unknown ; France (Algeria) ; gift from French Forestry Service.

30/5 1,493 lbs. ; *Pseudotsuga Douglasii ;* 1929 ; U.S.A. (Oregon and Washington ; West Cascade Mountains) ; The Manning Seed Company ; 95·9 ; 71 + 2.

30/6 100 lbs. ; *Abies grandis ;* 1929 ; U.S.A. (Washington ; West Cascade Mountains) ; The Manning Seed Company ; 93·7 ; 21 + 1.

30/7 13 lbs. ; *Picea alba ;* 1929 ; Denmark ; J. Rafn.

30/8 25 lbs. ; *Pinus Peuke ;* 1929 ; Serbia ; J. Rafn.

30/9 10½ lbs. ; *Larix europaea ;* 1929 ; Czecho-slovakia (Moravia, altitude 1310–1970 ft.) ; Semenarsky Zavod Statnich Lesu ; 93·4 ; 45 + 7.

30/10 50 lbs. ; *Pseudotsuga Douglasii ;* 1929 ; U.S.A. (Cowlitz, Washington) ; Long-Bell Lumber Company ; 92·1 ; 81.

30/11 102 lbs. ; *Abies grandis ;* 1929 ; U.S.A. (Cowlitz, Washington) ; Long-Bell Lumber Company ; 78·4 ; 12 + 2.

30/12 990 lbs. ; *Picea excelsa ;* 1929 ; Austria (altitude 660–1,640 ft.) ; J. Stainer ; 98·2 ; 92 + 3.

30/13 101 lbs. ; *Larix europaea ;* 1929 ; Austria (Tyrol) ; J. Stainer ; 83·8 ; 27 + 6.

30/14 68 lbs. ; *Alnus incana ;* 1929 ; Austria ; J. Stainer.

30/15 108 lbs. ; *Larix europaea ;* 1929 ; Austria (Inn Valley, Northern Tyrol, altitude 1,970–2,620 ft.) ; J. Jenewein ; 91·3 ; 65 +2.

30/16 650 lbs. ; *Picea excelsa ;* 1929 ; Austria (Inn Valley, Northern Tyrol, altitude 1,970–2,620 ft.) ; J. Jenewein ; 97 ; 90 + 1.

30/17 111 lbs. ; *Picea excelsa ;* 1929 ; Germany (Rübeland State Forest, Harz Mountains, altitude 1,300–2,300 ft.) ; Braunschweig Forstliche Versuchsanstalt ; 96·7 ; 78 + 5.

30/18 830 lbs. ; *Quercus sessiliflora ;* 1929 ; England (North) ; own collection.

30/19 1,020 lbs. ; *Carpinus Betulus ;* 1929 ; England (West) ; own collection.

30/20 50 lbs.; *Pinus insignis;* 1929; America (West); J. Rafn; 99·8; 76 + 4.

30/21 615 lbs.; *Pinus Laricio;* 1929; France (Corsica); P. Spinosi; 99·2; 59 + 10.

30/22 7 lbs.; *Thuya plicata;* 1929; America (Washington); J. Rafn.

30/23 21 lbs.; *Betula verrucosa;* 1929; Scandinavia; J. Rafn.

30/24 5 lbs.; *Cedrus deodara;* 1929; Italy; J. Rafn.

30/25 22 lbs.; *Pinus montana* var. *uncinata;* 1929; France (Mont Louis, Pyrenees); gift from French Forestry Service; 98·6; 68 + 14.

30/26 1½ lbs.; *Pinus Laricio* var. *pyrenaica;* 1929; France (Pyrenees); gift from French Forestry Service.

30/27 22 lbs.; *Larix europaea;* 1929; Switzerland (Laatsch, altitude 3,280–3,940 ft.); J. Roner.

30/28 3,406 lbs.; *Larix europaea;* 1929; Switzerland (Münster, altitude 3,940–4,920 ft.); J. Roner; 93·2; 48 + 6.

30/29 1,780 lbs.; *Picea sitchensis;* 1929; Canada (Queen Charlotte Islands, British Columbia); Canadian Government; 97·9; 82 + 3.

30/30 23 lbs.; *Tsuga heterophylla;* 1929; Canada (Queen Charlotte Islands, British Columbia); Canadian Government; 99·2; 85 + 2.

30/31 116 lbs.; *Pseudotsuga Douglasii* (Mixed seed); 1929; Canada (Coast and Interior of British Columbia); Canadian Government; 98·8; 84.

30/32 932 lbs.; *Pinus Laricio;* 1929; France (Corsica); Jo. Grimaldi; 99·7; 55 + 5.

