JOURNAL

OF THE

FORESTRY COMMISSION.

No. 18: APRIL, 1939.

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EDITORIAL.

The following changes have taken place in the Commission's personnel during the year.

Commission Staff Changes. Mr. W. L. Taylor was appointed a Commissioner in November, 1938, and in many respects he has taken the place of Sir Alexander Rodger at Headquarters. Mr. O. J. Sangar replaced Mr. Taylor as Assistant Commissioner for England and Wales, and Mr. E. Wynne Jones took over Mr. Sangar's work as head of the Census and Plans Branch.

In Division N. (W.), Mr. C. E. L. Fairchild and Mr. F. E. B. de Uphaugh have been promoted to Higher Grade District Officers.

Mr. D. H. Chapman resigned his appointment as District Officer to take up a post in the University of Cambridge, and Mr. W. J. Stiles, previously a District Officer on probation, has gone to the Inland Revenue Department.

Five new District Officers have been appointed on probation, *viz.:* Mr. J. T. L. Fitzherbert (N.W. (E.) Division), Mr. J. B. Stocks (E. (E.) Division), Mr. W. J. J. Portlock (N.E. (E.) Division); and in Scotland, Mr. I. J. Stewart (East Division) and Mr. R. J. Waterman (West Division).

Mr. B. M. Bird has been appointed at Headquarters as Development Assistant, his work being to arouse the interest of the public in forestry and to encourage private estate owners in the better management of their woodlands.

Memorial to Col. Steuart-Fothringham. On Saturday, 11th June, 1938, at the end of the Commissioners' tour in Scotland, a memorial to Col. Walter Steuart-Fothringham was unveiled by the Chairman in the presence of members of Col. Fothringham's family and others. The memorial, which is placed on a rock near the roadside on Drummond Hill Forest, takes the form of a large granite slab bearing the following inscription :—

ERECTED BY
THE FORESTRY COMMISSIONERS
IN AFFECTIONATE REMEMBRANCE OF
COL. WALTER SCRYMSOURE STEUART-FOTHRINGHAM
A MEMBER OF THE COMMISSION
FROM ITS FORMATION IN 1919
TO HIS DEATH IN 1936

From the road to the edge of the rock, which has a local legendary interest, a crescent-shaped space was cleared. The space in front of the memorial is laid with gravel and between it and the road is a rustic fence. Large plants of *Tsuga heterophylla,* which was a favourite tree of Col. Fothringham's, are planted on the sides of the crescent.

It is fitting that the interest which Col. Fothringham took in the work of the Commission should be commemorated in this way.

Photographs.

Photographs are urgently required for Commission use. All those who have cameras can assist and they are requested to do so without delay. That negatives and prints would be accepted was intimated in a circular distributed about a year ago. This request met with poor response and it is evidently necessary to indicate more clearly the Commission's requirements. By November next the Commission will have been in existence for twenty years and a special report will be issued summarising and illustrating progress made up to date. For this and other purposes photographs are wanted and they should be taken at once or during the coming summer.

It seems that nowadays we cannot get on without pictures and officers in the field probably do not realise how many requests reach Headquarters for good photographs showing what the Commission is doing. Demands upon our small collection are continually being made by forestry journals, weekly and monthly periodicals, the daily papers, the B.B.C., journals issued in connection with many organisations at home and abroad, for exhibitions at Shows, general propaganda, and for use in our own bulletins, leaflets and reports.

Photos of all kinds are wanted and they may be either large or small. They should include woods and plantations at various ages and stages of growth, both conifer and hardwood. The most generally acceptable pictures are those of thriving plantations rather than those showing failures or " how not to do it," but clear examples of damage by frost, rabbits, insect pests and fungi should also be sent. Curiously enough we are at present without reasonably good photos of forest or woodland fires, something really graphic of this sort would be most helpful. One would have thought that attractive pictures could have been obtained of forest workers' holdings, some perhaps with the cattle and poultry showing, or with the worker himself, his wife and family in the picture. Roads and bridges often make good subjects, tree-clad slopes, rivers and lakes bordered by trees, and picturesque cottages in a woodland setting are much in request. Efforts should not be limited to photographing plantations of the sample plot type, welcome though some of these may be.

Opinions differ as to the desirability or otherwise of including a human figure in silviculturally managed plantations. Those with an eye to quarter-girth measurement derive satisfaction from the occular estimates which comparison between man and tree permits. On the other hand the whole effect is often ruined by the intrusion of a " blot

on the landscape." Of course, a good deal depends on the "figure," for there are times when someone unobtrusively placed is an asset but, generally speaking, woodland scenes, even those of technical interest, are better without aids to computation such as men, women, surveying poles, walking sticks, spades, hats and camera cases. Such things as a rule are not only out of place in the picture but fail in their object of giving a sufficiently precise scale by which to judge dimensions. A concise note giving essential details of location, species, age, height, girth, volume, etc., should however accompany every photograph.

The nucleus of a classified collection of photographs has already been begun in the Publications Branch at Headquarters and field officers and others are requested to submit prints and negatives either through the respective Assistant Commissioners or Divisional Officers or directly to the Publications Officer at 25, Savile Row. The sum of two shillings is paid for each photograph accepted. This should recompense the camera man for outlays in developing and printing but he should keep well in mind that he is rendering a useful, in fact necessary, service to the Commission. He is assisting in the education of the public and helping to build up a valuable record of the Commission's forestry operations.

Contributors to the Journal.

The following Divisions have been selected as special contributors to next year's Journal: Division N. (W.); Division E. (E.); Division N.W. (E.); and Northern Division Scotland.

The special contributors to the present number of the Journal are Division S.E. (E.), New Forest, Forest of Dean, and, Scotland, South and West.

Change of Address.

Since the issue of the last JOURNAL the London offices of the Headquarters' staff and also those of the Assistant Commissioner (England and Wales) and of the Census and Plans Branch were removed to 25, Savile Row, W.1. The new building is modern and well-equipped and permits of the closer co-operation, officially and socially, of the personnel.

PROGRESS REPORT ON RESEARCH: JANUARY, 1938.

By W. H. GUILLEBAUD.

1.—NURSERY EXPERIMENTAL WORK.

(1) Experimental work on the use of different types of soil covering was continued during the past year ; the latest results emphasise the importance of using the right type of sand or fine gravel. A material may appear suitable to the eye but in practice it may turn out to be relatively inferior. A costing experiment carried out at Tulliallan and Newton Nurseries gave the following data :—

T. = Tulliallan and N. = Newton.

Type of Covering.	Total Cost of Material and Application and Weeding. £ per Acre.		Total Output of Seedlings 1,000s. per Acre.		Net Value of Seedlings. £ per Acre.		Profit or Loss on Treatment. £ per Acre.	
	T.	N.	T.	N.	T.	N.	T.	N.
Nursery soil ..	22·6	22·4	1,390	2,390	320	570	—	—
Sand ..	45·4	84·6	1,390	4,280	300	990	− 20	+ 420
Grit (up to ¼ in.)	59·9	73·5	1,640	4,540	350	1,060	+ 30	+ 490
Chips (¼—⅜ in.).	46·3	61·9	2,390	3,280	550	750	+ 230	+ 180

The sand and the grit used at Tulliallan were neither of them good covering materials, both containing a good deal of silty matter mixed with the coarser particles. The Newton sand and grit were ideal for the purpose, containing no very fine sand or silt.

The table shows that though the use of imported covering material increased the cost at Newton by about £55 per acre, the higher germination due to the use of sand or grit almost doubled the value of the stock, the increase in value being about nine times the cost of the treatment. It will be noted that the chips gave a greatly improved yield at Tulliallan which much more than covered the cost, but in the same nursery there was a loss of £20 per acre as a result of covering with an unsuitable type of sand. Cost of weeding was found to vary in the two nurseries; at Tulliallan, sand and chips cost little more to weed than the nursery soil; in both nurseries the grit-covered beds cost from two to three times as much to weed as the nursery soil. At Newton the sand and chips were nearly as expensive to weed as the grit-covered beds. The relative weeding costs were taken into account in calculating the results of the various forms of covering used.

These results are supported by a series of experiments in Kennington Nursery in which various forms of covering material were tested against Bedford silver sand which has been for years the standard covering material at Kennington. Bedford sand improved the germination of Sitka spruce, tsuga, and Lawson's cypress by from 50 to 100 per cent. compared with washed grit or limestone chippings. Powdered pumice was also tried but proved too light and so too easily removed by wind.

The practical conclusion from these experiments is that in nurseries liable to caking, and for small-seeded species such as Sitka spruce, tsuga, Lawson's cypress, it may pay to use the best form of covering material procurable. An increase in the yield of 1-yr. seedlings of the order of 50 per cent. can be easily obtained, and the resulting gain then far outweighs any initial difference in the cost of the covering material.

(2) Further work on the stratification of seed of *Pinus contorta* led to a slight break in the series of successful results. The data are as follows:—

Method of Treatment.	*Production of one-year Seedlings per lb. of Seed.*
A. Seed stored dry, sown 7th April..	44,000
B. Seed stratified 29th January, sown 7th April	24,000
C. Seed stratified 28th February, sown 7th April	68,000

In June a count showed that the B plots had produced quite as many seedlings as the control but, owing to a severe attack of damping-off, heavy losses were experienced in the plots sown with stratified seed. The losses were much greater in the B plots where the seed had had the longer period of stratification than in the C plots, and were evidently related to the time of germination. The A plots germinated on 17th May, the C plots nearly 3 weeks earlier, on 28th April, and the B plots another 6 days earlier, on 22nd April. It is remarkable that the relatively small difference of 6 days in the date of germination should have had such a big effect on the severity of attack. The later germinating control plots were virtually unaffected. Treatment with permanganate of potash failed to check the disease to any great extent.

It will be noted that despite a certain amount of loss from damping-off, short-period stratification (C plots) increased the output by about 50 per cent.

(3) Experiments on density of sowing in both countries led to the conclusion that the standard densities recommended in Silvicultural Circular No. 15 are satisfactory in most years for the spruces and Japanese larch. Thinner sowing than standard produced a larger proportion of the strongest grade of plants but when cost of preparation of ground and weeding are taken into account the balance is in favour of the standard density. On the

other hand heavier than normal sowings gave inferior results in most cases. One interesting point is that the proportion of " cull " plants was very similar in all densities. It appears that no matter how thin the sowing there is an irreducible minimum percentage of inferior plants, probably accounted for in many cases by delayed germination.

The question of the relative merits of drill sowing and broadcast sowing is one which has given rise to a good deal of controversy and at Kennington the density-of-sowing experiments have been duplicated by the two methods. The results of a P.36 experiment are set out below, the data relating to the standard density of sowing.

Number of Grade I Seedlings (2-year) per Pound of Seed Sown.

Species.	Broadcast Sowing.	Drill Sowing.
Sitka spruce	38,000	16,000
Norway spruce	19,000	19,000
Japanese larch	12,000	16,000

The increased production of Grade I seedlings of Sitka spruce in the broadcast beds is remarkable. There is some confirmation of this result from more recent experiments which are tabulated below :—

Total Outturn of Seedlings per Pound of Seed.

Species.	Nursery.	Broadcast Sowing.	Drill Sowing.
Sitka spruce ..	Tulliallan ..	48,000	34,000
Sitka spruce ..	Newton	99,000	47,000
Sitka spruce ..	Kennington ..	107,000	86,000
Scots pine ..	Tulliallan ..	43,000	44,000
Scots pine ..	Newton	46,000	49,000

The Sitka show a higher total yield from broadcast sowing in every case. No explanation can be put forward at present to account for this fact, nor is it clear why Sitka spruce should be the only one of the four species to show such an apparent antipathy to drill-sowing.

(4) In previous years none of the attempts made to increase the size of conifer seedlings by applying artificial manures has been very successful, but in the last two years trials have been carried out with a dilute solution containing ammonium sulphate, ammonium phosphate and potassium nitrate. The solution was applied at intervals of about 3 weeks, from the beginning of July to the middle of August, to 1-yr. and to rising 2-yr. seedbeds of European larch, Scots pine and Sitka spruce. At Altonside Nursery the manured seedlings were twice the height of the unmanured plants at the end of the second year and much superior both in colour and needle-length. In the case of Sitka spruce there was an increased production of long roots, but when samples were sent

to Dr. Rayner for detailed examination she gave an adverse report stating that the roots were no better than those of the controls and lacked the proper mycorrhizal structures which characterise healthy plants. At Kennington this treatment was applied to rising 2-yr. tsuga seedlings, some of the plants receiving two, and others ten, applications during the growing season. When lifted and graded the following results were obtained.

Percentage of Seedlings in each Grade.

——	Grade I over 3½ in.	Grade II 3½ in. and under.	Culls.
A. Unmanured	32	63	5
B. Manured, 2 applications	43	53	5
C. Manured, 10 applications	63	32	5

Treatment C has produced a substantial improvement in the size of the plants. It was observed on lifting these plants that the roots in C remained active till late in the year and that there was relatively little short-root development. The implications of this are not yet apparent.

(5) The most striking of all the various attempts to produce large 1-yr. seedlings of Sitka spruce has been obtained this year at Kennington by following up some preliminary experiments carried out by Dr. Rayner in P. 37, using soil collected from below an oak stand in the New Forest and mixed with hop-waste compost. When Sitka spruce was sown on this mixture of woodland soil and compost, very fine seedlings were produced. At Kennington a boarded seedbed was excavated and filled up in sections with the following soil media:—

A. Kennington Nursery soil.
B. Kennington Nursery soil plus 10 lb. of hop-waste compost per square yard.
C. Soil from an open oak stand in Bagley Wood "inoculated" with humus from a plantation of Sitka spruce.
D. The same soil plus compost.

Seed of Sitka spruce was sown broadcast on 26th April. The production and growth at the end of the first season are shown in the table below.

Soil Medium.	Production per lb. of Seed.	Average Size of Seedling.	Maximum Size of Seedling.
		Inches.	Inches.
A. Nursery soil	90,000	1	1¾
B. Nursery soil plus compost	88,000	1½	3
C. Bagley Wood soil	136,000	1½	3
D. Bagley Wood soil plus compost ..	116,000	2½	4½

The ordinary nursery soil produced a moderate seedling averaging 1 in. in height at the end of the year ; the composted Bagley Wood soil however gave a seedling averaging 2½ in. in height, a remarkable result in such an unfavourable growing season.

Dr. Rayner has been good enough to examine these seedlings and the following is a summary of her report.

A. Kennington Nursery soil. Root system poor. Roots devoid of normal mycorrhizas. Both short and long roots show a pseudo-mycorrhizal infection by a fungus of the "*Rhizoctonia*" type.

B. Nursery soil plus compost. Root system much more branched than in A: majority of roots non-mycorrhizal but some infection by *Rhizoctonia.*

C. Woodland soil. Root system fair. A few of the roots have normal mycorrhizas. The majority show infection of the *Rhizoctonia* type.

D. Woodland soil plus compost. Root system well branched with greater development of sub-laterals. There are many mycorrhizas of the normal type. Relatively little infection by *Rhizoctonia.*

The conclusion from this experiment, together with other observations made by Dr. Rayner, is that in many of our nurseries the conditions are not favourable for the production of good Sitka spruce seedlings. Why the natural woodland soil when treated with compost should produce such a fine type of seedling is not at all clear, but it is probably associated in some way with the nature of the humus.

(6) Experiments on the use of peat continue to give discordant results. At Tulliallan, where the soil is a clay loam, the total germination of Sitka spruce as well as the yield of Grade I seedlings have both been consistently lower in those plots which were treated with peat. Neither time of application of peat nor watering at time of application has affected this result. By way of contrast the use of peat at Kennington has given almost consistently better plants than the ordinary nursery soil and this superiority tends to be maintained after three successive sowings on the same peat/soil mixture. Taking these results in conjunction with various Divisional nursery experiments on the use of peat it seems that the reaction of a nursery soil to peat is at present unpredictable. On the evidence available those nurseries in which peat has given good results are much in the minority.

(7) A year or two ago Mr. Young got some very definite results at Ringwood Nursery with nitro chalk applied to Sitka spruce seedbeds before sowing. This manure greatly improved the size of the seedlings. A repetition at Kennington depressed the germination and resulted in no improvement in the size of the plants.

(8) An attempt was made at Tulliallan to assess the effect of cultivation between the lines of 2 + 1 (rising 2 + 2) transplants of European larch and Scots pine. The data are given in the table.

Height Grade.	No. and Per Cent. of Plants in each Grade.			
	Not hoed.		Hoed.	
Inches.	No.	Per Cent.	No.	Per Cent.
3— 4	90	1·8	48	·9
5— 6	693	13·8	525	10·0
7— 8	1,234	24·5	1,129	21·6
9—10	1,514	30·1	1,608	30·8
11—12	900	17·9	1,075	20·6
13—14	371	7·4	535	10·2
15—16	168	3·3	219	4·2
Over 17	57	1·1	86	1·6
Total ..	5,027		5,225	

The hoed plants have a slightly larger proportion of plants in the taller grades, but the response does not appear to have been marked. Scots pine showed little difference.

(9) A few preliminary experiments have been carried out at Kennington with growth-promoting substances. Hortomone A at the rate of ½ and 1 ounce per gallon of water was applied to cuttings of aspen and London plane. The treatment was carried out in March, the cuttings being soaked for 18 hours in the solution. The percentage success was as follows :—

	London Plane.	*Aspen.*
	Percentage rooted.	
A. Control	72	7
B. Hortomone A ½ oz. per gallon	16	10
C. Hortomone A 1 oz. per gallon	2	5

The plane rooted very well without treatment and the Hortomone was clearly harmful (probably too concentrated). The aspen showed little response to the treatment.

Another attempt was made to strike cuttings in a cold frame during the growing season, using two plant hormones, indolyl-acetic acid and naphthalene acetic acid. Two frames were used, in one the rooting medium consisted of 10 in. of sand over turfs over large stones, while in the other a 10-in. layer of sand was placed over 1 ft. of well-firmed horse manure. The cuttings were taken with a heel, and the heel clean cut with a sharp knife. The percentage of plants which

either developed roots or formed a callus from which roots may develop later is shown in the following table :—

Species.	Sand over Turf and Stones.		Sand over Horse Manure.					
	Control.		Control.		Indolyl-acetic Acid.		Naphthalene acetic Acid.	
	Callus formed.	Rooted.	Callus formed.	Rooted.	Callus formed.	Rooted.	Callus formed.	Rooted.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Elm	49	11	33	23	23	30	17	20
Plane ..	0	0	0	15	0	30	0	60
Norway spruce	51	20	0	0	0	0	0	0
European larch	11	33	27	17	13	13	0	0

The relatively good proportion of " takes " in the best treatments of the conifers is interesting but the most encouraging results are those for the elms in which it has been possible to root or develop callus on from 50 to 60 per cent. of the cuttings in a period of two months (August to October). This is of obvious importance in connection with the raising of stocks from disease-immune trees. There is some indication that indolyl-acetic acid has increased the rooting of the elm cuttings.

2.—Plantation Experiments.

Peat Soils.—During the past few years slagged Sitka spruce on the shallower scirpus-calluna peats at Inchnacardoch, Borgie and Glenrigh Forests have made encouraging progress. About 4 years after planting, *i.e.* when the main stimulus due to the slag was over, growth slowed down considerably and there was every indication of a check; but now (from 9 to 11 years after planting) there has been a decided resumption of growth and the prospects are much more promising.

At Achnashellach slagged Japanese larch of P.28 have been brashed and a first thinning is almost due.