30/33 1 lb.; *Pinus contorta* var. *Murrayana;* 1927; Canada; gift from Canadian Government.

30/34 7 lbs.; *Pinus contorta;* 1929; Canada (Northern British Columbia); Canadian Government.

30/35 2 lbs.; *Pinus monticola;* 1929; Canada (Shuswap Lake, British Columbia); Canadian Government.

30/36 3 lbs.; *Rhamnus Purshiana;* 1929; Canada (British Columbia); gift from Canadian Government.

30/37 97 lbs.; *Larix europaea;* 1929; Silesia (Sudeten); K. Gebauer; 90·1; 30 + 10.

30/38 5½ lbs.; *Alnus glutinosa;* 1929; Czecho-slovakia; K. Gebauer.

30/39 5 lbs.; *Betula pubescens;* 1929; Germany (Rathenow); Schultze & Co.

30/40 20 lbs.; *Cupressus macrocarpa;* 1929; U.S.A.; Vilmorin-Andrieux; 99·4; 8 + 6.

30/41 19 lbs.; *Pinus maritima;* 1929; France (Landes); Vilmorin-Andrieux; 99·5; 87 + 7.

30/42 2 lbs.; *Cryptomeria japonica;* 1929; Italy; Vilmorin-Andrieux.

30/43 4 ozs.; *Picea sitchensis;* 1929; U.S.A. (Sitka, Alaska); C. M. Petersen.

30/44 15 lbs.; *Abies nobilis;* 1929; England (West); own collection.

30/45 5½ lbs.; *Pinus cembra;* 1929; Austria; J. Rafn.

30/46 8 ozs.; *Pinus montana* var. *pumilio;* 1929; Eastern Alps; J. Rafn.

30/47 2¼ lbs.; *Pinus excelsa;* 1929; Italy; J. Rafn.

30/48 5½ lbs.; *Sequoia sempervirens;* 1929; America (West); J. Rafn.

30/49 5¼ lbs.; *Cupressus macrocarpa;* 1929; America (West); J. Rafn.

30/50 6 lbs.; *Pinus laricio* var. *Pallasiana;* 1929; Turkey; gift from Turkish Forestry Department.

30/51 639 lbs.; *Pinus Laricio;* 1929; France (Corsica); O. J. Rossi; 98·8; 37 +3.

30/52 2,791 lbs.; *Pinus sylvestris;* 1929; England (East); own collection; 99·3; 92 + 1.

30/53 4 ozs.; *Picea sitchensis;* 1929; America (North California); Long-Bell Lumber Co.

30/54 50 lbs.; *Pinus contorta;* 1929; America (West; Coastal region); Manning Seed Co.; 98·2; 72 + 8.

30/55 15 lbs.; *Abies nobilis;* 1929; U.S.A. (Spirit, Cascade Mountains, altitude 3,200 ft.); T. J. Lane; 97·7; 13 + 4.

30/56 15½ ozs.; *Pinus sylvestris;* 1929; Hungary (Lenti, altitude 620–790 ft.); gift from Station de Recherches Forestières, Sopron.

30/57 13½ ozs.; *Pinus sylvestris;* 1929; Hungary (Sopron, altitude 1,150-1,480 ft.); gift from Station de Recherches Forestières, Sopron.

30/58 2 lbs.; *Picea jezoensis;* 1929; Japan; gift from Professor M. Fujioka, Tokio.

30/59 9½ lbs.; *Picea Omorika;* 1929; Serbia; Sarajevo Forestry Department.

30/60 110 lbs.; *Pinus maritima;* 1929; Portugal (Leira); gift from Portuguese Government.

30/61 2 lbs.; *Pinus maritima;* 1929; Corsica; J. Grimaldi.

30/62 5 ozs.; *Pinus Laricio;* 1929; Italy (Mont Etna); gift from Forest Experiment Station, Firenze, Italy.

30/63 5 ozs.; *Larix europaea;* 1929; Italy (Trentino); gift from Forest Experiment Station, Firenze, Italy.

30/64 5 ozs.; *Pinus sylvestris;* 1929; Italy (Trentino); gift from Forest Experiment Station, Firenze, Italy.

30/65 5 lbs.; *Sequoia gigantea;* 1929; U.S.A. (California); H. Dehm.

30/66 100 lbs.; *Pinus sylvestris;* 1929; Scotland (East); Howden & Co., Inverness.

30/67 60 lbs.; *Pinus sylvestris;* 1929; Scotland (East); Innes Estate.

30/68 262 lbs.; *Pinus sylvestris;* 1929; Scotland (East); E. S. Grant.

30/69 169 lbs.; *Pinus sylvestris;* 1928; Scotland (East); E. S. Grant.

30/70 2¾ lbs.; *Pinus sylvestris;* 1929; Scotland (East); A. & G. Paterson, Ltd.

30/71 253 lbs.; *Pinus sylvestris;* 1929; Scotland (East); own collection, extracted at Seaton.

30/72 102 lbs.; *Pinus sylvestris;* 1928; Scotland (East); own collection, extracted at Tulliallan.

30/73 8¾ lbs.; *Pinus sylvestris;* 1929; Scotland (East); own collection, extracted at Tulliallan.

30/74 7 ozs.; *Picea alba;* 1929; Scotland (East); own collection.

30/75 245 lbs.; *Larix europaea;* 1929; Scotland (East); own collection, extracted at Seaton.

30/76 100 lbs.; *Larix europaea;* 1929; Scotland (East); own collection, extracted at Tulliallan.

30/77 99 lbs.; *Fagus sylvatica;* 1929; Scotland (East); own collection.

30/78 1 lb.; *Fagus sylvatica* var. *purpurea;* 1929; Scotland (East); own collection, extracted at Tulliallan.

30/79 221 lbs.; *Acer Pseudoplatanus;* 1929; Scotland (East); own collection.

30/80 30 lbs.; *Acer Pseudoplatanus;* 1929; Scotland (East); own collection, extracted at Tulliallan.

30/81 2 lbs.; *Pyrus Aucuparia;* 1929; Scotland (East); own collection.

30/82 2 lbs.; *Pyrus Aria;* 1929; Scotland (East); own collection.

30/83 2½ lbs.; *Pinus sylvestris;* 1928; Scotland (West); own collection, extracted at Tulliallan.

30/84 3½ lbs.; *Larix europaea;* 1929; Scotland (West); own collection, extracted at Tulliallan.

30/85 1½ lbs.; *Cupressus nootkatensis;* 1929; Scotland (West); own collection, extracted at Benmore.

30/86 8 ozs.; *Thuya plicata;* 1929; Scotland (West); own collection, extracted at Benmore.

30/87 3½ lbs.; *Chamaecyparis Lawsoniana;* crop year unknown; Scotland (West); own collection, extracted at Benmore.

30/88 24 lbs.; *Abies nobilis;* 1929; Scotland (West); own collection, extracted at Benmore.

30/89 1 lb.; *Tsuga heterophylla;* crop year unknown; U.S.A. (Orgeon, altitude 2,000 ft.); Long-Bell Lumber Co.

30/90 2 lbs.; *Picea sitchensis;* crop year unknown; (U.S.A. Alaska, altitude 300 ft.); Long-Bell Lumber Co.

30/91 1 lb.; *Picea sitchensis;* crop year unknown; Canada (British Columbia, altitude 300–1,000 ft.); Long-Bell Lumber Co.

30/92 1½ lbs.; *Abies concolor;* crop year unknown; U.S.A. (Oregon, altitude 3,000 ft.); Long-Bell Lumber Co.

30/93 1½ lbs.; *Abies concolor;* crop year unknown; U.S.A. (Oregon, altitude 5,000 ft.); Long-Bell Lumber Co.

30/94 3 lbs.; *Libocedrus decurrens;* crop year unknown; U.S.A. (North California); Long-Bell Lumber Co.

30/95 $2\frac{1}{4}$ lbs.; *Acer platanoides;* 1929; Scotland (West); own collection.

30/96 4 lbs.; *Ulmus campestris;* 1929; Scotland (West); own collection, extracted at Benmore.

30/97 600,000 seedlings (2 years); *Pinus sylvestris;* 1927; Scotland (East); Howden & Co., Inverness.

30/98 70,000 transplants (2 + 1 and 2 + 2); *Pinus sylvestris;* crop year unknown; origin unknown; Dunrobin Estate.

30/99 60,000 seedlings (2 years); *Pinus sylvestris;* crop year unknown; origin unknown; Landowners' Co-operative Forestry Society.

30/100 500,000 seedlings (2 years); *Pinus sylvestris;* crop year unknown; origin unknown; T. & W. Christie, Forres.

30/101 20,000 transplants (2 + 1); *Pinus sylvestris;* crop year unknown; origin unknown; Redcastle Estate.

30/102 300,000 seedlings (2 years); *Pinus sylvestris;* crop year unknown; origin unknown; G. R. Christie; Fochabers.