Growth of Sitka spruce and *Pinus contorta* has been so good on the hand-dug (imitation ploughing) plots at Borgie that the North Division plough was sent up there recently and several acres ploughed experimentally. This ploughing has been very successful in spite of rather unfavourable conditions due to frost followed by a quick thaw and a fall of snow. The furrows turned out very cleanly to a depth of 10-12 in. and the tractor showed no tendency to slip or get bogged in the peat, except occasionally in a small completely-ploughed plot. Most of the area was ploughed with furrows 5 ft. apart, but there was also a section with furrows 15 ft. apart to compare with normal turf draining and planting. The peat in this area was about 12 in. in depth and the vegetation scirpus with dwarf calluna. Part of the ploughed ground will be planted with blocks of pure Sitka spruce and Japanese

larch, part with mixtures of S.S./P.C. and N.S./S.P. and part with a group mixture of S.S., P.C., J.L., S.P. and grey alder.

Upland Calluna Soils.—In the previous number of the JOURNAL some data were given as to the effect of pine admixture upon the growth of Sitka spruce on ploughed ground at Teindland. The data related only to total height but during the past year the 1937 shoot growth has also been assessed and the following highly significant data obtained. The leading shoots of the Sitka spruce in the mixed plots averaged 2·1 in. longer than those in the pure plots, with a standard error of the difference of only 0·26 in. The effect of slag on the growth of the Sitka spruce in the mixed plots is now, after 10 years, showing up very clearly—mean length of the 1937 leading shoot of Sitka spruce in the slagged plots 4·6 in., in the unslagged plots 1·1 in., difference 3·5 in. with a standard error of 0·28 in. The data as regards percentages of checked plants are also quite striking; in the unmanured plots over half the Sitka spruce plants are still in check, while where manure was given over 95 per cent. of the plants are out of check. These results are of special interest because of the long time that has elapsed since the slag was applied; in ten years every trace of the phosphate will presumably have been leached out from the soil but the effect on the plants appears to be lasting. Root excavations show that by applying phosphate, long-root formation is markedly stimulated and as conditions gradually improve owing to enclosure and drainage, the manured plants with their bigger root systems are able to recover much more quickly than the plants which got no manure. The effect of the slag thus seems to be physiological rather than merely manurial, which greatly enhances its value on these poor soils. In the same experiment at Teindland the tsuga have picked up remarkably in the last few years and some of the slagged plots are almost forming canopy. In P.37 one or two of the Sitka spruce plots were re-cultivated (rough dug) between the rows of trees; the plants showed an immediate response in length of needle.

At Hamsterley a block of moorland adjoining the existing experiments is to be ploughed up and a small area planted this year, leaving the remainder for planting in P.40.

The Kielder experiments are all showing excellent growth of Sitka spruce, Japanese larch and *Pinus contorta*; the outstanding species is Sitka spruce which shows no signs of check in spite of a large proportion of heather in the vegetation. The same remarks apply to Clocaenog where Sitka spruce has made a surprisingly good start. The plots which got slag are more uniform in growth but the present indications are that the trees will establish themselves satisfactorily both at Clocaenog and Kielder without the use of manure.

Dorset Heaths.—A curious disease has appeared on *Pinus contorta* and *Pinus insignis* in this area. The needles do not develop properly and are much thickened and distorted; ultimately the shoots die. The disease is common on *Pinus insignis* in some parts of Australia where it is known as "fused needle," but has not been reported from any other country until this outbreak occurred at Wareham. For-

tunately the disease shows no signs of affecting Corsican pine which continues to be the best species at Wareham.

About 12 tons of hop-waste were obtained from a local brewery and successfully composted at Wareham under Dr. Rayner's supervision. The compost was used for various experiments on direct sowing including Sitka spruce, Norway spruce and Corsican pine. The most important of these was a 2-acre costing experiment on ploughed ground, in which seed patches were prepared at four feet apart, 2 lb. of compost dug in to each patch, and subsequently sown with Corsican pine seed which was covered with local soil. The total cost, including compost, worked out at the very high figure of over £13 per acre. The experiment will be repeated this spring and it is hoped to reduce costs considerably.

Thetford Heaths.—The series of plots dealing with the introduction of beech under Scots pine of varying heights and ages have improved greatly in the last two growing seasons. The improvement is most noticeable wherever there is a break in the pine canopy; under the full shade of the pine the beech are alive but stunted, with small leaves and slender buds. It seems clear that beech is comparatively intolerant of shade in this area ; this is unfortunate for the object of this series of experiments because it means that the pine must be drastically thinned at such an early age that most of the thinnings will be unusable, and consequently this method of establishing beech becomes very expensive. The absolute necessity of protecting the beech from grazing by deer, hares and rabbits is another point which has emerged in the course of the investigation. It should, perhaps, be observed that the reference made above to the intolerance of beech to shade does not imply that lack of light is necessarily the limiting factor ; on the contrary it is very probable that lack of moisture, due to the competition of the pine roots, plays an important part in retarding the growth of the beech.

The assessment of two P.30 experiments comparing the use of large and small plant material of various frost-tender species throws an interesting light on the problem of establishing such species at Thetford.

Experiment No.	Species.	Losses in		Average Height after 7 growing Seasons.	
		Large Plants.	Medium and small Plants.	Large Plants.	Small Plants.
		Per Cent.	Per Cent.	In.	In.
8 ..	Beech ..	70	80	—	—
	D. Fir ..	25	35	—	—
	J. Larch ..	45	55	—	—
	E. Larch ..	20	55	—	—
13 ..	Beech ..	40	90	23	8
	D. Fir ..	25	75	72	32
	E. Larch ..	40	70	48	36

With the exception of the Douglas fir in Experiment 8, losses in the small plants range from 55 to 90 per cent. The large plants have made a much better showing on the whole and, as the figures given for Experiment 13 indicate, the Douglas fir and larch are now getting out of danger from frost. The beech data illustrate the exceptionally difficult problem which this species presents at Thetford.

Chalk Soils.—Further examination of the experimental plots at Buriton has shown that of the three main blocks which were planted consecutively in P.30 to P.32, the first two are not situated on typical chalk sites but are on a belt covered with a thin deposit of clay-with-flints. This deposit (of Eocene age) provides better growing conditions than the true chalk and appears to be responsible for the success of the alder nurse plots. It is perhaps an open question whether the better growth of all species on the clay-with-flints deposit is due to the soil or to the fact that, at the time of planting, the ground had only recently gone out of arable cultivation and there was not the same dense growth of grass as on the true chalk. Whatever the factor may be it is quite clear that results obtained on clay-with-flints over chalk are not applicable to the chalk soils lacking that deposit—hence the failure of attempts to establish alder as a nurse on much of the chalk downs, which has been so puzzling in the past.

Of all the species tried as a nurse on the chalk the most reliable are unquestionably the two pines, Scots and Austrian. Of these, Scots pine is rather faster growing in early youth but has the disadvantage of very coarse branching ; Austrian is more compact in habit and the foliage denser so that the trees give greater protection. The best way to plant these pines as nurses for beech has not yet been found. The method adopted in the Buriton plots, in which the pines were planted at 7 ft. × 5 ft. leaving the beech to be introduced at a later date, is now obviously unsatisfactory, and other methods will have to be tried.

Loam and Clay Soils (*Hardwoods*).—The species plots on the heavy clay of the Drayton section of Rockingham Forest have recently been assessed. The data illustrate the relatively slow growth of oak, compared to that of pines and other conifers. Thus in Experiment 1 P.32, after 6 growing seasons, the following average total heights were found :—

Species.	Mean Height.
	In.
Oak	13
Lawson's cypress	25
Norway spruce	22
Scots pine	39
Pinus contorta	36
European larch	36
Oregon alder	84

Oregon alder is clearly the outstanding species as regards rate of growth.

The experiment was repeated in the following year, when two series of plots were formed, one on old (felled) woodland and one on old pasture. The two make an interesting contrast.

Species.	Mean Height on		Mean Shoot in 1937 on	
	Old Woodland.	Pasture.	Old Woodland.	Pasture.
	In.	In.	In.	In.
Oak	14	8	4	—
Lawson's cypress ..	30	13	9	7
Thuya plicata	26	16	7	5
Norway spruce	30	9	14	1
Scots pine	36	23	10	6
Pinus contorta	38	25	13	6

On the old woodland all the above species, except perhaps the oak, are well established and making good growth. On the grassland the spruce are having a severe struggle to become established and even the hardy pines are making but slow headway. It is not intended to suggest that the two sites are comparable in all respects except as regards past treatment, but the difference between the growth on old woodland and on pasture land is generally very well marked on these heavy Northamptonshire clays.

Walnut plantations at Bedgebury and Tintern, formed with large plants raised in Kennington Nursery, have proved disappointing ; the shoots have died back on the majority of the plants in spite of careful planting, hoeing and manuring. We seem to be still a long way from solving the problem of how to establish walnut on old woodland sites. On the other hand, spring frosts have been very severe during the past few years and a succession of favourable seasons might bring about an improvement.

3.—Sample Plot Work.

The most interesting sample plots remeasured during the past year were the two *Abies grandis* plots at Novar and a Douglas fir plot on the Beauly Estate. The *A. grandis* plots were thinned respectively to a B (light) and D (very heavy) grade. The B grade now carries 800 trees per acre with an average volume of 12 cu. ft., and the D grade 270 trees per acre with an average volume of 20 cu. ft. per tree (true measure under bark). The B grade plot has yielded in 17 years 3,800 cu. ft. per acre in thinnings and the D plot the remarkable intermediate yield of 6,900 cu. ft. The plots are not yet 40 years old.

The Douglas fir plot at Beauly was established by the Chairman himself in 1919 in an 18-yr.-old stand. There were then 1,100 trees

per acre averaging about 50 ft. in height. Of these, 170 trees were selected as élite stems and a thinning made favouring these stems. A number of the élites were pruned up to a height of 28 ft. and only this lower part of the stem measured for volume. When measured in November 1938, there were 122 élite stems remaining (about 40 had been lost owing to storm damage); these averaged 11 in. quarter-girth at breast height and contained an average volume of 18 cu. ft. quarter-girth in the first 28 ft. of stem. The object in view when the experiment was started in 1919—namely the production of sawmill timber in 40 years—has thus been attained.

4.—Research Work at Aberdeen University.

During the past year Dr. E. V. Laing began an investigation into the botanical differences observable in trees of European larch in Scotland, with the object of gaining clues as to the racial origin of the trees. Differences have been observed in respect of the female flower, the mature cone, leaf anatomy and the twig. Five distinct types of trees have been provisionally recognised and in the case of some of these it is possible to associate botanical type with habit and with silvicultural characteristics. Similar observations have been made on Japanese larch and hybrid larch.

Dr. Laing is giving special attention to the problem of the hybrid larch, and trees have been selected for cross pollination of the European and Japanese larches. The dates of flowering of the male and female of both species will be recorded. A more detailed examination of hybrids from different sources is also to be carried out.

5.—Mycorrhiza Research.

Dr. M. C. Rayner has extended her observations on tree mycorrhiza to include beech. During the past year samples of beech plants were sent to Bedford College from all the nurseries in England and Wales raising beech on a large scale. Examination of this material revealed remarkable differences between the root systems of plants in different nurseries. At the one end of the scale the plants were sturdy with large, deep green, leaves; these were characterised by well-developed root systems, the sub-laterals abundant and all or nearly all showing normal mycorrhizal structure. At the other end of the scale were weakly plants with small yellow leaves and thin buds, the roots usually deficient in sub-laterals and either entirely lacking in mycorrhiza or infested with a semi-parasitic form of fungus. Broadly speaking, the worst plants came from nurseries with heavy soils, but there were one or two curious anomalies. The practical significance of these observations on the root structure of beech is still uncertain and can only be determined by means of field experiments.

Dr. Rayner has also examined numerous batches of Sitka spruce plants, some collected from nurseries and some from plantation experiments. This species also shows a great range in the type of root system according to nursery of origin or soil treatment. Here again

the practical implications must await the result of the plantation experiments which have been planned to compare the different types of plants.

An interesting experiment has been carried out by Dr. Morton of Bedford College, working under Professor Neilson Jones. Dr. Morton filled flower pots with different types of soil, including soil from Wareham Forest, both with and without the addition of compost made from hop-waste. In the middle of each pot a large wad of cotton wool was buried, and the pots kept moist and at room temperature for several months. When examined it was found that the cotton wool in the untreated Wareham soil was completely unaltered, being as fresh as when it was put in. In most of the other soils, *e.g.* ordinary garden soil, there was evidence that the cotton wool had been attacked, though the lump was still much in evidence. In the Wareham soil to which the compost had been added all trace of the cotton wool had disappeared and the soil had altered greatly in texture and colour, now closely resembling a black potting mold. The experiment confirmed the hypothesis, originally put forward by Dr. Rayner, that in the Wareham soil there is some condition preventing cellulose decomposition and that the addition of an organic compost might rectify this by enabling the cellulose-splitting organisms to function.

6.—Soil Research.

Dr. Muir has completed writing up his soil survey of the Bin and Clashindarroch Forests and it is hoped that this will be published shortly. In addition he has surveyed the soil conditions in some of the permanent sample plots established in Scotland. Dr. Muir also visited and reported on the soils of Rothbury Forest in Northumberland. Rothbury Forest lies on the Fell sandstone series of the carboniferous limestone ; the rock is overlain with a sandy glacial drift apparently very poor in nutrients. Prior to enclosure the vegetation was of the grazed grass-heath type but in the 10 to 15 years which have elapsed since the area was fenced heather has become dominant over the greater part of the ground. Dr. Muir found that over a large part of the Forest the soils were of the type termed by the pedologists " gleyed podzols," *i.e.* leached soils exposed periodically to excess of moisture. On these gleyed podzols a " greasy " type of raw humus has been formed and it is this humus layer and the local occurrence of iron pan which seem to be mainly responsible for the difficulties experienced in getting trees established at Rothbury. Judging by analogy with Teindland and Allerston, ploughing would probably have solved the planting problem, both by improved drainage and by disturbing the injurious humus layer ; unfortunately the greater part of the Forest had been planted before the ploughing technique was introduced into Divisional practice. It is hoped, however, that as canopy gradually forms, the surface soil conditions will improve and, concurrently, the growth of the trees.

7.—Vole Research.

Further progress has been made by Mr. C. Elton with the aid of investigations in the laboratory and in the field. The census work has shown that ordinary methods of control such as poison, " virus " and traps, are useless because the scale of the vole populations is out of all proportion to the numbers which can be destroyed by any of the above methods. On the other hand, Mr. Elton believes that a satisfactory form of control might be devised by means of semi-permanent poison baits, *i.e.* baits which would retain their virulum and attractiveness over a long period and so keep the vole population below the density at which damage is likely to occur. This involves quite a different principle from the previous attempts at poisoning which were always applied after the vole " peak " had been reached.

8.—Advisory Committee on Forest Research.

A full meeting of the Advisory Committee on Forest Research was held at Bettws-y-Coed in July, 1938. Gwydr, Coed-y-Brenin and Beddgelert Forests were visited and the Committee were interested to see the differential response of Sitka spruce to basic slag on the peat bogs at Beddgelert. On the better, grassy, peat the effect of slag has been relatively slight while on the poor fibrous type of peat, carrying *Erica tetralix* and scirpus, slag has produced a thriving though slow-growing plantation ; almost all the unslagged plants are still completely in check and many have died.

The Advisory Committee consists of the following members.—

Sir Roy L. Robinson.	Chairman.
Professor F. T. Brooks.	Professor of Botany, Cambridge University.
Sir Arthur W. Hill.	Director of the Royal Botanic Gardens, Kew.
Mr. G. V. Jacks.	Assistant Director of the Imperial Bureau of Soil Science.
Sir Guy A. K. Marshall.	Director of the Imperial Bureau of Entomology.
Mr. J. N. Oliphant.	Director of the Imperial Forestry Institute, Oxford.
Professor J. H. Priestley.	Professor of Botany, Leeds University.
Mr. W. A. Robertson.	Director of the Forest Products Research Laboratory.
Sir William Wright Smith.	Regius Professor of Botany, Edinburgh University.
Mr. W. H. Guillebaud.	Secretary.

9.—Entomology.

Chafer Grubs.—Mr. J. M. B. Brown has devoted the whole of the past year to a study of the biology of three out of the four species which do damage in our nurseries. The fourth species, *Rhizotrogus*, appears to occur only in the Eastern Counties of England and even there is of relatively minor importance. Mr. Brown has prepared a full report, the summary section to which will be found on page 52 of this Journal.

It is only with the aid of a much more complete knowledge of the life-histories of the chafer beetles than we possess at present that we are likely to discover if there is a weak joint somewhere in their armour. Foresters and Foremen in charge of nurseries could aid the investigation materially by noting any facts which come to their notice regarding the position of the larvae in the soil at different times of the year, time of flight, habits of the adult beetles during the flight period, etc. The information should be sent to Mr. Brown through the Divisional Officer.

Pine Beetle.—Mr. H. S. Hanson has completed the field work in connection with his investigation of the pine beetle and is now writing it up for publication. A note on control has been prepared for circulation to the technical staff.

Pine Weevil.—Mr. Brown has furnished an interesting report on a fairly large-scale experiment on trapping for pine weevil in standing woods in the New Forest. The experiment started in 1935. There are six areas of from 3 to 5 acres each treated as follows :—

A. Control. Felled spring 1936, planted spring 1938. Traps first laid after planting.

B. Felled spring 1936, planted spring 1938. Trapped during 1936, 1937 and 1938.

C. Felled spring 1936, planted spring 1938. Traps laid in standing wood during 1935, continuously trapped since then.

D. Biological control method (not reported on).

E. Felled spring 1937, planted spring 1938. Trapped during 1937 and 1938.

F. Control. Felled spring 1937, planted spring 1938. Trapped during 1938 only, *i.e.* after planting.

The experiment thus covers planting with Scots pine two years (A, B, C) and one year (E, F) after felling ; trapping only in the year of planting (A, F) ; trapping between felling and planting (B, E), and finally, trapping for one year before felling (C). The density of trapping was approximately 30 traps per acre in A to E and 18 in F. The cost of trapping during 1938 ranged from 18*s.* to 37*s.* per acre. The following table shows the number of weevils

caught during 1938 and the percentage of plants which were either killed or very badly damaged by the weevils :—

Plot.	*Area.* Acres.	*No. of Weevils caught.*	*Percentage of Plants killed or very badly damaged.*
A	3	2,900	29
B	3	2,500	29
C	3	1,500	35
E	3	10,900	19
F	5	10,700	19

The figures are puzzling, for in spite of the comparatively small number of weevils caught on the untrapped control area A, the damage has been appreciably greater than in the more recently felled E and F areas, where a much larger number of beetles was attracted to the traps.

The trapping records since the experiment began are summarised in the table below :—

	Plot.				
Year of Trapping.	*A.*	*B.*	*C.*	*E.*	*F.*
1935	—	—	4,900	—	—
1936	—	9,200	7,300	—	—
1937	—	6,400	4,100	4,600	—
1938	2,900	2,500	1,500	10,900	10,700
Total to Date ..	2,900	18,100	17,800	15,300	10,700

A peculiarity of these totals is the small number of weevils trapped in the control plot A, and the fact that, as remarked above, this bears no relation to the actual damage.

Mr. Brown concludes that the apparent failure of the method of trapping before planting may be due partly to the relatively small size of the plots, *i.e.* that there was so much to and fro movement of weevils between the felled area and the surrounding woods and plantations that the effect of localised trapping was soon neutralised, and partly that the trapping was not sufficiently intensive. It should be observed that more intensive trapping can be virtually ruled out on economic grounds.

Of greater interest than the actual results of the investigation are a number of practical considerations arising out of the work.

(1) *Relative Merits of Billets and Bundles of Pine Twigs.*— Both types of traps were employed throughout the 1938 trapping season and the catches booked separately. It was found that the attractiveness of the two types varied remarkably with the time of year. In the early part of the season (from March until the middle of August) each billet caught twice as many weevils as each bundle of twigs. In the second part of the season the position was dramatically reversed, the twigs

catching nine times as many weevils as the billets. The actual figures are :—

Number of Weevils caught per 100 *Traps of each Type.*

	Billet Traps.	*Bundles of Twigs.*
March to mid-August ..	430	220
Mid-August to October ..	280	2,550

A further interesting observation was that twig bundles which had been laid about the beginning of July were very attractive to young weevils in August, *i.e.* after the sprays had dried out and the needles were falling off. In this condition the sprays are evidently useless as food and the presumption is that the weevils are seeking shelter either from the sun or from enemies. Mr. Brown recommends that where pine billets are available they should be used from the beginning of the trapping season until about the middle of June and then replaced by bundles of live pine twigs. Collection of weevils from the bundles is most easily done by shaking the bundles over a piece of sacking.

(2) *Importance of Weeding.*—Observations showed clearly that the greatest intensity of damage occurred wherever the plants were more or less smothered in dense grass. The weevils congregate where there is shade and moisture. It is strongly recommended that wherever weevil attack is feared the plantation should be thoroughly weeded at the beginning of July and bundles of twigs laid as traps to catch the young weevils emerging from the stumps and roots of the felled trees.

(3) *Duration of Trapping.*—In the south of England traps should be in position by 1st April in a normal year. When March is exceptionally mild, as was the case in 1938, an earlier start with a skeleton system of traps is advisable. On an area producing its first big crop of young weevils trapping should be continued until the middle of October.

10.—Mycology.

American Tour.—During 1938 Mr. T. R. Peace visited the U.S.A. and Canada, and met the principal forest pathologists in those countries. The main objects of the visit were to see the working of the elm disease control scheme in the U.S.A., to study certain coniferous diseases which are, or may become, important in this country, and to obtain information on the methods used for vegetative propagation with the aid of the so-called growth-promoting substances. Extracts from Mr. Peace's report will be found elsewhere in the Journal.

Elm Disease.—Mr. Peace carried out the usual survey in July. In spite of the very dry spring the number of diseased trees showed

a drop in several areas. It is doubtful if this is anything but a temporary check in the progress of the disease.

As the disease is completely out of control in this country the most promising line of work is the isolation of immune strains of elm. There are two methods of approach, firstly to raise immune forms from seed and secondly to discover, by actual inoculation with the disease, if any of the existing elm trees are disease-resistant, and if so to propagate from them by vegetative means. The first method has already been tackled by the Dutch and we have in this country a stock of plants raised from an immune elm seedling to which the name *Ulmus foliacea* Christine Buisman has been given. A number of these plants has been distributed among the English Divisions and the remainder has been sold, through the Horticultural Trades Association, to private firms of nurserymen.

Experiments on the propagation of elms from cuttings are also in progress.

Diseases on Spruce.—A number of diseases of varying degrees of importance have turned up on Sitka spruce and Norway spruce. The most serious of these appears to be a case of die-back in an established Sitka spruce plantation near Canonbie in Roxburghshire. The symptoms closely resemble attack by *Armillaria,* but there is no evidence of that fungus. Mr. Peace thinks a *Phytophthora* may be responsible. These diseases are being kept under observation and also investigated in the laboratory.

Adelopus Needle-cast on Douglas Fir.—In recent years a needle-cast disease of Douglas fir caused by a fungus known as *Adelopus gäumanni* has been creating considerable alarm on the Continent. First discovered about 14 years ago in Switzerland the disease has, since 1934, spread rapidly northwards into Germany. The coastal and intermediate forms of Douglas are attacked and entire stands are said to have been ruined. Upon learning that *Adelopus* had been described as an unimportant fungus in Britain in a paper published in 1928 by Dr. Malcolm Wilson and Mr. J. S. L. Waldie, application was made to the Forestry Commission for permission to send a party of German and Dutch pathologists to make a week's tour in England and Scotland to investigate the status of the disease in our plantations. By an ill chance the visit coincided with the European crisis in September and the German pathologists were recalled just after the tour had started. The disease was, however, located in a 20-year-old plantation of Douglas fir on the Bowmont estate in the south of Scotland, but only on a few trees. Mr. Peace has subsequently visited this estate and the disease will be kept under observation.

Canker on young Oak in the Forest of Dean.—A widespread and quite destructive canker has been discovered attacking young oak in the Forest of Dean. The canker affects the dominant trees in natural regeneration of about 20 ft. in height and a single tree may carry from six to ten cankers on the main stem. The organism responsible

has not yet been identified. The latest reports are to the effect that the disease does not appear to be spreading.

Death of Ash Buds.—The failure of the terminal bud of ash to develop is a very common phenomenon and is responsible for the repeated forking which is such an annoying feature of many ash plantations. Several plots of ash are under detailed observation and it is hoped to track down the cause of the damage.

Miscellaneous.—The work on the relative frost resistance of different strains of European larch is drawing to a close and the results will shortly be published.

Mr. Peace has reported on a trial of different forms of covering to prevent frost-lift. With the particular soil concerned it was found that a half-inch layer of dried peat litter gave almost complete protection, road chippings on the other hand were relatively ineffective. The failure of the road chippings is not in accordance with results at Tulliallan and other Commission nurseries but it is possible that the chippings are more effective against frost-lift when used for covering the seed at the time of sowing than when applied at the end of the first growing season.

REPLANTING AND AFFORESTATION ON CHALK SOILS.

(*Silvicultural Circular No.* 17 *issued March,* 1938.)

Preface.

The following note refers to the treatment of decrepit woods and open downland which have been acquired by the Commissioners. It has been prepared by Mr. Felton and summarises the results of his experience which now extends over eleven growing seasons.

The soil conditions are peculiar but the problem of getting hardwoods established in grassy or frosty sites is common to most parts of the country. An interesting feature which may have application elsewhere is the proposal when planting beech under birch to keep a proportion of the straightest and best birch with the idea of producing clean stems for plywood. R.L.R.

General.

The soils are loams of varying depths overlying chalk and the economic species best suited to the soils and general environment are beech generally and ash (or alternatively sycamore) in selected places. Both require careful " nursing," the reasons for which appear to be twofold—protection against frost and the regulation of light to the optimum requirements of the young tree.

The areas under treatment can accordingly be divided into two main types :—

(i) *Woodland and Semi-woodland.*—" Nursing " material is already present or will come in quickly when rabbits are removed. The woodland is in various stages of devastation ; it is very various in composition. At its best it consists of wide-spreading oak standards in coppice of hazel, hornbeam, ash, blackthorn, etc. Where the standards were removed 20 or so years ago birch (principally) with some ash have often come in to form dense thickets. Included in the woods are areas bare of trees and covered with bracken, brambles or scattered coppice.

The semi-woodland is grazed downland in course of natural reversion to (or from) forest conditions. The semi-woodland may also consist of spreading yew, thorns and occasional oak and beech in groups.

(ii) *Downland.*—Nursing material is not present and will come in naturally at a very slow rate.

The Silvicultural Problems.

The Woodlands.

The object is to raise a crop of beech enriched so far as may be with ash. The essence of the problem is the handling of the nursing material—on the one hand to keep it sufficiently dense to

nurse efficiently, and on the other hand to keep it sufficiently open to permit the beech or ash to develop freely. Obviously these are contradictory considerations.

Generally speaking the regeneration to beech and ash cannot proceed satisfactorily until the spreading oak standards have been removed. There are then four types of nursing available:—

(i) In the blanks left by the standards, merely side shade; this will be supplemented in time by the incursion of such species as birch, sallow and dogwood.

(ii) Thickets of natural birch.

(iii) High coppice consisting of birch and ash singly or in mixture.

(iv) Shrubby growth such as dogwood and privet or low coppice (hazel).

The third and fourth types sometimes occur in association.

Preparatory Treatment.—None is required in the holes left by the oak standards. They may be convenient places, other conditions being favourable, for the introduction of small groups of ash—say 16 plants spaced 4 ft. 6 in. × 4 ft. 6 in., surrounded by beech at normal spacing (see below). The high coppice, birch thickets, etc., will be thinned (singling clumps and generally favouring the best stems) so that the canopy is distinctly broken ; the low coppice will be drifted through at a spacing of 5 to 6 ft.

Planting.—Well-furnished beech at the rate of 2,000 per acre will form the matrix. Very small plants should not be used, especially in grassy places; good transplants undoubtedly do well, but it is not yet clear that equally good results cannot be obtained with seedlings if they are carefully weeded for the first two or three years. For ash large transplants are required.

Subsequent Treatment.—The plants must be carefully weeded against grass, low coppice, dogwood, etc., until they are sufficiently developed to look after themselves. High coppice appears to afford the best nursing effect and it is necessary in such cases to prevent the formation of a lower canopy over and round the plants. The best indication of the light requirements of the young plants is the diameter of the buds and shoots. So long as they are normal there is no need to admit more light. There is now a good deal of local evidence on this subject, the general indication being that light is not admitted quickly enough. Apart from the admission of light to the young beech every effort will be made to encourage young natural ash and straight ash coppice shoots. A limited amount of pruning may be necessary.

Blank Areas in Woodlands.—There is sufficient evidence to show that on the majority of sites beech may be easily raised with larch nurses. Allowing for the birch, etc., which will come in naturally, the larch and beech can be planted in alternate rows, larch 5 ft.

spacing and beech 3 ft. in the rows, but where birch may be expected to come in freely, artificial nursing can safely be dispensed with.

The Semi-Woodlands.

Wide-spreading individual trees must be removed, ringed or otherwise killed. Ash coppice when promising, should be reduced to two or three stems per stool, dense coppice (clumps) of other species (hazel, dogwood) to be thinned out. Wherever the natural yew can be adapted to shelter belt purposes it should be retained. Groups of timber trees or trees likely to grow into timber (*e.g.* natural or planted birch, natural ash and oak) can be thinned and underplanted, if necessary, with beech. The treatment of open spaces in semi-woodland will be similar to that of those in woodland proper, ash groups being limited to the pockets of deep soil.

Consideration of light, shelter, planting and subsequent treatment will otherwise be as for woodlands.

The Downlands.

The main silvicultural Problem is the quick provision of nursing material, without which the beech establishes itself very reluctantly. The present position is as follows. It does not appear to matter very much what the nurse is ; thorn, gorse, grey alder, and pines all appear to work satisfactorily, with the proviso as to grey alder and larch that the local conditions (soil and exposure) are suited to these species. Natural thorn is very slow in appearing and developing. It cannot be relied upon for the purpose. Larch is very variable and usually disappointing. It hangs for a number of years and a proportion then begins to grow freely. Only on deep soils or in sheltered positions has the growth been consistently satisfactory and the same remarks apply to grey alder. Both Austrian and Scots pine grow slowly but steadily—neither is subject to heavy losses. Both, particularly Austrian, are undesirable from the amenity standpoint, but Scots pine is probably the most reliable and satisfactory of all the nurse trees yet tried out on open downland. The status of broom as a nurse is still to be determined; on the deeper soils it grows vigorously and serves its purpose, but at higher elevations particularly where soils are thin its development from sowings is slow, irregular and, so far as experience shows, not to be depended upon for nursing purposes.

Planting and subsequent Treatment.—Apart from questions of nursing, the successful formation of beech plantations necessitates the utilisation of strong, well-furnished transplants and careful planting. Notching does not suffice. Weedings can be regulated according to the vigour of the plants as indicated by the diameter of bud and substance of shoot, but in grass careful weeding is necessary in the early stages. As with the woodland and semi-woodland types it is not yet certain that a stout seedling beech cannot, if nursed, be made to succeed on open downland.

Dense Gorse.—Drifting is the only method. Drifts must not be too wide or the nursing effect will be lost ; they cannot be too narrow or the sides close in too quickly. Moreover there is insufficient space in which to dispose of the cut material. Generally, and this has yet to be determined, the best course appears to be to make the drifts as wide as they can be without sacrifice of shelter. Drifts of 7 ft., allowing for two rows of trees, with 3 ft. of gorse between may prove to be correct.

PLANT ROLL MACHINE.

Revised Instructions for the Use of the Implement.

The Société Provençale Agricole, Marseilles, explain that the extensive use of the plant roll machine under extremely difficult natural conditions has confirmed the favourable conclusion of the first trials, from the point of economy and of the success of the resulting plantations. At the same time the necessity for modifying the directions originally issued for the use of the implement has become apparent.

1. Paper glazed on one face, which was recommended, has shown itself too slow to disintegrate, while simple newspaper, the cheapest of all, gave the best results.

2. It has been found advantageous to use a mixture of soil and humus for making the plant-roll.

3. The paper, which has been twisted at the bottom of the roll, must be cut off or torn off at the time of planting, so as to allow the root freedom to extend vertically.

In detail the new methods to be followed are :—

Preparatory Arrangements.—Provide newspaper, cut in rectangular pieces. These to have a length of about 4 in. more than the roots of the plants to be rolled, and the width necessary to go round the cylindrical mould of earth a little less than twice, that is to say about 6¼ in. for the present model, which gives moulds of a little over 1 in. in diameter.

At the place where the plant-rolling must be done (nursery or depôt of plants received), have or prepare good vegetable earth mixed with humus. Sift it dry through a 1-mm. or 1½-mm. mesh. If there is need for it, water it the day before using, in such a way that, when it is used, it is moist but not wet. The plants, particularly conifers, must have their roots quite intact and covered with moist earth. At no time must they be exposed to the sun or the wind, which would dry the rootlets.

The machine is put on a table, before which the operator is seated. Table and seat can both consist merely of planks nailed on two stakes sunk in the ground. On the table, near the edge facing the operator, a screw-eye and a ring-bolt are screwed down through which are passed the two pieces of the rod jutting out behind the apparatus. The latter is thus fixed on an axle around which it is movable. Under its front part are placed branches or boughs of living bushes which keep it raised up a little.

On the table, on either side of the apparatus, are put, in the most handy position, sheets of paper, soil, and plants. At the side of the operator is placed a basket or a box, into which are put the rolled plants as they are prepared.

Plant-rolling.—Push the roller to the back with the two handles. Put one plant on the folds of the canvas and some earth surrounding the roots, and projecting about 2½ in. from their ends. Then the edge of a sheet of paper, which is lying on the canvas, is slipped under the little heap of earth.

Draw the two handles downwards and towards oneself. This movement rolls the earth and plant into a cylinder which arrives in the slit at the front of the apparatus.

It must be pulled out without letting the paper become unrolled. For this purpose the roller is first of all pushed with one hand, in order to release the cylinder, while the other hand gently supports the paper, to prevent it from unrolling. Then with both hands the operator lifts the rolled plant, the flexible branches placed underneath raising it up and facilitating the operation. He then secures the roll by twisting once or twice the bottom part of the paper which is not full of earth.

The plant thus rolled is placed in the case or the basket at the side of the operator.

Planting.—Each workman can work alone. For this purpose he carries a small box or basket full of rolled plants, and a dibbler to make the holes. This dibbler is a circular or polygonal shaft of iron or steel with a diameter of about 1 in., with the lower end pointed.

The workman drives the dibbler vertically into the spot where he wishes to put a plant. He then deepens the hole thus made by thrusting the dibbler in again as many times as is necessary to get to a depth a little greater than the average length of a rolled plant. To get the required depth without repeated trials it is convenient to mark in a clear way on the dibbler the point to which it must be driven in. Then taking one of the rolled plants, the workman cuts off at the bottom, either with his hands or with scissors, the piece of paper without any soil, which has been previously twisted. Immediately afterwards, and with the necessary precaution, he thrusts the plant in the hole in such a way that the neck of the root is at the surface level of the soil or slightly underneath.

In order to press the earth which surrounds it against the rolled plant it is sufficient to thrust the dibbler into the ground to the same depth at a few centimetres distance from the first hole, then, in this position, to push towards the plant ; first the bottom part of the tool, then the top part.

VISIT TO FINLAND: AUGUST, 1938.

By W. H. GUILLEBAUD.

The usual annual meeting of the Standing Committee of the International Union of Forest Research Organisations was held in Finland in August, 1938. The Chairman of the Commissioners intended to be present but was taken ill shortly before the date of the meeting and I went in his stead.

The first part of the time spent in Finland was taken up with official meetings of the Committee in Helsingfors and visits to the Timber Testing Station and other institutions in the neighbourhood. The following week the Committee made a short tour by road through southern Finland.

The general position of forestry in Finland has been well set out in two articles contributed recently by Sir Alexander Rodger to the Empire Forestry Journal. The following data taken from these articles will perhaps serve by way of orientation.

Finland has 64 million acres of forest, the principal species being Scots pine, Norway spruce and birch.

The rainfall is of the order of 20 in. per annum, of which almost half falls in the form of snow. The soils in the south of Finland are for the most part sandy and relatively free from stones.

In 1935 forest industries furnished about 85 per cent. of the total value of goods exported from the country, the principal products being sawn timber, pulp, paper and plywood. The sawmills and pulp mills are on a grandiose scale. One new mill near the town of Kotka has an output capacity of 100,000 tons of sulphate pulp per annum, this requires 25 million cu. ft. of Scots pine timber. Great Britain takes about 50 per cent. of the total output of the Finnish mills and is thus by far her most important customer. The following are some of the points which struck me as of special interest in the course of my tour.

1. In the first place I was surprised at the large proportion of small private forests in the south of Finland. In this relatively fertile part of the country the bulk of the forests are in small blocks. Taking the country as a whole 50 per cent. of the area and 75 per cent. of the annual increment belong to private owners. The discrepancy between area and increment is due to the fact that the State Forests are mainly situated in the north of the country where the productive capacity of the land is low.

Furthermore, there is a vast amount of highly productive forest in small private ownership. I was told that almost 20 per cent. (5½ million acres) of the private forests are in small blocks averaging not more than 80 acres in area. I saw some large stretches of forest in the course of my tour but my prevailing impression of south Finland is of an undulating country with farmland of 100 acres or so in area alternating with small blocks of woodland.

The importance of the small private forest owner to the timber industry of Finland is recognised by the Government which has developed an elaborate scheme of partly State and partly co-operative assistance and control. So far as I could judge from the private forests I saw from the road, the general standard of management is good. I saw practically no understocked areas and the chief defect observed was lack of thinning. Nature has been very kind to the Finns ; they have practically only three species to deal with, Scots pine, Norway spruce and birch and these grow up together quite harmoniously in mixture ; regeneration is merely a matter of letting in a little light and there are no rabbits to worry about. Even the most negligent private owner can hardly go far wrong so long as he maintains a forest crop on the soil.

2. The Forest Research Department is independent of the Forest Service being directly responsible to the Minister for Agriculture, who is also the political head of the Forest Service. The Research Department administers sixteen research forests totalling over 250,000 acres.

Apart from three big forests in the north of Finland the average area of a research forest is 5,500 acres. I was informed that in practice no difficulty was experienced as regards sales of produce from these forests. What happened in practice was that the neighbouring State forests fixed their contracts first and then the research forests came into the market and had to be content with somewhat lower prices.

3. The Research Department is just completing the second complete survey of the forest resources of Finland. The first survey was carried out in the years 1921 to 1924. The new survey was started in 1936 and will be complete, so far as the field work is concerned, by the autumn of 1938 and will thus have occupied three seasons. The results are expected to be available by the spring of 1939.

The method adopted in both surveys has been a systematic sampling of the country by means of a line survey. The lines are 8·13 miles apart in the south of Finland and 16·25 miles apart in the north of the country. The second survey is a good deal more elaborate than the first ; 200,000 survey forms will have been filled in and from 15,000 to 20,000 sample plots measured. The survey forms are abstracted on to punched cards of the same type (but larger and more elaborate) as those used in the present British Census. The plot data are not entered on to punched cards. Professor Ilvessalo who is in charge of the survey, was interested to hear of the British Census. He was quite ready to agree that the line survey method might not be applicable to our conditions.