30/103 500,000 seedlings (2 years); *Pinus sylvestris;* crop year unknown; origin unknown; B. Reid & Co., Aberdeen.

30/104 503,000 seedlings (2 years); *Pinus sylvestris;* crop year unknown; origin unknown; W. Smith & Son, Aberdeen.

30/105 162,000 seedlings (2 years); *Pinus sylvestris;* crop year unknown; origin unknown; Innes Estate.

30/106 21,500 transplants (2 + 2); *Pinus montana* var. *uncinata;* crop year unknown; Denmark; Howden & Co., Inverness.

30/107 2,000 transplants (2 + 2); *Pinus montana* var. *pumilio;* crop year unknown; Denmark; Howden & Co., Inverness.

30/108 250,000 seedlings (2 years); *Picea excelsa;* crop year unknown; origin unknown; Smith & Meldrum, Forfar.

30/109 497,000 seedlings (2 and 3 years); *Picea excelsa;* crop year unknown; origin unknown; Liverpool Corporation.

30/110 300,000 seedlings (2 years); *Picea excelsa;* crop year unknown; origin unknown; B. Reid & Co., Aberdeen.

30/111 153,000 seedlings (3 years); *Picea excelsa;* crop year unknown; origin unknown; E. Wiseman, Elgin.

30/112 200,000 seedlings (2 years); *Picea excelsa;* crop year unknown; origin unknown; W. Smith & Son, Aberdeen.

30/113 9,000 seedlings (2 years); *Picea excelsa;* crop year unknown; Scotland (West); Landowners' Co-operative Forestry Society.

30/114 26,000 seedlings (2 years); *Picea excelsa;* crop year unknown; Scotland (East); Landowners' Co-operative Forestry Society.

30/115 250,000 seedlings (2 years); *Picea excelsa;* 1928; Germany; Dickson & Co., Edinburgh.

30/116 45,000 seedlings (2 years); *Picea excelsa;* crop year unknown; origin unknown; C. Arnot & Sons, Forfar.

30/117 3,850 seedlings (2 years); *Alnus incana;* crop year unknown; Scotland (East); B. Reid & Co., Aberdeen.

30/118 60 lbs. cones ; *Pinus sylvestris ;* 1929 ; England (North) ; own collection.

30/119 714 lbs. ; *Fraxinus excelsior ;* 1929 ; England (North) ; own collection.

30/120 147 lbs. ; *Fagus sylvatica ;* 1929 ; England (North) ; own collection.

30/121 212 lbs. ; *Juglans regia ;* 1929 ; England (West) ; H. Davies.

30/122 157 lbs. ; *Aesculus Hippocastanum ;* 1929 ; England (North) ; own collection.

30/123 2,585 lbs. ; *Acer Pseudoplatanus ;* 1929 ; England (North) ; own collection.

30/124 28 lbs. ; *Pyrus Aucuparia ;* 1929 ; England (North) ; own collection.

30/125 12 lbs. ; *Betula pubescens ;* 1929 ; England (North) ; own collection.

30/126 16 lbs. ; *Carpinus Betulus ;* 1929 ; England (North) ; own collection.

30/127 418 lbs. ; *Castanea vesca ;* 1929 ; England (North) ; own collection.

30/128 114 lbs. ; *Malus communis ;* 1929 ; England (North) ; own collection.

30/129 18,176 lbs. ; *Quercus Robur ;* 1929 ; England (North) ; own collection.

30/130 10 lbs. ; *Chamaecyparis Lawsoniana ;* 1929 ; England (West) ; own collection.

30/131 14 lbs. cones ; *Picea excelsa ;* 1929 ; England (West) ; own collection.

30/132 84 lbs. cones ; *Thuya plicata ;* 1929 ; Englnad (West) ; own collection.

30/133 28 lbs. cones ; *Larix leptolepis ;* 1929 ; England (West) ; own collection.

30/134 406 lbs. cones ; *Alnus glutinosa ;* 1929 ; England (West) ; own collection.

30/135 387 lbs. ; *Fraxinus excelsior ;* 1929 ; England (West) ; own collection.

30/136 767 lbs. ; *Fagus sylvatica ;* 1929 ; England (West) ; own collection.

30/137 1,073 lbs. ; *Acer Pseudoplatanus ;* 1929 ; England (West) ; own collection.

30/138 4,456 lbs. ; *Castanea vesca ;* 1929 ; England (West) ; own collection.

30/139 127 lbs. ; *Juglans regia ;* 1929 ; England (West) ; own collection.

30/140 18,325 lbs. ; *Quercus sessiliflora ;* 1929 ; England (West) ; own collection.

30/141 1,456 lbs. ; *Quercus sessiliflora ;* 1929 ; England (West) ; H. C. Webb.

30/142 88 lbs. ; *Quercus pedunculata ;* 1929 ; England (West) ; own collection.

30/143 1,365 lbs.; *Aesculus Hippocastanum;* 1929; England (West); own collection.

30/144 19,457 lbs.; *Quercus Robur;* 1929; England (West); own collection.

30/145 1 lb.; *Sequoia gigantea;* 1929; England (East); own collection.

30/146 1 lb.; *Thuya plicata;* 1929; England (East); own collection.

30/147 21,037 lbs.; *Fagus sylvatica;* 1929; England (East); own collection.

30/148 8,716 lbs.; *Castanea vesca;* 1929; England (East); own collection.

30/149 38,294 lbs.; *Quercus pedunculata;* 1929; England (East); own collection.

30/150 481 lbs.; *Fraxinus excelsior;* 1929; England (East); own collection.

30/151 671 lbs.; *Acer Pseudoplatanus;* 1929; England (East); own collection.

30/152 215 lbs.; *Carpinus betulus;* Crop year unknown; England (East); own collection.

30/153 6 lbs.; *Acer platanoides;* 1929; England (East); own collection.

30/154 94 lbs.; *Aesculus Hippocastanum;* 1929; England (East); own collection.

30/155 3,462 lbs.; *Quercus sessiliflora;* 1929; England (East); own collection.

30/156 8,632 lbs.; *Quercus Robur;* 1929; England (East); own collection.

30/157 2,000 transplants (2 + 1); *Fabus sylvatica;* crop year unknown; origin unknown; English Forestry Association.

30/158 71,000 transplants; *Fagus sylvatica;* crop year unknown; origin unknown; G. W. Pledge.

30/159 750 transplants (1 + 1); *Fagus sylvatica;* crop year unknown; origin unknown; Compton Estate.

30/160 46,400 transplants (2 + 1); *Larix leptolepis;* crop year unknown; origin unknown; W. Treseder, Cardiff.

30/161 21,000 transplants (2 + 1); *Larix europaea;* crop year unknown; origin unknown; W. Treseder, Cardiff.

30/162 8,900 transplants (2 + 1, 2 + 3); *Larix europaea;* crop year unknown; origin unknown; Hales Estate.

30/163 6,300 transplants; *Larix europaea;* crop year unknown; origin unknown; Compton Estate.

30/164 1,000,000 seedlings (1 year); *Larix europaea;* crop year unknown; origin unknown; T. & W. Christie, Forres.

30/165 59,000 transplants; *Fraxinus excelsior;* crop year unknown; origin unknown; Power & Co., Waterford.

30/166 7,400 transplants (1 + 1); *Fraxinus excelsior;* crop year unknown; origin unknown; Compton Estate.

30/167 10,000 seedlings (1 year); *Fraxinus excelsior;* crop year unknown; origin unknown; Compton Estate.

30/168 50,000 transplants (2 + 1); *Fraxinus excelsior;* 1926; origin unknown; Power & Co., Waterford.

30/169 4,250 transplants (2 + 2); *Quercus pedunculata;* crop year unknown; origin unknown; Compton Estate.

30/170 16,750 transplants; *Picea sitchensis;* crop year unknown; origin unknown; Compton Estate.

30/171 650,000 seedlings (1 year); *Larix europaea;* crop year unknown; origin unknown; W. Treseder, Cardiff.

30/172 505,000 seedlings (1 and 2 years); *Larix europaea;* crop year unknown; origin unknown; English Forestry Association.

30/173 100,000 seedlings (2 years); *Larix europaea;* crop year unknown; origin unknown; Chambers Green Nurseries.

30/174 30,000 transplants (1 + 1); *Larix europaea;* crop year unknown; origin unknown; Royal Botanic Gardens.

30/175 94,000 seedlings (2 years); *Larix leptolepis;* crop year unknown; origin unknown; Learmonts.

30/176 75,000 seedlings (2 years); *Larix leptolepis;* crop year unknown; origin unknown; English Forestry Association.

30/177 78,000 transplants (2 + 2); *Fagus sylvatica;* crop year unknown; origin unknown; Liverpool Corporation.

30/178 3,000 transplants (2 + 1); *Tsuga heterophylla;* crop year unknown; origin unknown; Liverpool Corporation.

30/179 1½ lbs.; *Larix leptolepis;* 1929; England (West); own collection.

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