4. Work on forest soil research has been under the charge of Professor Aaltonen during the past 15 years. The chief object of the work has been to determine in what degree the various measurable properties of the soil determine its productivity. Finland is a very suitable country for such an investigation ; conditions are probably as little complicated as anywhere in the world, and it is interest-

ing to find Aaltonen admit that he had made little real progress. Certain very broad distinctions can be drawn but these are always liable to break down locally. Aaltonen is now inclined to the view that it is the moisture relations of the soil which probably outweigh all other factors in importance. The quantitative study of soil moisture is still in a very early stage, but this may well become one of the most important lines of investigation in future soil research.

There is no biologist attached to the soil department and consequently the factors investigated have been mainly chemical and physical. In conversation Aaltonen admitted the importance of the biological factors.

We were shown some interesting soil profiles near Helsingfors which seemed to indicate that the thickness of the A. horizon (leached layer underlying the humus) was greater in young soils, *i.e.* in soils which had been under the sea until recent times, than in old soils which had been exposed to weathering since the last ice age. No explanation could be given of this apparent anomaly.

5. There is a separate branch of the Research Department for the investigation of peat lands. The director is O. J. Lukkala. In Finland the peat lands cover an area of about 30,000,000 acres, or 35 per cent. of the entire area of the country.

Of this great area only 20 per cent. is completely devoid of trees ; the fen types of peat carry spruce, birch and aspen, the ericaceous peat bogs carry Scots pine and only the sphagnum bogs are bare. Drainage of peat lands under forest only started on a large scale in 1908 in the State Forests. With the passing, in 1928, of a Law for the Improvement of Forests, the work was extended to private forests.

The total area of peat land considered as drainable amounts to 12½ million acres and of this 1½ million acres have been drained up to the present time. Work is now proceeding at the rate of about 150,000 acres per annum.

Drainage conditions in the remediable bogs are remarkably good as is evident from the fact that there is a drainage length of only 2½ to 3 chains per acre as compared with the 30 to 40 chains required for turf-planting in Great Britain. The Finnish drains are, however, much larger than our turf drains, being about 3 ft. wide and 2½ ft. deep. They cost on an average 6*s*. 2*d*. per chain, or from 15*s*. to 18*s*. per acre. I saw one drained area which was said to be more or less typical. This was drained 30 yrs. ago when the crop consisted of stunted birch and pine. As soon as the peat was drained spruce began to seed itself and there is now a promising crop of pine and birch up to 70 yrs. of age with a thick understorey of Norway spruce, the older of which is 30 yrs.

There is no doubt that the drainage operations being undertaken will lead to an important increase in the area of productive forest in Finland.

6. I was much impressed by the fine appearance of some 2-yr. + 2-yr. spruce transplants growing in a nursery in which the

soil appeared to be a coarse and poor sand. Great importance was attached to maintaining a high level of fertility. Besides applying as much farmyard manure as is obtainable, a green crop is taken every third year in strict rotation and artificials and compost are applied to the green crop. The results were certainly striking.

7. A great deal of pruning has been done in the past ten years, chiefly on birch and to a lesser extent on Scots pine. Spruce is seldom or never pruned, partly because the most profitable market for this species is for wood pulp, and partly because the knots in the spruce in the more northern parts of Finland are small as well as live, and in practice the presence of numerous small live knots does not appreciably reduce the value of the sawn timber.

In the case of Scots pine pruning is virtually confined to the dead branches, but a low green branch is pruned provided it is not more than ½ in. in diameter. In cutting live branches it is considered important to make an upward blow with a knife edge before beginning to saw ; hence the pruning saw in general use, one devised by Heikinheimo, has a knife attached at the base of the saw. In other respects the saw is similar to that used in this country, except that the teeth are not set backward to cut only on the pull-stroke.

8. An interesting experiment with regard to provenance of seed has been carried out with the needle-cast fungus, *Lophodermium pinastri*. Finnish and German Scots pine were raised in a nursery and infected with *Lophodermium* spores of Finnish and of German origin. The death rate was approximately 80 per cent. in the German pine and 20 per cent. in the Finnish pine and was equally high in both types with either strain of *Lophodermium*.

A similar experiment was carried out with the same seed in a nursery in Germany, using in this case, however, only the local German strain of *Lophodermium*. Results were the same as in Finland. The experiment is of interest as showing that provenance may affect not only the outward form of the trees but also their capacity to resist disease.

The Research Department has given a considerable amount of attention to the question of provenance and has many experimental plots in different parts of the country. In the case of Norway spruce it is found that plants from seed of a southerly origin when raised in a northern latitude grow faster than the local race but if the difference in latitude is too extreme the spruce of southern origin suffer from early frosts in the autumn owing to the shoots' not ripening in time. In the case of Scots pine it is much less safe to bring seed from south to north than it is with spruce.

Within the last few years the Finns have taken up the question of tree breeding, chiefly with birch and larch. The most striking results have been obtained with the so-called Maser birch. This is a form of verrucose birch in which curious irregularities form in the wood, giving the timber a veined appearance which is very attractive.

The character appears to be hereditary as seed collected from Maser birch yields up to 60 per cent. of seedlings true to type.

9. There are over 300 sample plots under observation and much attention has been given to questions of technique. The need for a large number of sample trees has gradually become more apparent. In practice this involves the measurement of standing sample trees. A specially constructed iron ladder is used for the purpose. We were shown extension callipers for measuring upper diameters, these are made specially at the Research Institute and appeared to be very well constructed and unlikely to get out of order.

Heights are measured with a specially constructed hypsometer of the Christen type but with arithmetical instead of geometrical divisions. According to Professor Lönnroth the art in using a Christen is to hold a stick resting on the ground in the same hand as the instrument ; this steadies the instrument. When taking the readings the head must not be moved.

10. A factory turning out birch plywood was visited. The logs were not large, about 9 in. mid-diameter, but they were very straight and cylindrical. Only the butt lengths were free from knots and yielded high grade plywood ; the upper lengths yielded knotty plywood which was utilised none the less, the knots being punched out of the sheets by circular or oval dies of different sizes according to the size of knots and pieces of clear wood of the same size glued in place. There seems no reason to suppose that we could not grow birch in this country which would be suitable for plywood, but it must be grown, as it is in Finland, as a forest tree, either pure or in mixture with pine, spruce, or other species.

Generally speaking I was impressed by the amount of side shade which birch appears to tolerate in Finland and I was told that the trees quickly recover from such shade when the stand is opened out by thinning. I rather doubt if the tree would be as tolerant to partial suppression under our conditions.

11. There is no fixed rotation or annual yield laid down. The usual procedure is to divide each forest into 10 periodic blocks, working through one block each year and carrying out thinning and regeneration fellings as and when required.

The standard system of regeneration is the shelterwood compartment system which appears to give excellent results.

The rotations vary with the quality of the soil, ranging from about 75 yrs. on the *Oxalis-Myrtillus* type to 100 yrs. on the *Vaccinium* and *Calluna* types. These are in the main pulpwood rotations, as only a small proportion of the timber is of milling size. Of recent years the price of pulp wood has been almost as high as that of milling timber, and financially, the shorter rotations required to produce pulp wood make this definitely more profitable.

FORESTRY AT GLASGOW EXHIBITION.

By D. MAITLAND.

Do you pronounce the " z " in capercailzie ? The answer appears to be " Yes " if you are a Southron, " No " if you are a Highlander. Anyhow, the two magnificent specimens—cock and hen—of this bird among the " Friends and Enemies of the Forest " proved to be the focus of much admiration and served as a starting-point for many conversations on aspects of forestry other than ornithological. A collection of over 30 stuffed birds and beasts in a woodland setting, beautifully posed in characteristic attitudes, was certainly the most popular of all the exhibits in the building, and its attraction was enhanced by a black curtain hung in front of it to keep off the glare from the roof lighting. Queues waited to pass behind this curtain, and approaching newcomers chuckled as they looked at the title above it, " Birds and Beasts," and at the row of ankles and trouser-ends that appeared below.

The whole of the Commission's exhibit aimed at being popular. Six coloured dioramas, with lighting effects ingeniously varied by a dimming apparatus, told the story of the forest in broad outline from nursery to sawmill, and were supplemented by a great number of photographs covering the same ground in greater detail. Among the photographs two short series which proved of special interest were those depicting the reclamation of Rendlesham and of the Culbin Sands. A large-scale map of the British Isles, with all the forest areas marked on it which are under the Commission's administration, attracted much attention, though frequently the first object of the visitors was to trace the route by which they had reached Glasgow or to spot the name of some forest near their home. However, one thing leads to another, and the geographical approach to the subject of afforestation was often just as effective as the ornithological.

An ambitious effort, which fell a little short of perfect accuracy, was a model of the 53,000 acres of loch and mountain in Argyllshire, which have been opened as a National Forest Park. It covered an area well known to Glasgow motorists and hikers, and its slight shortcomings in detail were readily forgiven for the bird's eye view which it presented of the district as a whole. A line of green moss along its lower slopes indicated the planting of trees, actual and prospective, up to an altitude of about 900 feet. Another much smaller model represented a forest worker's holding, and was a revelation to many visitors of the successful efforts of the Commission to keep its workers contented in an often isolated rural life. Unhappily the miniature live stock on the holding were a temptation to small boys, and sheep and poultry had several times to be replaced.

One whole section of the Commission's exhibit was supplied by the Forest Products Research Laboratory. Here were illustrated the correct use and care of circular saws, approved methods of stacking poles and scantlings, the elimination of dry-rot from buildings, and many other points of interest to people connected with the timber and wood-working industries.

Undoubtedly the space occupied by the Commission was well worth the trouble, and helped large numbers of the public to realise something of the national importance of afforestation.

TRACTOR PLOUGHING AT HALWILL.

By C. R. Wellington.

The following notes are based on my experience of tractor work at Halwill Forest and elsewhere and refer mainly to low-lying, heavy land generally with a peat covering overlying a stiff clay subsoil, where correct drainage is of the first importance. The general scheme for ploughing such land requires a certain amount of forethought to make the best of the ploughing and the following notes, it is hoped, may give some ideas to those who are new to tractor work. I shall therefore deal with the operations in the sequence in which they are generally tackled.

The area to be ploughed is usually fixed on some time in advance, and I make a point of having it burned over in the spring of the year in which it will be ploughed. This facilitates most of the subsequent operations, and enables me to explore the ground for wet patches which might bog the tractor, and places where rocks just under the surface might damage the plough. Such areas are "flagged" as a warning to the driver. I then proceed to deal with the points given below.

(1) The compartment boundaries are generally fixed, and these may not afford good extraction routes. I have therefore to put in these routes to the best advantage for extraction and drainage. When the tractor arrives the first job is to plough out the rides and roads, and it is not really enough just to run a ride from one point to another, it should be laid out to obtain sufficient fall; a fast run-off is not necessary, a gentle flow being best. It is generally possible to lay out a system of rides to allow all the headlands to run, and to connect up any points required for extraction. Too much care cannot be given to this operation as the functioning of the whole drainage system depends on the initial layout of the ride system.

(2) I plough a boundary headland completely round the area to be dealt with, leaving sufficient room between this headland and the boundary of the area for the tractor and plough to travel on. The furrow of the headland should be thrown away from the centre of the area, so that the inland furrows may empty into the headland. These headlands I plough as deeply as possible.

(3) The fire-line system is then traced out and fully ploughed to the required width. Now, in order to get the full ploughing to lie evenly, it is necessary to make the first "cut-in" somewhat shallower than the normal ploughing, so that the succeeding furrows will fall flat into position. If owing to heavy vegetation or other causes the first furrow is not thrown out enough to enable the next furrow to lie, then the only course is to plough the first furrow deep, and after cutting it up into suitable lengths move it out of the way by hand.

Much subsequent hand-work on levelling fire-lines can be saved by attention to this point. When the fire-line has been ploughed, I run the tractor over it without the plough to bed down the furrows. This makes the line more tractable to work with spring harrows, and also to plough at some future date. It may occur to the reader that as the ploughing for planting will cross the fire-lines, it is not necessary to run over them as a special job as such crossings would level them in any case. In practice, however, it is advisable to do so, as even if the plough is lifted out, the points often catch on the first furrow and pull it out of place, necessitating heavy spade work to get the fire-line in order again.

(4) Operations 1, 2 and 3 now being completed, the first " cut-in " of the actual ploughing is made. The plough is adjusted for the required depth and width. The cut-in is the first line ploughed, from which the tractor ploughs away on each side, up one side and down the other, traversing the area left outside the headland to get from one side of the cut-in to the other. This line is selected to give as long a run as possible in a direction which will secure the drainage fall necessary for the type of land being ploughed, and its direction will vary according to the conditions from almost horizontal to directly up and down the slope. Its position may be in the centre of a compartment and the whole compartment ploughed out from that line, but more generally it is necessary to divide the compartment up into two or three portions with a cut-in in the centre of each section. The ploughing will cut across extraction roads, fire-lines, rides or even compartment boundaries, and the plough has to be lifted out when it comes to these. It will, however, stop at the headland. In order to stop the furrows at the headland or at a drain previously put in, it is best to drop into first gear and go slowly to cut into them tidily, and take the tractor over the drain without destroying it too much. The whole area inside the boundary headland having been ploughed, there only remains the portion outside, which the tractor has been using to travel over and turn on, and this is then ploughed in a circular direction parallel to the headland itself This method permits of the maximum area in any enclosure being ploughed.

General Observations.—I have found that the best results are obtained by ploughing this type of land when the ground is wet as less rolling back of the furrows occurs than when the soil is dry. When rolling back occurs, if I have any fire-lines in the vicinity I go on to them as a fairly good job can be made of them, as previously described, and moreover, many lines which are being ploughed for the second time can only be done when they are dry and firm.

Good ploughing cannot be done with worn shares, and it is not an economy to wear them down too much before sending them to be repointed. The furrows must be cleanly cut to lie well, and a share too much worn down cannot be successfully repointed.

Where a large programme of ploughing has to be done, and shares have to be repointed, a new share should be kept in hand as a pattern for the smith. As this type of work is becoming a lost art, owing to the more general use of forged steel shares with modern mechanised ploughs, one should seek out a smith of the old school who is accustomed to such work.

With regard to the tractor driver himself, a good ploughman is the first consideration, and if my choice lay between a farm ploughman, either mechanical or horse, with some working knowledge of machinery, and a qualified mechanic from a town garage or workshop, I would choose the ploughman for the following reasons. The maintenance of a modern tractor with its instruments and indicators is fairly simple to learn, and an intelligent ploughman can soon master it, but the niceties of good ploughing are not so readily picked up.

The planning of the ploughing scheme and the execution of the work should receive the closest attention on the part of the forester, as a badly carried-out scheme often involves a lot of additional expense in linking up drains and fitting up turfs for planting. On most areas there are portions where heavy weed growth is met with, which causes the furrow to roll back, due, I think, to poor penetration of the shares. It seems to me more economical to plough only the land on which the plough makes a good job, and to prepare the difficult areas by hand, as an area with say two-thirds fall back will cost more to complete by hand-work, than if entirely done by hand.

The Ransomes D.F. Major Deeptrac and Oliver D.F. Type 218B have both been successfully used at Halwill, where the land is rather more suited for ploughing than the average in the south-west, but some patches of heavy weed growth are met with where falling back occurs, and all foresters who have to tractor-plough would welcome a machine which could deal with such areas.

In conclusion, I think it is a good plan to let the driver have the Saturday morning free from actual ploughing to go over the tractor and plough, and put everything in good order for the week's work as this ensures against irritating stoppages when out on the moor.

A FEW NOTES ON AMERICAN FORESTRY.

By T. R. Peace.

In the main, my tour was concerned with forest pathology, but a good deal of information was collected on matters of general interest. Some brief notes on miscellaneous questions are given below.

Nursery Practice.

Soil Treatment and Layout.—The main production from one nursery being 2-yr. seedlings, the rotation is arranged on that basis. After a crop of seedlings is removed the ground is fallowed till the autumn and then sown with oats and vetch. This green crop is ploughed in the following June, and the ground again left fallow till the conifer crop is sown. This would appear to be unusually liberal treatment. The beds are of standard width, but are divided into short lengths by board surrounds. The bed surface is at the same level as the intervening paths. The small surrounded beds are said to lessen soil wash. The side boards on the beds last about three years. These small board-surrounded beds were not seen at the other nurseries.

There seems a tendency in all the nurseries visited to send out a smaller final plant than is usual in this country.

Weeding.—Most of the nurseries visited were well supplied with cheap labour, mostly boys from Civilian Conservation Corps camps. Though these boys are often unskilled and rather slow, they are surprisingly willing, and certainly benefit the nurseries in many ways. Probably to some extent owing to the abundance of this cheap labour, all the nurseries visited were extremely clean. There was general agreement among those in charge of them that thorough weeding pays financially.

Irrigation.—Semi-permanent overhead pipes are used for watering the seedbeds. In the summer they are used more than twice a week. In one nursery they are so arranged that the whole length of each pipe turns automatically through a small angle, lifting and lowering all the jets on it, so that a wide area is covered by the spray. At this nursery the seedbeds are only watered twice a week and the transplants are never watered.

Irrigation by running water in furrows and by sprinklers attached to temporary pipes is used. Areas watered by sprinklers are done every other day during the drier and hotter parts of the season for 15 to 20 minutes. In the case of furrow irrigation the water is allowed to run until the beds are entirely soaked. In view of the climate an ample water supply is considered absolutely essential for any American nursery; it must be available to combat dry weather after germination or after transplanting.

Seedbed Covering.—A satisfactory type of seedbed sand spreader is in use at one nursery, a blue-print of which was received.

Sheltering.—The boards surrounding small beds at one of the nurseries are used to support rigid rectangles of lath sheltering. These are considered superior to the roll type of lath sheltering. At another nursery only the more delicate species such as spruce and *Thuya* are shaded, and then from June to September. Roll type of lath sheltering is used. Sometimes they are put about 2 ft. above the bed, and tilted against the sun. At this height they do not have to be removed for weeding. They are not removed for overhead watering, though there is a certain amount of " drip " from the laths.

Lining-out.—In the past hinged lining boards have been used. These differ from the English pattern in having no notches, but are padded along the face with car-door felt. Thus the seedlings can be placed at any desired spacing without the necessity of changing the board. An improved lining board hinge, recently perfected at this nursery, is described in the Annual Nursery Report. Recently, experiments have been made with a lining machine which plants five rows at a time. It slides on the surface of the ground, being pulled by a stationary tractor winding a wire cable on a winch. Five men are seated on it, and they feed the plants between two soft rubber belts running on rollers. A furrow is made by a small plough share ahead of the plants, and two other small shares fill in the furrow, while the plants are still held by the rubber belts. The major difficulty at the moment is to make the machine run straight. If it goes crooked it crushes the plants that have just been lined. The whole thing can be covered by a curved hood to protect the men sitting on it. In tests they lined-out 35,000 plants in 3½ hours, using one man at the winch motor and one fetching plants in addition to the crew of five. The machine moves six feet a minute and plants 50 trees a minute in each row.

A special tool is used to make the lining trenches. It takes the form of a wedge-shaped blade about 9 in. deep and 2½ ft. long. The top 4½ in. is about 2 in. thick solid metal. In the lower 4½ in. it tapers from this width to the cutting edge. It has a short handle on the top. As it is very heavy it does not take much extra pressure to force it to its full depth into the soil. Thus a slit 9 in. deep, 2 in. wide at the top, and 2½ ft. long is quickly made.

Wrenching.—The wrenching of the roots of seedlings at the beginning of the second year is becoming a very general practice. By this means 2-yr. seedlings with bushy root systems and more easily lifted are produced, or the plants can be left in the beds a third year with less liability to long straggly root systems. Machines have been made by the nurseries themselves usually out of scrap iron, or condemned road machinery, which drag large knives underneath the seedbeds cutting the roots at a predetermined depth.

Wrenching is carried out in April of the second year. The root-cutter is a heavy sled made chiefly of old locomotive rails. The

blade is an old road grader blade and is set at a depth of 4½ in. It is hauled along the beds by a stationary tractor with a winch-drum and a wire rope. Occasionally it throws up on a rock or old stump, but this trouble naturally can be lessened as the nursery grows older.

A root-pruning machine at one of the nurseries is more complex than that at others. The blade is moved from side to side, giving a sawing motion, by two men working hand levers. It has wider runners, with shares digging into the soil to pull the machine down and keep it from jumping. In addition it has side shares to make room for the movement of the ends of the blade.

Lifting.—Most nurseries use their pruning machine for lifting the seedlings at the end of the second year. At one nursery the pruner is fitted with a different blade. This has curved flat prongs on its front edge. As these prongs curve upwards they shove the seedlings up as the machine moves forward. At another nursery the pruner blade is merely set at a steeper angle, so that it lifts instead of cuts.

Removing Stones.—A nursery has successfully used a potato digger for removing stones from the soil.

Frost-lift.—At most of the nurseries visited frost-lift was quite a serious problem. As it only occurs in the absence of snow cover, the danger period is much shorter than in this country, being limited to comparatively short periods in the autumn before snow has fallen and in the spring after it has melted. For this reason a more complete covering of mulch can be given to the seedlings than would be possible in this country without damage to them.

Straw is frequently used as mulch, but sometimes damages the seedlings. They are going to try chopping it shorter. Peat, by holding moisture, is said to increase frost-lift. Burlap placed over the usual lath sheltering had been tried with some success. Higher board edges to the beds lessen frost-lift, as does increased density of sowing. But sowing must not be very dense if the seedlings are to be left two years in the beds.

Storage, Packing and Despatch.—Owing to the delay in planting times caused by the late disappearance of snow at high altitudes, and owing to the limitation by snow of the time available for lifting in the nursery, plants must be lifted when they can, and stored at the nursery. Plants are often baled and stored for as much as three weeks before despatch. Before sending out stock the plants are sprayed against rabbits and other rodents using a solution made up as under: dissolve 7½ oz. of strychnine (alkaloid) in 48 liquid oz. of chloroform ; after it is dissolved add 12 liquid oz. of Resyl (50 per cent.) (Resinol or Balsam), and ½ oz. flaked aluminium as a tracer. It is best made up at temperatures above 60° F.

Stock at one nursery is packed in special wooden frame crates (described in Annual Nursery Report) and stored in a room with a temperature of 40-50° F. and a humidity of 98 per cent. With

a refrigerating plant the aim now is to keep the temperature just above freezing.

Planting Tool.

In the Savenac Nursery area an interesting planting tool was in use. This is a small mattock with a handle about 15 in. long, and a blade about 8 in. long and 2 in. wide, set at right-angles to the shaft. This is thrown into the ground to make a vertical hole, and the end of the handle, which after the throw should be lying practically on the surface of the ground, is pulled up to widen the hole and allow the plant to be inserted.

White Pine in Northern Idaho.

White pine (*Pinus monticola*) is the only really valuable species in this district, and silviculture aims at increasing it at the expense of the rest of the stand. One method is to girdle the older trees of undesirable species and remove the young ones. White pine should then seed into the gaps. Another method is to clear fell, burn and replant. Seeding would be preferred to planting if the seedlings could be successfully protected against rodents. Chipmunks eat paper "hot caps," and wire guards are expensive and have to be removed to let the seedlings through. Rodent poisons have been tried with some success, but what is really needed is a good repellant.

Cupressus macrocarpa.

Two interesting matters were noted with regard to this species. In the first place, in Britain it has always been considered a difficult species to move, and most nurserymen supply it in pots, unless very small plants are bought. In California it is the general practice to supply ornamental trees and shrubs in old food or oil cans. Thus trees and shrubs are often catalogued as "1 gallon 50c., 5 gallons $2," and so on. A small industry for washing these cans, turning in the upper edges and reselling them to nurserymen exists in California. These cans have been used to a small extent in the afforestation of particularly dry sites. But *C. macrocarpa* is almost invariably sold bare-rooted or at the most balled, and can be quite successfully moved in this way. In fact, I heard of one case where wild seedlings had been successfully transplanted. No explanation can be given as to why a tree difficult to transplant in our favourable climate, should be so much easier in the more difficult climate of California.

Secondly, in this country *C. macrocarpa* when young has a typically pyramidal outline. This is due not so much to a steep angle of branching, as to the shortness of the horizontal branches. In California, even away from the sea, the tree makes much longer lower branches, both when very young and later on. Thus the tree is typically more than half its height in width across the base, being therefore something like a Norway spruce in shape. This difference may be due either to climate or race.

Labour and Roads.

Methods such as those mentioned above for the encouragement of white pine are only possible when using cheap labour. Such labour is now available in a large number of the American forests in the form of C.C.C. boys. These C.C.C. camps resemble our Ministry of Labour camps, though I think the average age of the men is lower in the States. The labour they provide is admittedly unskilled and often rather slow. On the other hand, a great deal of work has been done in the forests that it would have been impossible to do without them.

The camps are run by the Army, but the actual work is done under the supervision of trained foremen, and is arranged by the Forest Service or other authority concerned. C.C.C. labour has been used for road-making, forest sanitation (removing diseased and especially cankered trees) in the eastern hardwood forests, nursery and plantation work, mosquito control, fire control, Dutch elm disease, scouting, and so on.

In connection with forest road-making, despite the amount of cheap labour available, a great deal of heavy machinery is used. Packed earth roads or semi-metalled roads are made with great rapidity with the aid of large motor shovels and heavy graders. These can move quite large boulders and are therefore usable in rocky districts. It is surprising that so little of this machinery is in use on public and private roads in this country.

Fire Control.

Fire control, in comparison with this country, forms a very large proportion of the activities of the Forest Service. This is inevitable, for until fire is successfully controlled other forest activities are hardly worth while. The American method of using readings from small meteorological stations to estimate the fire hazard for the day for an area would seem a useful one. Based on these fire hazard estimations the precautions taken can be varied from a general stand-by of all fire control men, to their general release for other duties, when the risk is nil. Various factors such as wind, humidity and the weight of standard pieces of wood, are used in calculating the fire hazard for the day from standardised tables. This method might be usefully applied in this country.

Shelter Belt Plantings.

This project has had to live down unfortunate publicity. It was never intended to plant a strip of forest 100 miles wide, nor was it ever supposed that the plantings would make major alterations in the general climate. The whole idea of the plantings is to protect individual fields from drying winds and thus lessen drought damage and stop soil blowing. Judging from the effects of older belts they are likely to do this quite successfully and if planted extensively they will in effect alter the general climate as every field will be protected.

The project is confined to six states, Texas, Oklahoma, Kansas, Nebraska, S. Dakota and N. Dakota. The aim is eventually to have 6 per cent. of the total land area planted (neglecting of course wild and undeveloped regions). In a few small areas this ideal has already been nearly attained. At the moment belts can only be planted to protect land carrying annual crops. Grassland or alfalfa fields cannot be protected. The first plantings were done in the winter of 1934-35. 1934 and 1936 were drought years, 1937 was a bit dry, 1935 was normal and 1938, up to July, was normal. The belts cannot, therefore, be said to have grown under particularly favourable conditions. Over the whole shelter belt region the average survival up to 1937 was 72 per cent. A few cases have been almost complete failures, but most of the plantings are amazingly successful.

The belts are normally ¼ of a mile or more in length and 7 rods wide. Originally they varied in width from 5 to 10 rods, but 7 rods has now been adopted as a standard. The strips usually run east and west, the prevailing winds being from the N.W. and S.W. The trees are spaced 8 by 10 ft. regardless of species. The Forest Service supplies the trees, plants them and erects the fences. The farmer has to prepare the land, supply the fencing materials, and cultivate the ground till the trees are well established. Originally more work was done by the Forest Service, and less by the farmer; but now that the advantages of the belts are becoming better appreciated, the farmers are more willing to undertake a larger share of the work. Cultivation of the ground till the trees meet is absolutely essential. They cannot stand competition with grass and herbaceous weeds.

The following species are in general use in Nebraska: *Ulmus pumila*, cottonwood (*Populus* spp.) Russian olive, caragana, *Robinia pseudacacia*, *Juniperus virginiana*, *J. scopulorum*, choke cherry, walnut and laurel leaf willow. Farther south *Ulmus parvifolia* is superior to *U. pumila*, and farther north *U. americana* takes the place of *U. pumila*, which is insufficiently hardy. There are usually two or three rows of elm and two or three rows of cottonwood in each belt, and one to two rows each of various other species. The elms and the cottonwoods give far the most rapid growth, and will provide shelter for the rest of the belt, as well as early shelter for the fields. In some of the 1934-35 belts the elms and cottonwoods were already well over head height in July, 1938.

It is not intended to thin the belts, for as the trees grow older there will be sufficient losses owing to drought and suppression. Old belts have suffered considerably from drought in the last few years, but there are still sufficient trees left to form a good shelter, and where they are protected from stock some of them have started to seed in thick natural understorey. It is hoped, therefore, that, once established, the belts will with reasonable care give permanent shelter, and in addition supply some fencewood and fuel to the farms.

CUTTINGS: METHODS OF TREATMENT.

By T. R. Peace.

During my tour in America last summer, I concentrated on getting general information on such questions as the best rooting medium for cuttings and the most suitable temperatures for the growth of cuttings—things which cannot be altered for each individual batch of cuttings. In addition I collected specific information on chemicals and strengths used for the rooting of conifer and elm cuttings.

[Owing to limitations of space, references to individual research stations cannot be quoted, but the character of the work being done is indicated in the following summary. Ed.]

Rooting Medium.—The three media used are peat-moss, sand, and peat-moss-sand mixtures. In general the third is favoured, because it dries out less than sand, and because it provides more nourishment for the rooted cutting, but there is no clear agreement on this question.

Temperature.—It was generally agreed that the soil temperature should be higher than the air temperature. This was only possible if hotbeds or electrically-treated frames were used, the latter being considered the more desirable as they are more easily controlled. The best results with difficult species have been got by the use of electrically-heated frames. If propagation is to be done on a large scale, outdoor methods will presumably have to be elaborated. At most of the stations visited, difficulties were experienced in keeping the air temperature of the frames low enough in the summer, especially if the soil was heated. This has led some to abandon soil heating during the summer months. This difficulty would not be so serious in this country. In general, however, it was considered that the best results were procured using a soil temperature between 65° F. and 75° F. and an air temperature 10° lower.

General Notes.—It is considered that cuttings of hardwoods taken while the tree is in leaf must have the leaf area reduced. This is usually done by removing all but one leaf, and sometimes by leaving only half of that leaf. This seemed, in a number of cases, to lead to a premature rotting of the remainder of the leaf, and in my opinion is not desirable. It would appear that slanting the cuttings favours the preservation of the remaining leaves by bringing them nearer the soil surface and thus keeping them more moist. A researcher working on *Robinia* cuttings found that better results were procured if the bases of the cuttings were injured before they were placed in the chemical solution; he also considered it important that the cuttings should not be placed in water before they were put in the chemical solution, but should go into that solution as soon as possible after they are cut. Another, using oak, has produced evidence

that the ability of a cutting to root is to some extent controlled by its position on the tree from which it was taken. It was found that cuttings from the base of a shoot gave a higher take than those from the middle of the shoot, and a much higher take than those from the tips. It is possible, however, that this difference may merely be due to the better quality of the lower cuttings.

Conifers.—It was generally agreed that conifers of the *Thuya, Cupressus, Juniperus* type were the easiest to root, and the pines the most difficult, the spruces occupying an intermediate position. With most conifers, especially those hardest to root, very long periods are needed before rooting takes place. Indo-butyric acid was very generally in favour for use on conifers. One recommended strengths between 20 and 60 milligrams per litre for a period of 20-24 hours; others recommended stronger solutions, namely, 50 to 100 or even 200 milligrams of the same chemical per litre. Opinion differs as regards the best time for taking pine and spruce cuttings; one had had a 90 per cent. take with pine cuttings taken at that time, another considered January, February or early March the best time for *Pinus ponderosa* cuttings. Experiments are now in progress to try the effect of smearing a lanoline paste containing indo-butyric acid on the young shoots for some time before they are removed from the parent tree; it was found that from January to the time of breaking of the buds was the best period for taking spruce cuttings, and July onwards best for conifers of the *Thuya, Cupressus* type. Hot water treatment of pine shoots, a treatment recommended in the past to make rooting easier by removing the resin, has been tried and found to be ineffective.

Pines grown from side branch cuttings grow perfectly straight, also spruce, provided the terminals of the first side branches are used.

Elms.—*Ulmus americana* has been successfully rooted by a number of workers. It is difficult to keep the cuttings in good condition until they are rooted, and a very careful watch on the air and moisture supply is required. One worker recommends indo-butyric acid at 10-20 milligrams per litre for 24 hours or at 40-60 milligrams per litre for 6-8 hours; the latter treatment may be more successful in preventing wilting of the leaves; another uses summer wood discarding the tip of the shoot as far back as the fourth leaf, and indo-butyric acid at strengths from 30-200 milligrams per litre, but a strength of about 50 is best. This gives fairly good rooting and does not damage the cuttings. Higher strengths give better rooting of those cuttings they do not kill. Elms have been rooted successfully in July, using growth substances mixed with inert dusts, instead of in solution. Here indoleacetic acid is preferred to indo-butyric acid because it can be used over a wider range of strengths without damaging the cuttings. An 11 per cent. take was obtained with *U. americana* using indoleacetic acid in July, and it was found that storing cuttings through the winter in moss at 40° F. promoted callus formation. No one yet claims that he can get a high enough

take with elms to make it a commercial proposition. The percentage take is usually low and the methods uncertain. In the case of root cuttings they should be of pencil thickness, and should be planted with the top (the end nearest the tree) at soil level in a warm temperature. These cuttings should be taken just before growth starts.

Miscellaneous.—Aspen has been rooted using green wood cuttings in August and 10-20 milligrams of indo-butyric acid per litre for 6-12 hours. One or two leaves were left on each cutting and they were struck outdoors in a bed of sand shaded by burlap. Hardwood cuttings of aspen have also been struck in December and January, using 10 milligrams of the same chemical per litre. It is possible that they might have struck better if they had been taken later, nearer the time of onset of growth. Another has rooted hardwood cuttings of *Robinia pseudacacia* in the spring. Potassium alpha-naphthaleneacetate and potassium indoleacetate in concentrations of 200-400 milligrams per litre were best. Indo-butyric acid was not so successful.

Throughout the tour a very strong impression was received of the difficulty of giving figures and methods that could be used for more than one species. In fact, there is often an amazingly wide difference between methods used by different persons for rooting the same species. As it seems impossible to lay down rules which can be applied to all species, it is to be hoped that Committees or Institutions in the countries concerned will find it possible to publish summary results for different species. Growth of trees and shrubs from cuttings is of importance to many scientific workers as well as to the nursery trade, and the publication of such summaries would render the results of research work on growth substances available to those who lack time to carry out the experiments needed and who have no inclination to sort out the figures they want from literature mainly concerned with the more scientific aspects of the subject.

SUMMARY REPORT ON CHAFER INVESTIGATION, 1938.

By J. M. B. Brown.

The past season was largely spent in the study of the biology and ecology of *Melolontha, Phyllopertha* and *Serica*. No work has been done on *Rhizotrogus*.

1. Phenological observations on the emergence and swarming of the adult beetles were necessarily restricted to a few localities and the data do not, therefore, hold all over the country, nor may they hold for other seasons. Around Fairoak Nursery, in the Forest of Dean, and at Oxford, *Melolontha* appeared in the first few days of May, but severe frosts on 7th to 9th May completely interrupted the flight. Cockchafers were plentiful in better weather in mid-May ; but further cold nights in the third week and rain in the fourth week again checked the activity of the beetles. Occasional specimens of cockchafers were seen in the field in early July, but it is believed that unfavourable spring weather prolonged the flight. Greatest activity was recorded on some warm evenings about 7th to 9th June. At Delamere, *Phyllopertha* appeared, as usual, in the first week of June (3rd June was the first swarming day) and the flight (*i.e.* the period of adult activity) lasted until about 25th June ; but after 17th June, beetles were scarce about the nursery and on the food plants. On the hill pastures of Merioneth, emergence and flight were a few days later than at Delamere. In Perch Nursery, in the Forest of Dean, emergence of *Serica* began in the first week of July, but unseasonably cool weather spread the emergence and flight over a considerable period and some of the beetles collected there on 20th June, when they were plentiful, survived until the end of the month.

2. In general, adult flights are narrowly restricted to certain hours of the day. *Melolontha* activity begins about half an hour after sunset and lasts for a little more than an hour. This means that in May they are active from 9 until shortly after 10 and in June, from about 9.45 until about 11 p.m. *Serica* becomes active about half an hour to an hour after sunset, *i.e.* about 10 p.m. or shortly before ; it is not known for how long into the night their activity lasts. *Phyllopertha* is diurnal and its normal period of activity lasts from 10 a.m. until 1 p.m. Low temperatures and heavy rain may suspend the activity of all three species and *Phyllopertha* is also checked by overcast skies or light rain. British summer time has been used in all the above data. Apart from this normal daily activity, the adults of *Melolontha* occasionally gather in large swarms and traverse considerable distances. These swarms appear to be restricted to flight years in districts where the beetles are abundant.

3. Lists of food plants have been compiled for *Phyllopertha* and *Serica* but no attempt was made to add to the published lists of cockchafer food plants. *Melolontha* feeds readily on oak, horse chestnut, beech, birch, chestnut, sycamore and fruit trees (especially *Prunus*

spp.). Trees in open sunny situations are much more popular than trees in close formation. Except for the short period of activity in the evening, feeding continues through the 24 hours, unless cold weather drives the beetles back to earth. *Phyllopertha* appears to prefer bracken and such woody plants as oak, birch, broom, hazel, robinia and various *Rosaceae* (hawthorn, rose, cherry, damson, rowan, blackberry), but other kinds of trees and various herbaceous plants were also eaten. Most of the information about *Serica* was obtained in captivity. Twelve species of trees were accepted, chiefly birch, hazel, maple, oak, rowan, beech, wych elm ; also bramble, bilberry and hawthorn and several kinds of nursery weeds, including *Polygonum aviculare* (knotgrass) and *Rumex acetosa* (sorrel). *Serica* also feeds readily on bracken. *Melolontha* may be found feeding on shrubs and hawthorn hedges, as well as on the tops of tall trees. *Phyllopertha* and, more especially, *Serica* are mainly restricted to low shrubs and the lowest branches of trees.

4. Pairing occurs mainly on the food plants, but *Phyllopertha* and *Serica* may also pair among the ground vegetation. It takes place within a day or two of emergence in the case of *Phyllopertha* and probably of *Serica,* and a few days after emergence in the case of *Melolontha.* The males can mate more than once and it is probable that the females mate before each deposition of eggs. *Melolontha* adults did not behave normally in captivity and the interval between emergence and egg-laying could not be reliably measured. It appeared to be more than three weeks in the past season, but might well be less in more favourable weather. Other observers have given two to three weeks as the approximate interval. The observations made at Kennington and in the field were in accordance with the opinion—contested by some—that the females normally deposit a second and often a third clutch of eggs at intervals of two to three weeks after the first, feeding and pairing occurring between successive depositions.

Phyllopertha lays a first clutch of eggs some four to seven days after emergence and, with this species too, it appears to be normal for the females to resume feeding and to deposit a second clutch about a fortnight after emergence. A further feeding and egg-laying may take place, but these third clutches are probably rare and small. Accurate estimation of the interval between emergence of *Serica* and the first egg-laying was frustrated by inclement weather in July ; but observations at Inchnacardoch in 1937 and Kennington in 1938 indicate an approximate interval of about a week, or slightly more, in normal circumstances ; egg-laying thus commences about the end of the second week of July. Observation of captive beetles suggested that second clutches are small and rare, but this requires confirmation. It should be noted that, with all three species, unseasonably cold weather early in the flight may considerably prolong the interval between emergence and oviposition. The number of eggs in a clutch is about the same for all the three species. For *Melolontha,*

15 to 30, average 21 ; for *Phyllopertha,* 15 to 25 ; for *Serica,* 15 to 28, average 21. Second clutches appear to be generally slightly smaller than first clutches.

5. All three chafers lay eggs freely in undisturbed turf and probably equally readily in cultivated ground which carries a good cover of vegetation ; while *Melolontha* and *Phyllopertha,* at least, will lay eggs in 1-yr. seedbeds or fallow ground, even if these are kept practically free of weeds. *Melolontha* and, more especially, *Phyllopertha* choose sunny situations ; *Serica* appears to prefer shady places. Light, sandy soils are preferred, particularly by *Phyllopertha* and *Serica ; Melolontha* is less fastidious, but is never plentiful in clay country. The immediate factors which determine where the eggs shall be deposited are still rather obscure. The proximity of the adults' food plants, the presence of vegetation, the access of sunshine, the temperature of the surface and its porosity (including, in some cases, the occurrence of beetle exit-holes), all seem to be directly or indirectly involved. But the manner in which they operate on the individual chafers awaits elucidation. The problem has been discussed in more detail in the notes on *Phyllopertha.* A good deal of information has been collected about the depth of egg-laying for each species, but this varies considerably in relation to the nature of the soil and the vegetation covering it and cannot therefore be conveniently summarised here.

6. The egg stage occupies about 7 or 8 weeks, in the case of *Melolontha,* and some 4 weeks in the cases of *Phyllopertha* and *Serica.* On hatching, the larvae commence feeding on the fine rootlets and root hairs. The date when feeding is discontinued and hibernation begins, as also the date when feeding is resumed in the spring, appears to depend upon the soil temperature and thus, indirectly, upon the prevailing weather. Considerable differences are, consequently, found from year to year, but it may be said in general that in the South and Midlands of England, the grubs go down in the middle or latter half of October and return in the first half or the middle of April. They are, therefore, active for a period of between six and seven months annually, which includes, however, short fasts during moulting and occasional periods of drought. The depth of hibernation varies with the character of the soil and of its vegetative cover. In a sandy or sandy loam soil, in open situations, the hibernating larvae may be at 3 to 10 in. under turf, 6 to 18 in. under beds of seedlings and 12 to 20 in. in bare soil. In the shelter of oakwoods, *Serica* larvae occur more superficially.

7. The pupal stage, which occupies about a month (six weeks in the case of *Melolontha*), is preceded by a well-marked pre-pupal stage, of some four weeks' duration, in which the larvae abstain from food and remain quiescent in underground cells, where important internal morphological changes take place. After eclosion of the imago (*i.e.* when the pupa changes to a beetle), suitable weather for emergence is awaited in the soil : with *Melolontha,* this means that

eight months are passed by the beetle in the soil, before it issues in May.

8. The observations of the past season have confirmed the prevalent opinions about the duration of the life-cycle. *Melolontha* requires four years. It is probable that a series of warm summers may permit a three-year development in the South of England, or five years may sometimes be required on the outskirts of cockchafer range, yet these variations from the normal are rare and unimportant. *Phyllopertha* completes its development within 12 months and all the larval feeding is done between mid-July and mid-October. *Serica* requires 2 yrs. and there is some evidence that, in cool, shady situations, individuals may require 3 yrs. Flight years are noticeable only where cockchafers are abundant, as recently in the Forest of Dean and Monmouthshire, where 1930, 1934 and 1938 were notable flight years. This series appears to hold for most of the other affected parts of the country. No observations have given any indication of a major and a minor swarm in the case of *Serica,* although this species and *Phyllopertha* are, doubtless, subject to wide fluctuations in numbers from year to year.

9. The natural enemies of the chafers have not received much study either at Oxford or in the field. The most important of these is the *Dexia* parasite of *Melolontha,* which is being thoroughly investigated at Farnham Royal. A number of predators on the eggs and young larvae of *Phyllopertha* and *Serica* have been listed. They belong to the coleopterous family, *Carabidae,* and observations on the commonest species were made in 1937, at Delamere and Inchnacardoch.

10. Experiments with chemicals have been limited to small-scale trials of naphthalene as a deterrent against *Melolontha* in the Forest of Dean and a more extensive trial of naphthalene and flowers of sulphur against *Phyllopertha* at Delamere.

The results of the deterrent experiments on seedbeds in Fairoak Nursery are not yet available. The Perch experiment was inconclusive, but seemed to justify further trial of naphthalene as a deterrent to oviposition by *Melolontha.* A dressing of 4 oz. per sq. yd. gave 60 to 70 per cent. control ; 2 oz. per sq. yd., as also 10 oz. of lime per sq. yd., were ineffective.

At Delamere, naphthalene also gave a considerable measure of control as a deterrent to oviposition by *Phyllopertha.* One oz. per sq. yd. was without effect, but 2 and 3 oz. per sq. yd. gave results ranging from 30 to 70 per cent. control. The sulphur treatments ($\frac{1}{4}$ to 1 oz. per sq. yd.) were wholly ineffective. The results of parallel experiments on seedbeds are not yet available.

11. Extensive trials with a sweeping net at Delamere and careful examination of the beetles trapped indicated that there would be little advantage in employing such a net as a supplementary control measure against *Phyllopertha.* The catches, which were not remarkably big, included only 3 per cent. of females.

RAISING OF BIRCH AND ALDER FROM SEED.

Difficulties are frequently experienced in the raising of seedlings of the various species of birch and alder. Such difficulties are due probably to the smallness of the seeds concerned and to the exacting nature of their requirements during and immediately following germination. Small seeded species of this type are generally very sensitive to tilth conditions which are governed partly by the type of soil and partly by the weather conditions before and at the time of sowing. However, by paying special attention to seed-covering this difficulty can be overcome. Density of sowing is also an important factor and one difficult to regulate ; also climatic conditions during the relatively short germination period have a very marked effect upon the subsequent crop. Germination takes place rapidly during warm, humid weather, and over-stocked seedbeds are a frequent occurrence ; poor or irregular stocking may also result from local soil variations. Generally speaking, there has been no certainty of success of sowing, and outturn has shown considerable variation from year to year.

In this note, it is proposed to indicate briefly the methods that are now in use in Kennington Nursery as a result of research and experiment over a number of years in the cultivation of these genera. It should be borne in mind that certain aspects of the treatments apply particularly to this nursery and may require slight modification according to local conditions of soil, etc.

Birch.

The Seed.—The average number of seeds per pound is approximately 650,000. Tests carried out in a Hearson incubator show an average laboratory germination of 18 to 24 per cent.

Preparation of Seedbed.—The soil is worked to a fine tilth. The incorporation of broadleaved humus into the surface layers while the beds are being prepared is an advantage. Ammonium sulphate, applied at the rate of ½ lb. per 100 sq. ft. and raked into the surface of the bed at the time of sowing, stimulates growth.

Treatment of Seed.—After harvesting, the seed may be either stored in a dry state or stratified until required for sowing. Dry stored seed is usually sown without soaking ; in this case an after-sowing treatment can be applied as a means of weed control. On the other hand, when dealing with stratified seed, no after-sowing treatment against weeds is possible.

Method of Stratification.—A convenient method of stratifying the seed is to prepare a pit 2 ft. in depth with sides and ends covered with ⅜-in. mesh wire-netting. The bottom 6 in. is filled with sand or gravel to ensure efficient drainage. It will be found convenient, where small lots of seed are to be dealt with, to construct a narrow

pit approximately 2 ft. in width which can be partitioned off. A known weight of seed is mixed with coarse silt-free sand, sufficient sand being applied so that the seed is well separated. The mixture is placed in a partition of the pit which can be filled to within 12 in. of the surface. The partitioned off portion of the pit is then completely filled to ground level with pure sand. Further attention is not usually necessary until the seed is removed for sowing in the spring. Stratification can take place after the seeds have been harvested in the autumn or delayed until the end of January.

Sowing stratified Seed.—Sowing takes place when the seed is plump and on the point of germinating ; normally this is during the first week in April. It is important that the seed be sown immediately after removal from the stratification pit and not allowed to dry out. The stratifying medium is sown together with the seed. During dry conditions the beds are well watered immediately after sowing and before covering is applied.

Density of Sowing.—The seed is usually sown broadcast at the rate of 1 lb. to 200 sq. ft. of seedbed.

Seed Covering.—The seed is lightly covered with coarse silt-free sand ; this aids in moisture conservation. The most satisfactory results have been obtained when coarse silver sand, such as is used in horticulture, has been employed. The sand employed at Kennington comes from the Bedford pits.

Watering and Protection.—After sowing, frequent watering is necessary. The surface layers of the bed are kept in a moist condition until germination is well established. Moisture is retained for a longer period when sand of the texture of Bedford sand is employed for seed covering. Evaporation takes place much more rapidly when very coarse grit or ¼-in. chippings are used.

The application of lath shelters is only necessary during hot periods. Continuous shading, especially in a wet season, is not beneficial.

Weed Control.—Measures of weed control can only be applied with safety to beds in which the seed has been sown in a dry state. In such instances, the effect of continuous watering is to produce a heavy crop of annual weeds, which germinate much more quickly than the tree seed and frequently cause heavy losses by their removal. Spraying the beds immediately after sowing with a 1 in 80 solution of sulphuric acid at the rate of 1 gallon per sq. yd. reduces annual weeds appreciably but has little effect on perennials. Such treatment tends to reduce the total production of tree seedlings, counting all grades, which, if germination has been very good, may be an advantage for by this means the actual yield of usable seedlings may be raised.

For the above treatment, 98 per cent. sulphuric acid of commercial quality is employed, two fluid ounces being required per 2 gallons of water. In mixing, the acid must always be applied to the water.

The solution is applied through a lead-coated sprayer fitted with jets specially designed for use with acid.

Subsequent Treatment.—The seedlings are usually lifted and lined-out after one year in the seedbeds.

General Recommendations.—Where supplies of seed are available at an early date, stratification is recommended. The stratification pit should be constructed on a well-drained site. Where surface water is troublesome, a shallower pit can be quite effective. The selection of a suitable covering material free from silt, and liberal watering of the seedbeds until germination is established, are considered important factors in the raising of birch.

Alder.

The Seed.—The average number of seeds per pound is approximately 280,000. Tests by Hearson incubator show an average germination of 20 to 29 per cent.

General Recommendations.—The treatment of this species is very similar to that of birch except as stated below.

The seed has not been found to respond satisfactorily to stratification, and dry storage is recommended. With regard to artificial manuring, ammonium phosphate applied at the rate of ½ lb. per 100 sq. ft. of seedbed at the time of sowing and lightly raked into the surface layers of the soil has been found to stimulate growth. As with birch, alder species are very sensitive to overcrowding in the seedbed.

Research Nursery, Kennington.

ROYAL SCOTTISH FORESTRY SOCIETY.

1938 Meeting.

By C. A. Connell.

The tour on this occasion was held in Northumberland and the first day's outing was spent on the Middleton Estate, Belford, which is a few miles north of Alnwick. Of this estate, 800 acres are given over to properly managed forestry operations and the results of uninterrupted control during the last 48 years are very interesting.

The estate sawmill was first inspected; the main item is a 47 b.h.p. crude oil engine by Ruston and Hornsby, which drives the rackbench, pendulum cross-cut saw, main and subsidiary circular saws. The quality of conversion is excellent and the outturn equally good. Internal arrangements of the various machines are such that the minimum man-handling has to be done. Neighbouring buildings contain a pressure creosoting plant, bandsaw for small work, planing machine, power grindstone and broom-handle making machine. Three sheds are reserved for the seasoning of sawn timbers.

Through the centre of the forest part of this estate runs a forest railway, having its terminus in the sawmill, and having for motive power a twin-cylinder Diesel-engined locomotive. Considerable loads of produce in the round can be transported on one journey, while the converted seasoned produce is taken from the sawmill and seasoning sheds to a main sales dump on the side of the Great North Road.

The estate has a flourishing connection in the sale of forest produce of all types, apart from fulfilling its own requirements. This has been achieved by careful consideration of market requirements and running of a mill on up-to-date lines and at continuous full pressure, enabling costs to be kept within the limits of local large-scale timber firms.

The rainfall of the district varies between 17 in. and 40 in. with an average of 26 in.; the soil is derived from a formation of Whinstone Crag.

The first plantation seen was an interesting one, of P. 20 S.S., thinned three times to date, and recently pruned to a height of 17 ft. Further thinning appeared to be necessary, but altogether the crop was entirely satisfactory. Following this, a promising plantation of larch, pine and beech, of P. 30 was seen. The mixture appeared to be correctly proportioned and the growths were more or less equal. Adjoining this was an unusual stand, a mixture of ash and black Italian poplar. The ash had been transplanted from a naturally regenerated group when a fair size. The growth of the plantation was reasonable, though there are bound to be difficulties ahead as the poplar are far too hemmed-in by the ash. The vegetation consisted chiefly of bramble, wild currant and

willowherb. P. 16 plantations of S.S. and S.P./C.P./N.S. were seen, followed by an interesting stand of *Thuya plicata* which obtained the second prize at the Royal Show of 1935. This stand has been brashed, has a maximum height of 40 ft., and at the moment is ready for a further thinning.

There is a block of mixed hardwoods 75 years old, which did not attract particular attention, and should shortly be realised. A good stand of P. 12 D.F. was then inspected: this has been brashed and completely pruned; it exhibited good growth both as to height and girth. After this a P. 1890 larch stand was seen; this has been badly managed and is very poor. A discussion was held on it and it was decided that the best method of future management would be along the lines of underplanting after a heavy thinning. Subsequently, stands of moderate J.L. P. 06, E.L. and D.F. were seen. The D.F. were interesting in that they had been planted at the end of July, a successful "take" being achieved. Some very good plantations of mixed D.F., *Thuya*, *Abies grandis* and *albertiana* were also inspected, together with a stand of unusual mixture, poplar and D.F. In the last, difficulty will be experienced over the lack of headroom for the poplar. On the way to one of the three estate nurseries, which contain S.P., N.S., hybrid larch and D.F., some promising young plantations of N.S. and *Abies grandis* were seen.

A discussion was held by the party on pruning, and all noted that every tree in all pruned stands had been treated. The owner stated that the work is carried out by female and boy labour and finds that it is impossible to have selection of trees for pruning carried out otherwise than by skilled men, of whom he has none. All trees are therefore pruned, to lower costs by dispensing with supervision. The tools used are secateurs and handsaws; the Mathieson curved saws on poles are not liked or used. The assembly, while accepting the owner's reasons, rightly deprecated the pruning of every tree in the stand.

The second estate to be visited was that at Healey, some miles south of Corbridge, and here there are some 1,500 acres of woodlands. The general impression obtained was that management is good in all its phases, and the value of the woods is steadily increasing. The rainfall averages 30 in., while the soil consists mostly of a thin layer of peat, either over sandstone or sandy-clay with a clay subsoil. An interesting point is that the owner has in his possession records going back to 1816, kept by previous foresters. Their usefulness cannot be overestimated.

Planting started in 1816 and continued for 10 years, when there was a lull until the period 1842-1854. Sales of thinnings commenced in 1833 and of standing timber in 1854. Since 1920, 535 acres of standing timber have been sold and 931 acres replanted, the average programme being 52·4 acres and average cost £13 18*s.* 4*d.* per acre; cost to establishment stage has been £15 per acre. During

the same period the average number of acres sold or utilised has been 31·47, and the average price realised per acre has been £79 6*s.* 1*d.*

The first plantation seen was a second rotation of larch, now ripe for utilisation. The first crop was planted 1818-1823 and gave 120 trees to the acre with a content of 5,500 cu. ft.; the current crop was planted 1869-1878, and has a stocking of 285 trees and 2,900 cu. ft. per acre. There is a mixture with the larch of S.P., C.P., D.F., S.S. and N.S. Next was seen an S.P. plantation planted in 1868, thinned for pit-props last year, and in which there are two Forestry Commission sample plots. The average height is 53 ft., with maximum 61 ft.; the trees exhibit a very good form and all the party agreed that every effort should be made to get seed from them for future plantations. They are growing on sandy-clay over sandstone, with some peat. Regarding the two sample plots, the one which has been heavily thinned has a content per acre of 3,593 cu. ft. t.u.b. and p.m.a. increment of 131 cu. ft.; the one lightly thinned shows 3,562 cu. ft. and p.m.a. increment of 80 cu. ft. The stand was altogether very good.

A halt was made at a stand of S.P. planted in 1867, which is being thinned and converted into pit-props. The quality of props on view was excellent. As to the technique of preparation, Schalmesser and English-pattern peelers are used ; often the lower part of the tree is peeled before felling, and it has the advantage of removing the root-swelling ; the trimming out of the branches is done right into the bark, thus leaving a clean run for the peeler from top to bottom of the prop.

An interesting plantation of mixed E.L., J.L., C.P. with some D.F., S.P. and N.S. was seen; all the species gave a level height with a suggested tendency of the C.P. to get away in the near future. This was planted in 1910, and there are 750 trees per acre with a content of 2,150 cu. ft. All materials from thinnings are readily sold; use of S.P. poles after felling and before sale is made for beetle-trapping purposes.

During the afternoon the Forestry Commission's nursery at Widehaugh was inspected. In spite of severe frost damage sustained in early May, all crops were showing noticeable growth.

The third estate to be visited was that of Kyloe Wood, adjoining Middleton Estate and only about 2 miles from the coast. The estate is entirely woodland, being just under 1,000 acres ; the rainfall averages 29 in.; little snow or frost is experienced; elevation is between 300 ft. and 600 ft., while soil conditions are very variable, there being areas of boulder clay, peat over sandstone, medium loam over whinstone, and limestone.

The main interest lies in the variety of conifers of which there are upwards of 100. The present owner took possession and control in 1930 and his object of management is gradually to bring the wood into the condition of a normal forest, while at the same time preserving and safeguarding the specimens of rarer trees.

This wood is a good example of the interest taken by an owner who, on acquiring it, knew very little about forestry but who, through intelligent work and unbounded enthusiasm, has learned a considerable lot himself and has at the same time brought the woods into a state of good management, silviculture taking its proper place alongside utilisation. A further interesting point is that there are 24 species of forest trees naturally regenerating themselves on this estate.

First seen was a small hardwood area, chiefly of ash, with good natural regeneration ; and adjoining is an area recently underplanted with *Abies grandis,* growing well. The owner stated that he undertook this because the weed growth was beating the rate of natural regeneration. Next was inspected a block of 30-yr.-old *Thuya plicata,* thinned and pruned with pole saws 3 years ago and now ready for a further thinning. This stand took the first prize at the Royal Show, 1935. It really was a magnificent stand and shows what can be done with the species on right sites in this country.

A 50-yr.-old area of naturally regenerated hardwood followed ; the trees are small because of neglect in early years but are now developing good crowns as a result of thinnings. A Forestry Commission sample plot of pure ash was seen, and from information provided it appears there are 201 trees giving 658 cu. ft. (t.u.b.) to the acre. In a discussion on the treatment of this plot it was agreed that a heavy thinning, such as has just been done, would have been advantageous earlier, though knowledge of this was not at that time available owing to the backward state of the stand.

A very fine stand of 26-yr.-old S.S., thinned in 1932 and 1937 and high-pruned was seen. Following this, an area of Fraser River Douglas, 25-30 yrs. old, was inspected and found to be very satisfactory. Other interesting plantations passed by included one of naturally regenerated *Cupressus lawsoniana,* groups of 28-yr.-old *Abies grandis,* D.F., *Sequoia gigantea, Thuya plicata* and *Tsuga heterophylla* (all high-pruned) and an area containing naturally regenerated S.P., E.L., S.S., D.F., *Abies pectinata, Abies nobilis, Tsuga heterophylla, Thuya plicata, Cupressus lawsoniana,* J.L., sycamore, oak, birch and rowan. The main feature of a large part of the estate is the ease with which these species may be naturally regenerated if the correct silvicultural conditions are provided. It was generally agreed that under these circumstances the best method was that actually being followed, *viz.,* felling of groups among standing timber, the allowing of all species to take their chance, and the gradual joining up of the groups as seed years permitted. It was not considered that the prevalent types of ground cover, ling, bracken and grass, would be detrimental if the group working was adhered to. A very well-thinned stand of 35-yr.-old E.L. was seen ; this was given a thinning, rather light, in 1931 and a heavier one in 1936. The response has been marked.

A discussion on pruning was held at a spot where a stand of E.L., 35 years old, and one of D.F. a few years younger had been pruned to 30 ft. or higher with hand-saw and ladder. The criticisms were

all levelled against the practice of pruning every tree. The owner stated that the brashing up to 6-7 ft. was done with saws and took 2½ minutes per tree ; the high pruning to 14 ft. took 2½-3 minutes when climbing the tree and 4 minutes per tree when using a pole saw ; the high pruning to 30 ft. and higher took 10 minutes per tree over and above the brashing. The saw was preferable to the billhook as the latter so easily leaves small snags which in the case of spruce may take up to 30 years to occlude. Some of the party were against any brashing or pruning of naturally regenerated areas, but agreed that it was necessary and, indeed, desirable on artificially-afforested areas.

On the fourth day the Harwood Forest of the Forestry Commission was inspected. The difficulties to be contended with were explained, the methods of drainage, turfing and planting were demonstrated and plantations in and out of check were examined. Particularly interesting was the scheme to help S.S. in check, by putting additional turfs, vegetation side down, round the roots of a planted tree. This, for reasons which would appear to be chiefly moisture conservation, quicker decomposition of surrounding vegetation and better stability of root temperatures, has made a marked improvement. The use of an Allen autoscythe for heather-cutting was also demonstrated.

The neighbouring estate of Wallington was visited, where fine park trees of large beech and oak were seen. One mighty oak gave 31 ft. to the first branch and quarter-girth of 35 in. t.o.b. at breast height. Two old larches, reputed to be part of the first consignment sent to the Duke of Atholl, are still vigorous. One measured 42 ft. to the first branch with 33 in. quarter-girth t.o.b. at breast height. The best beech was one measuring about 18 ft. in girth. Wallington Hall was visited through the courtesy of Sir Charles Trevelyan ; it contains some fine Italian plaster work, pictures by Gainsborough and Reynolds, and china from the peak period of that art in China.

Finally the all-electric sawmill belonging to Hulne Park was seen at Alnwick ; it handles the timber used on the estate, consists of three motors running rackbench, circular saws and creosoting pumps, and costs only an average of 3*s*. per day worked.

The writer wishes to acknowledge his indebtedness to the Commissioners for their kindness in sending him on this tour.

FORESTRY COMMISSION SOCIAL SERVICE ASSOCIATION.

Annual Report of the England and Wales Committee, 1938.

The following report on the work of the Social Service Association will be submitted for approval to the Departmental Whitley Council.

During the past year the scheme for the adoption of the Jubilee Social Centre at Chester-le-Street has worked well and smoothly. With the gradual revival of industry many of the members have found local employment but continue to use the Club as a social centre, finding it a welcome alternative to the streets or the drabness of their own homes. Recently there has been an influx of young lads who have not yet found employment. The need for such community centres is stressed by all the social workers in the north-east of England and in giving their greatly appreciated financial assistance the contributors to the scheme can feel assured that the money is being well and usefully spent.

An analysis of a typical quarter's expenditure by the Club will give an indication of the way in which the available funds are expended. Rates account for £2 15*s.* 1*d.*, heating and lighting £13 17*s.*, canteen £21 17*s.* 4*d.*, leather and wood for handicrafts £11 9*s.* 10*d.*, games £2 10*s.* 4*d.*, piano instalments £2 13*s.*, repair to roof £2 0*s.* 7*d.*, newspapers £1 7*s.* 6*d.*, miscellaneous £5 3*s.* 1*d.* : total £63 13*s.* 9*d.* On the income side the principal items are, the Forestry Commission Grant of £12 10*s.*, £20 6*s.* 10*d.* from the canteen (showing this as virtually self-supporting), £12 16*s.* 5*d.* raised by dances, £9 11*s.* 9*d.* by weekly contributions from the members, £2 19*s.* 6*d.* for boot repair work and the balance of £5 3*s.* 2*d.* by way of miscellaneous receipts, making a total revenue of £63 7*s.* 8*d.* A balance of £19 15*s.* 6*d.* was carried forward at the end of the quarter.

The appended statement shows subscriptions to the value of £102 6*s.* 6*d.* contributed by 125 members of the England and Wales staff. A donation of £2 was sent in March towards a summer excursion for the children and £2 2*s.* given to a guarantee fund in aid of

Receipts and Payments.

Year to 31st December, 1938.

Receipts.	£	*s.*	*d.*	*Payments.*	£	*s.*	*d.*
Balance, 1st January, 1939	45	12	8	Contributions (Community Service Council, Durham, etc.) - ..	104	2	0
Subscriptions (deductions from salary)	102	6	6	Balance in hand ..	43	17	2
	£147	19	2		£147	19	2

Audited and found correct

(Sd.) W. E. Coggins

6th February, 1939.

the summer festivals organised by the Social Service Centres in Durham. The remainder of the payments represents the annual grant of £100 of which half goes direct to the Chester-le-Street Centre and half to the Durham Community Service Council for instructors, supervision, etc. In addition to this financial assistance several parcels of clothing, books, etc., were sent to Chester-le-Street to raise funds for a Christmas party and a total of £9 9*s.* 3*d.* was raised by this means.

In October two members of the Committee of our Association, Mr. S. W. Edwards and Mr. J. Butcher, visited Chester-le-Street and met members of the Club Committee. It is understood that as a result of this visit some of the men have been accepted for Forest Workers' Holdings in Northumberland. The following report has been prepared by Mr. Butcher.

The Chester-le-Street Social Centre.

I am very glad to have had the opportunity of establishing personal contact with the members of the Chester-le-Street Social Centre. I first visited the Centre in company with Messrs. S. W. Edwards and F. G. Good on the 28th October, 1938.

The Centre is just off the High Street, almost opposite the Employment Exchange, comprising a large timber building painted in the familiar brown and green colours. At the entrance there is a large notice board similarly painted informing all visitors that the Centre has been adopted by H.M. Forestry Commission. The main hall is about 50 ft. × 20 ft. in which they have a table-tennis table and a platform suitable for concerts and plays. In addition to the main hall there are three or four small rooms where rough carpentry and boot and shoe repairs are carried on during the day, while in the evening they are used for committee work, reading, etc.

We were given a North Country welcome and shown round the Centre and the Chairman and Secretary explained their activities. We were shown specimens of rough carpentry and boot and shoe repairs and it was evident that the men I saw took a keen interest in their jobs of work.

It is quite clear that the Committee appreciate the financial assistance we can give and also that they utilise to the best advantage what money we can contribute.

I was in the northern Special Areas for the purpose of stimulating interest in Forest Workers' Holdings and I briefly explained the scheme and showed them some photographs of the houses available and some illustrating forest work. Mr. Smith, the Secretary, informed me that Mr. Hopkinson had promised to attend on Tuesday evening the 1st November, 1938, and invited me to address the members on the Forest Holdings Scheme. I gladly accepted this invitation but unfortunately Mr. Hopkinson was unable to be present as he had to be in Yorkshire. However, we had a good meeting and there was keenness at the prospect of work. In response to numerous

requests, I made another visit to talk to the wives and it was quite evident that several of them were anxious to take the opportunity of permanent work. In some cases I had to discourage applications as it was apparent they would not prove suitable as Forest Holders. Some of those who applied did not satisfy the selection panel and others failed the medical examination, but three families were eventually accepted.

By the courtesy of the Durham Community Social Service Council I was able to visit several Social Centres within the Durham County and in my view the Chester-le-Street Social Centre is, of those I visited, one of the best organised.

J. BUTCHER.

SOCIAL SERVICE IN SCOTLAND.

By T. W. CLELAND.

In the last issue of the JOURNAL the effort of the Commission's staff in England and Wales on behalf of the unemployed was described under the title "Forestry Commission Social Service Association." Similar effort is being made by the Scottish staff, not in an association confined to the Commission but in co-operation with the staffs of other Government Departments in Scotland, in a society known as the Civil Service (Scotland) Community Service Association. The composition of the Association which was constituted on 30th September, 1936, is shown in the following particulars taken from the Annual Report for the year ended 30th September, 1938.

Staffs.	*No. of Members.*	*Subscriptions.*			
		£	*s.*	*d.*	
Agriculture, Department of	135	115	18	7	
Fishery Board	54	48	3	0	
Forestry Commission (Scotland) ..	56	34	14	0	
General Board of Control	11	19	17	6	
Health, Department of	214	216	6	4	
Inland Revenue (Comptroller's Office and Estate Duty Office)	46	50	16	0	
Labour, Ministry of	465	259	13	2	
Post Office	75	50	14	8	
Prisons Department	42	28	0	0	
Register House	71	44	0	10	
Registrar General	14	9	16	0	
Scottish Education Department ..	58	76	0	9	
Scottish Juvenile Welfare and After-Care Office	14	6	18	0	
Scottish Office	37	32	15	9	
Transport, Ministry of	69	40	18	4	
Unemployment Assistance Board, 16 Departments	213	20	19	1	(part year)
	1,574	£1,055	12	0	

The object of the Association is "to assist in alleviating as far as possible the distress occasioned by unemployment in Scotland by helping unemployed men and women either through existing voluntary agencies or otherwise, to occupy their time usefully and healthfully." It acts through a General Council on which the Forestry Commission members have, like other staffs, a representative.

The appeal for subscriptions was issued to all members of the staff in Scotland from Foremen in charge of forests upwards. The response, both in amount (£34 14*s.* annually) and in spirit has been very encouraging. (The staff in England and Wales is to be congratulated on raising a yearly subscription of £101 5*s.* The Assistant Commissioner for England and Wales has, of course, a larger personnel under his control than the Assistant Commissioner for Scotland and the Headquarters' staff gifts swell the amount.) A recent appeal, addressed to those who have been added to the Scottish

staff since the first approach, has produced five new members representing a sum of £3 14*s.* per annum—figures not included above.

The Civil Service (Scotland) Community Service Association's first decision on policy was not to "adopt" centres but to originate or assist schemes, particularly of a kind with which it would be identified. That decision was supported by the Scottish Council for Community Service, whose experience had been that "adoption" was not suited to Scottish conditions and might discourage centres not "adopted." The Unemployed Camping Movement had been proving very successful. Under it, families of the unemployed were assisted to holidays at either Rothesay or at Butlaw, near South Queensferry. Families from the Special Areas were assisted on a large scale by the Commissioner. The Association decided therefore to confer a similar benefit on families from the hardest hit districts outside the Special Areas. Selected families (father, mother and children—irrespective of the number so long as the oldest child is under sixteen years of age) have been given a week's holiday at a total cost to each family of 15*s.* In the two years of its existence the Association has thus provided holidays for the unemployed, outside the Special Areas, as follows :—

Year.	*No. of Families.*	*Approximate No. of Persons.*	*Association's Contribution.*
			£
1937	159	800	532
1938	258	1,330	1,065

The following letter of appreciation from the father of one family —he has been unemployed for years—was written to the Forestry Commission member who sent in the nomination :—

> "We are just now back from our holiday and we must say it is the best I have ever had. My family and I thank you ever so much. We must say that the organisation of such a camp is beyond describing. It will long live in our memories as the happiest holiday we ever spent. Thanking you and all donors and staff for a happy, happy week."

It is probable that support of the Unemployed Camping Movement will continue to be the principal activity of the Association. It continues, however, to examine other proposals. It has issued an appeal for books and magazines for centres and clubs for the unemployed and it is at the present time considering whether it can assist in providing supervisors for two clubs. Such action would of course mean "adoption" and would therefore necessitate a change of policy to some extent. If it can bring further comfort towards the unemployed and their families the Association is not afraid of the charge of inconsistency. In furtherance of its purpose it welcomes suggestions and invites new financial support.

CULTIVATION OF EUROPEAN AND AMERICAN WALNUTS.

Experimental work on the raising of vigorous, well-formed planting stocks of walnut has shown that the practice of "stumping" suitable plants generally assists in the development of well-ripened shoots, thereby reducing the tendency to die-back, and increases the production of trees suitable for planting. Stumping is explained in further detail below, but briefly the operation consists of cutting back both shoot and root at the time of transplanting. This treatment is recommended in the cultivation of walnut. It should be pointed out that research on this question is still proceeding. Stumping was first successfully applied to old transplants ; 1-yr. seedlings were found to be unsuitable for such treatment, but 2-yr. seedlings responded quite well and, at the present time, are recommended, provided the seedlings are vigorous.

Juglans regia.

Treatment of Seed.—The effect of size of seed on viability is considered to be an important factor for this species. The size of the seed varies considerably, and consignments containing a large proportion of small seed are liable to produce low yields. The number of ungraded seeds per pound averages about 80. The seed should be stratified in sand in an open pit immediately after harvesting until required for sowing in the spring.

Sowing.—For the production of vigorous seedlings for stumping, wide spacing together with manuring is considered necessary. The seed should be removed from stratification when on the point of germinating ; at Oxford this is usually at the beginning of April. At this stage bad seed is more easily detected and can be discarded. The ground should be manured with farmyard manure at the rate of 30 tons per acre. The seed should be sown by dibbling and spaced 6 in. within and 12 in. between the rows. Where really good quality seed is employed, the spacing within the rows could be increased up to 12 in. The effect of manuring on growth is not usually apparent until the second growing season. The seedlings remain undisturbed for two seasons.

Transplanting.—Suitable stocks for stumping should have a stem diameter at root collar of approximately ¾ in.; smaller plants do not satisfactorily respond to stumping and should be left to grow on. The stumping operation consists of cutting back the stem with a sharp knife to within 1 in. of the root collar, and the primary root to within 6 to 8 in. All damaged roots should be clean cut with a knife. The plants are then lined-out at a spacing of 2 ft. by 2 ft. in ground manured with farmyard manure at the rate of 30 tons per acre. Subsequent growths are reduced to a single shoot per plant as soon as growth is sufficiently far advanced to determine the best placed shoot to form the leader ; this is usually at the beginning of June.

During the second year after transplanting, shortening of the branches may be necessary to maintain the leading shoot in full vigour. The plants are usually sufficiently well developed for planting in the forest at the end of the second year. Special attention should be given to lifting as the roots are easily damaged. It is suggested that all broken roots should be clean cut with a knife.

Juglans nigra.

Treatment of Seed.—The seed of this species is usually more uniform in size than *J. regia.* The average number of seeds per pound is about 38. The seed should be stratified as for *J. regia.*

Sowing.—As for *J. regia* except that germination takes place somewhat later and quite frequently a number of the seeds do not germinate until the second year.

Transplanting.—As for *J. regia.*

Planting of Walnuts.

Choice of Site.—The most important requirement as regards a site for the planting of walnuts is that it should be moist but well drained. The actual quality of the soil is less important but brown earth is presupposed, podsols not being suitable. Frost hollows must be avoided as walnut species are very sensitive to frosting. The greater the risk of frost, the larger should be the plants employed.

Planting.—Pit-planting is the only method that can be recommended ; preferably the holes should be opened in the autumn in order to give the soil time to weather before planting. It is suggested that the trees be planted in groups, say, of three trees, 3 ft. apart in a triangle. The groups themselves could be 15 ft. apart centre to centre.

Subsequent Treatment.—Plants should be kept free of grass and other vegetation by hoeing, for the first two years after planting.

If the group method of planting is employed, as suggested, the best tree of the three in each group should be selected at the earliest possible date and the others cut back. A clean bole should be secured by pruning from the earliest years onwards.

As soon as the trees are properly established, that is to say about 10 ft. in height and growing well, a small number of beech should be interplanted between the walnuts unless there is already on the ground sufficient coppice to form a " fill-up " crop.

RESEARCH NURSERY, KENNINGTON.

THE OWL—THE FORESTER'S FRIEND.

By D. M. Morgan.

I shouldered my gun one evening and made my way to an old dew pond on the mountain top, intending to have a shot at some wild duck that paid a visit to the pond occasionally. It was a beautiful evening in late August. The sun was a crimson ball and was about to sink behind a ridge in the west ; hardly a breeze blew ; scarcely a leaf moved on the tall poplar by the roadside. I could hear the laughter of children from the hayfields in the distance where the farmers laboured with their belated harvests. By the time I had reached my destination the sun had dipped behind the ridge but its rays made a mighty fan ; the long shafts of golden light shot heavenwards, caught the little wisps of grey cloud that were scattered about the western sky transforming them all in turn from grey to mauve, vermilion, gold, then they resumed their natural colour as the sun passed from them and went further on its westward journey.

I sat down close to the pond beside an old turf bank and between two tall clumps of rush, turned up the collar of my coat, cocked the gun and propped it up between my knees, buried my hands between my legs and waited. I waited there for about twenty minutes then suddenly a big white owl came swooping over the bank, twittering as he came. He made a few short circuits over the field and over the pond, then came back quite close to me and landed on an old straining post on the bank not more than ten feet from my shoulder. I turned my head very gently in order to observe him. He took a good look around from his perch, let out a terrifying screech—" tu-wit tu-wit tu-woo-o-o "—and almost immediately swooped down about ten yards from me and returned to the straining post with a squeaking mouse in his claws. The squeaking was soon over and I could hear him clapping his beak with apparent enjoyment. The first capture disposed of, he repeated the performance ; a short detour of the pond and field, flying low over the ground and twittering as he went, back to his perch, a screech, then a swoop. Again he returned to his perch with something in his claws, although by now it had grown too dusk for me to see clearly below the skyline, but I saw him bring several meals to the old straining post to consume, even though I could not see exactly what his prey was on each occasion.

Whilst I sat there watching the owl at his hunting I came to the following conclusions :—

1. Owls take their prey by first flying low over the ground, twittering as they go. This has the same effect on their quarry as a hawk has on game (it crouches down until it thinks the danger has passed). Then from some point of vantage the owls screech, therefore startling their quarry again, and swoop on it.

2. Owls like a perch from which they can get a good view and upon which they can consume their prey, especially if these perches are near banks or hedgerows.

3. We could encourage owls to our nurseries or other places where mice or even young rabbits are a pest, by driving stakes into the ground irregularly over the area. The stakes should be about six feet above ground and should be about three inches diameter on top.

4. Beetles and moths are also included in the owl's diet and since these, too, are night prowlers the owl is the bird to deal with them most effectively.

Dusk faded into darkness ; a big bright star twinkled in the east. No ducks came, so I gladly stretched my cramped limbs and bade my friend the owl, " Good hunting and . . . . Goodnight ! "

STRATIFICATION OF SEED OF DOUGLAS FIR, PINUS CONTORTA AND BIRCH.

(*Silvicultural Circular No.* 18 *issued November,* 1938.)

General.

Experiments carried out at Kennington Nursery on the treatment of stored seed have demonstrated that, for certain species, stratification in sand in an open pit for relatively short periods previous to sowing stimulates germination and increases the production of usable seedlings. The treatment has been particularly beneficial with old seed. On the other hand, many species germinate satisfactorily after dry storage, and, in these cases, it has been found that stratification has no marked beneficial effect and may even prove detrimental.

The species which so far have been found to respond to stratification are old seed of Douglas fir and *Pinus contorta,* and fresh seed of birch. The results obtained are as follows.

Experimental Data.

Douglas fir.—In all experiments of this species, one seed lot only was used, from seed year 1930, the identification number being 31/29 and the origin Lower Fraser River Valley, British Columbia, altitude 200-400 ft. Seed was stored throughout in airtight containers.

	Production of usable 1-yr. Seedlings per lb. of Seed.		
	Grade 1.	*Grade* 2.	*Total.*
1933 *Experiment—with seed 2 years old.*			
A. Seed stored dry and sown 3rd April ..	1,600	2,200	3,800
B. Seed stratified in sand 30th Jan., sown 3rd April	13,100	8,900	22,000
Improvement due to stratification ..	720%	300%	480%
1934 *Experiment—with seed* 3 *years old.*			
A. Seed stored dry and sown 12th April ..	360	990	1,350
B. Seed stratified in sand 30th Jan., sown 12th April	8,800	12,200	21,000
Improvement due to stratification ..	2,300%	1,100%	1,400%
1935 *Experiment—with seed* 4 *years old.*			
A. Seed stored dry and sown 27th March	1,100	3,600	4,700
B. Seed stratified in sand 30th Jan., sown 27th March	2,300	6,100	8,400
C. Seed stratified in sand 28th Feb., sown 27th March	1,500	6,500	8,000
Improvement due to stratification on 30th Jan.	109%	70%	80%

Pinus contorta.—In both experiments of this species, old seed from seed year 1933 was employed ; the identification number was 34/40 and

the origin U.S.A. Olympic Peninsula, altitude 300-500 ft. Seed was stored throughout in airtight containers.

	Production of usable 1-yr. Seedlings per lb. of Seed.		
	Grade 1.	*Grade 2.*	*Total.*
1936 *Experiment—with seed 2 years old.*			
A. Seed stored dry and sown 7th April ..	5,200	3,600	8,800
B. Seed stratified in sand 1st Feb., sown 7th April	19,700	15,500	35,200
C. Seed stratified in sand 28th Feb., sown 7th April	13,300	12,200	25,500
Improvement due to stratification on 1st Feb.	280%	330%	300%
1937 *Experiment—with seed 3 years old.*			
A. Seed stored dry and sown 22nd April	9,500	17,800	27,300
B. Seed stratified in sand 30th Jan., sown 22nd April	29,400	27,100	56,500
C. Seed stratified in sand 28th Feb., sown 22nd April	30,300	28,100	58,400
Improvement due to stratification on 30th Jan.	210%	50%	110%

Birch.—For this species, fresh seed only was employed and was of local collection from the previous seed year.

	Production of usable 1-yr. Seedlings per lb. of Seed.		
	Grade 1.	*Grade 2.*	*Total.*
1932 *Experiment—with fresh seed.*			
A. Seed stored dry and sown 13th April ..	170	3,300	3,470
B. Seed stratified in sand 8th Dec., sown 13th April	500	5,000	5,500
C. Seed stratified in sand 30th Jan., sown 13th April	200	3,800	4,000
Improvement due to stratification on 8th Dec.	170%	50%	60%
1933 *Experiment—with fresh seed.*			
A. Seed stored dry and sown 3rd April ..	600	200	800
B. Seed stratified in sand 4th Feb., sown 3rd April	2,000	4,000	6,000
Improvement due to stratification ..	230%	1,900%	650%
1935 *Experiment—with fresh seed.*			
A. Seed stored dry and sown 27th March	900	3,200	4,100
B. Seed stratified in sand 19th Dec., sown 27th March	500	4,800	5,300
C. Seed stratified in sand 30th Jan., sown 27th March	700	4,800	5,500
Improvement due to stratification on 19th Dec.	—	50%	30%

Note.—The reduction in the number of Grade 1 seedlings as a result of stratification was probably due to overcrowding in the seedbed.

Other Species which respond to Stratification.

Other species which appear to benefit from stratification but which have not been thoroughly tested are: *Nothofagus procera, Nothofagus obliqua, Nothofagus dombeyi, Cedrus atlantica* and beech.

The open pit method of stratification is also recommended for the storage of seeds which often remain dormant for one year, such as *Pinus peuke, Cupressus nootkatensis, Tilia parvifolia* and *Liriodendron tulipifera* and, of course, ash. All these species have been successfully stratified at Kennington.

Species which do not respond to Stratification.

Seed of the following species has not shown any appreciable response to stratification treatment: Japanese larch, European larch and alder. On the other hand stratification has not proved harmful.

Stratification of Corsican pine has a detrimental effect on the germination of the seed. It is also not to be recommended for Scots pine, Sitka spruce or Norway spruce.

Method of Stratification.

The method employed is to prepare a pit 2 ft. in depth and to line the sides and ends with $\frac{3}{8}$-in. mouse-proof netting, suitably supported with stakes, and constructed to take a cover of the same mesh netting on a frame to keep out vermin. The bottom 6 in. of the pit should be filled with gravel to ensure an efficient drainage. A little sand should be sprinkled over the top of the gravel, and on this a piece of the small-mesh wire-netting is placed. The netting serves to separate the seed mixture from the gravel below, without interfering with the drainage.

It will be found convenient, when several smallish lots of seed are to be dealt with, to construct a long narrow pit, say about 2 ft. wide and to use boards of the same width to partition the pit off into compartments. The seed is weighed out and mixed with an equal or rather large bulk of clean sand, sufficient sand being used to ensure that the seeds are well separated from each other. The mixture of seed and sand is poured into the given compartment which can be filled to within 12 in. of the surface. A piece of wire-netting is placed on the top of the mixture and clean sand shovelled on until flush with the surface. In the case of very small lots of seed, the seed may be mixed with sand and placed in well-drained flower pots which are then submerged to a depth of 18 in. in the pit and covered over with sand. After the seed has been placed in the stratification pit further attention is unnecessary until it is removed for sowing in the spring.

The following points are considered to be important:—

(1) The pit should be constructed on a well-drained site and not subject to waterlogging at the depth at which the seed is stored.

(2) The seed should be mixed thoroughly with the sand and not laid down in layers.

(3) The pit, or partition of the pit, should be completely filled to ground level with pure sand throughout the period of stratification.

Dates recommended for Stratification.

Douglas fir: The best time for commencement of stratification appears to be about the end of January.

Pinus contorta : Any time between the latter part of January and the end of February.

Birch : In December.

Sowing.

Sowing should take place when the seed is plump and on the point of germinating ; usually this is during the first week in April. It is important that the seed should be sown immediately after removal from the stratification pit and not be allowed to dry out. The stratifying medium is sown together with the seed and the whole must be well mixed. The rate of sowing can be calculated readily, knowing the original weight of seed stratified.

A WORKER'S HOLDING THAT APPEARED.

By N. W. PERRY.

To design and build a worker's holding and find a suitable family to occupy it mean a considerable amount of work, and sometimes a deal of worry, on the part of the Commission's staff. It might therefore be worth while seeing whether there are any descendants of Ann Hicks available as they might well prove helpful.

During the last century, Ann Hicks succeeded in designing, building and occupying a " holding " on land belonging to the " Officers of Her Majesty's Woods, Forests, Parks and Chases " without the said officers' knowledge, although apparently with their permission.

It is perhaps a slight exaggeration to call Ann Hicks a " forest worker," because she sat in one of the parks and sold apples, gingerbread, biscuits, sweets and ginger-beer to the children and others who passed by. Each day the old woman would bring her trestle-table and set it up with a big umbrella over it, and nobody really questioned her right to " work " there so she began to plan how she might dig herself in and become a fixture.

Her first move was to petition the Office of Woods and Forests to be permitted to have a " wooden locker " to lock her goods in for the night. Although it was quite out of order, Ann Hicks got her wooden locker, and it was a pretty spacious one.

It then appears that " after a discreet interval of time she sent in her next petition, asking that she might have a " brick enclosure," which would be safer. Persistence again won the day, and her brick enclosure in due course appeared, well built, considerably bigger than the original wooden locker, with a door and a window, and in fact not unlike a miniature cottage. Time passed and then another petition went up stating that her " locker " was not large enough, and asking permission to make it bigger, so that she might have " room to store her ginger-beer bottles!" This might have alarmed the authorities, for ginger-beer bottles are not so tall that they require much head-room, but her petition was granted, with the condition that it was " not to be more than five feet." So its walls were heightened to five feet, which gave sufficient head-room not only for ginger-beer bottles but for herself.

After some months petition No. 4 appeared, informing the Office of Woods and Forests that the roof leaked and asking permission to have it repaired. This was granted, and the roof was repaired, but, in the process of repairing, it mysteriously sprouted a chimney, and inside the " locker " developed a well-built fireplace, on which she was able to cook, and so add hot dishes to her original menu of ginger-beer and apples and ginger-bread!

Petition No. 5 was to the effect that boys annoyed her by peeping in at her window: might she, therefore, be permitted to put up a

fence of hurdles to keep them away? All trustingly the Office of Woods and Forests granted her petition—they had got into the habit by this time—and her fence appeared. It was movable, and it soon began to move. It gradually took in more and more until behold the persevering Ann Hicks with a well-built little cottage and a tea-garden planted solidly in the middle of a royal park."

The trouble started when the land on which Ann Hicks had settled was required for some special purpose. She stoutly refused to budge. Such a protest did she make that it is said the matter was brought up in Parliament before she was finally made to go.

With a little encouragement, however, surely many other like-minded people would be only too willing to erect houses on suitable Commission land and so increase the F.W.H. statistics !

UTILISATION OF THINNINGS.

By B. GALE.

The disposal of poles cut in thinnings presents a problem which can be solved in some measure by the aid of a small sawmill. It need not be an elaborate outfit. A simple bench with fence, stout enough to be accurate, with 12-in., 18-in. and 24-in. saws, is sufficient to start with. The addition of an improvised travelling carriage mounted on trestles is a help in dealing with heavier poles.

The power unit, if petrol or paraffin, should not be too weak, as if the load is sufficient materially to decrease the correct number of revolutions per minute, the engine is not developing anything like its rated horse power and unless pressure is eased it will ultimately stop. A 10-h.p. petrol engine at present in use will drive a 24-in. saw through hard timber, and this is about its limit. A steam engine rated at 7 h.p. would drive a 48-in. saw and two smaller saws in addition. A car or lorry if geared from the transmission or driving wheel, has an advantage over stationary engines in possessing gears which can be engaged according to the work in progress.

With even a small plant the following can be made:—

Larch posts.—Gate heads and rails. Short lengths can be sawn down the centre or quartered and pointed for fencing stobs.

Scots pine.—Poles sawn through the centre make good fence or gate rails. Short lengths treated in the same way make palings.

Sitka spruce.—The best for rails and palings, being lighter than Scots pine and almost as tough as larch.

The sawing of softwood poles improves their lasting qualities as creosote takes readily on the cut surface. Waste ends, bends and dead poles can be sawn into logs which are often saleable when there is no demand for cordwood.

A fence-making machine is a profitable investment enabling poles down to 1½ in. diameter to be made into a substitute for chestnut pale fencing. As it is hardly possible to cleave small poles they have to be sawn. The machines are simple to operate and their possibilities are endless, for in addition to fencing, such things as seedbed protection, crates for packing, rabbit-proof tree guards, and gates can be made from material which would otherwise be waste. It should be borne in mind that the element of danger in sawing small poles can be as great as in converting heavy timber, and speeding up should be secondary to the acquisition of skill.

Detailed costings have not been kept and with so many small sales a precise analysis would be very difficult. It is clear, however, that the work pays and that without a sawmill the disposal of all the produce would not be possible as is the case at present. The plantations, although in a poor state when taken over twenty years ago, are self-supporting both as regards supervision and planting

costs. The figures given below represent work done at the sawmill and timed by myself in order to keep a check on income and expenditure.

Converting pine poles 8 to 9 ft. long by 3 in. diameter into rails by sawing through the centre, costs about 1*s.* per 100 rails, excluding trimming and carting to the mill. Selling for 25*s.* per 100, gives a return of 50*s.* per 100 poles, which would be unsaleable in the round and therefore without value. In addition these would have had to be barked against beetle at considerable expense.

The cost of sawing Sitka spruce might be slightly higher, especially if it is at all green, when the fibres drag and jam the saw. Returns are similar to those for pine, except in the case of selected poles which are seasoned and sawn down for ladder poles and command a high price. Larch often binds on the saw, and has to be withdrawn a few times until a wedge can be inserted, thereby increasing the cost of sawing; but the value of the sawn material is double that of pine or spruce. The cost of converting Sitka spruce poles 1½ in. to 2½ in. diameter (which are normally unsaleable) into three wired fencing poles 4 ft. high, 2½ in. apart, is as follows:—

Cross-cutting, stripping, sawing and pointing: 1*s.* 7½*d.* per 100 poles.

Cost of making 10 yds. of fencing: 1*s.* 3*d.*

Total cost excluding wire and value of poles is 3*s.* per 10 yds.

This sells at 12*s.* 6*d.* for 10 yds.

Cost of firewood logs depends largely on cartage to the mill and would therefore vary in every forest. The main advantage is that the number of car owners who will collect a few bushels or cwt. of logs is unlimited, while few people will go to the trouble of buying cordwood, arranging and paying for cartage and cross-cutting.

CEIRIOG EXPERIMENTAL AREA.

By F. C. Best.

This area of some 35 plots was planted in the Denbighshire hills by Mr. Fraser Story in 1907. Bulletin No. 12 contains a detailed account of the plots as measured in 1929. Unfortunately the latest measurements available to me were taken in 1933, but in the four years' interval some interesting developments took place as shown below:—

Order of Height.		*Order of Ht. Increment*
1929	1933	1929–1933
J.L.	1. *A. grandis*	1. *A. nobilis*
D.F.	2. D.F.	2. D.F. (Fraser)
S.S.	3. J.L.	3. *A. grandis*
A. grandis	4. *L. americana*	4. *P. omorica*
E.L.	5. S.S.	5. *L. americana*
L. americana	6. D.F. (Fraser)	6. *Thuya*
C.P.	7. E.L.	7. *L. occidentalis*
Ash	8. N.S.	7. D.F.
S.P.	9. Syc.	9. N.S.
N.S.	10. Ash	9. S.S.
Syc.	11. S.P.	9. Be.
Be.	12. C.P.	9. J.L.
D.F. (Fraser)	13. Be.	9. Syc.
Oak	14. *Thuya*	14. S.P.
Thuya	15. *P. omorica*	15. E.L.
L. cypress	16. Oak	15. Ash
D.F. (blue)	17. L. cypress	17. Oak
A. concolor	18. D.F. (blue)	18. C.P.
P. omorica	19. *A. concolor*	19. L. cypress
L. sibirica	20. *L. sibirica*	

A. nobilis and *L. occidentalis* are several years younger than the other species and so are not included in the order of height growth. The less common species are represented only in small groups now well sheltered by the adjoining plots so the complete lack of exposure has to some extent accounted for their rapid height increment in recent years.

The following remarks apply to autumn, 1938, just nine years later than the data contained in Bulletin No. 12.

European larch is growing more slowly now and is not satisfactory in the exposed plots where growth is slow and form bad.

Nearly all the larch in the larch-Douglas fir mixtures have been suppressed by Douglas fir. In the larch-Scots pine mixture the latter have managed to hold their own in exposed places, but elsewhere the larch have dominated them. Norway spruce were left

behind in early years and only in the wide-spaced and heavily-thinned mixed plots have they been able to push through, but now they are beginning to take the lead. European larch cannot be considered a very satisfactory crop but the tendency seems to be towards improvement.

Japanese larch continues to look well and is much superior to European. During early years Japanese larch quickly suppressed all other species mixed with it and turned the plots into pure plantations. In adjacent plots *Abies grandis* and Douglas fir have already overtaken Japanese larch, and Sitka spruce is likely to do so before long as height growth is falling off rather quickly.

Of the other larches *L. americana,* represented only in one small group, is very little behind J.L. If this tree is capable of growing on poorer and wetter soils than Japanese larch it is certainly worth further trials. *L. occidentalis* has made great progress after a bad start and now appears to be drawing up to European larch, but early failures have left an uneven crop from which reliable conclusions cannot well be drawn. The small group of Siberian larch has gone from bad to worse as was anticipated.

Neither the Scots nor the Corsican pine is satisfactory at this high elevation, but Scots has grown quite fast. It is surprising that Corsican is no taller than Scots, but the form is better.

The spruces are particularly interesting as the four species are all looking very well but show a remarkable dissimilarity in height growth.

In 50 per cent. mixture with Norway spruce, Sitka spruce has now formed an almost pure crop. According to the latest figures growth is now falling off, but this plot is on the exposed side of the plantation and certainly appears to be developing nicely. Mixed with Douglas fir most of the Sitka were suppressed early, but the surviving trees are now only a little behind the Douglas in height and they are vastly superior in form.

Norway spruce is well represented and is now one of the most promising trees. Its early suppression by European larch is a normal occurrence, but the mixture has been maintained in the wide-spaced plot by careful thinning. The best results are to be seen in pure plots where growth is now rapid and canopy even. Form is quite good but not so clean as in the case of Sitka.

Picea omorica is planted in one group only where it has made good recent growth and, although still some way behind Norway spruce, looks very well indeed. The stems are clean-growing and short-branched. The tree is decorative and justifies further trials under poorer conditions. *Picea morinda* started extremely slowly but is now growing steadily, although at a slow rate. The very healthy appearance encourages the hope that it might tolerate very much more adverse conditions.

Oregon Douglas fir has just about overtaken Japanese larch and has shown remarkably good growth considering the elevation and

early chermes attack. The form is very rough and the leaders wind-blasted, and it is doubtful if long, reasonably clean timber will be obtained. Tapering and coarse-branched habit are characteristic of Douglas fir on exposed sites. Two plots of the Douglas have been seriously damaged by wind and snow although the other species have hardly been affected.

The group of Fraser River Douglas is very small but encouraging, and the absence of chermes has enabled it nearly to catch up with the Oregon variety. The blue Colorado Douglas fir of which little was expected, has gone off badly and looks as though it will never come to anything.

Thuya plicata appears free from disease and has come on well since 1929, with good, even growth and nice form. Unfortunately the windfall in the adjoining Douglas fir plot is now extending to the *Thuya*. Lawson's cypress has dropped behind the *Thuya* in recent years. Many double leaders from ground level have now been removed and the crop is improving.

Four species of silver fir have been planted but the common *pectinata* was a failure from the start and the few remaining trees are now about the same height as the Norway spruce.

Abies concolor has gone off badly in recent years and suffered severely from snow. The trees look unhealthy and are making little growth. Remarkable progress has been made by *Abies nobilis* which, nine years ago, was behind the *concolor*, but is now growing fast and looking excellent although current height growth is not so fast as the 1933 measurement suggests. The group has been very uneven but, with the formation of canopy, is levelling up.

Abies grandis is the most striking tree in the plantation and is already as tall as any and has continued rapid height growth. The form is good and the leaders show little sign of wind-blast in marked contrast to Douglas fir.

Conclusions.—The area is typical of the land we should class as Japanese larch ground in North Wales, and it is clear that this is the best species for quick and excellent results with low establishment costs. The even and vigorous growth of Douglas fir is satisfactory, but it is doubtful whether cheap planting methods would not lead to difficulties in establishment and subsequently increased windfall. European larch is so much less vigorous than Japanese that its use is not economic, and the pines are likely to be even less profitable. Both Norway and Sitka spruces promise, on long rotation, to produce good yields of well-grown timber; but it may be that, of all the species tried, *Abies grandis* will give the highest volume of clean, large timber.

The production of hardwood timber is clearly possible with the aid of conifer shelter belts, but is probably not a practicable proposition in large-scale afforestation at any rate in the first rotation at such elevations (over 1,000 ft.).

The growth of *Thuya, Abies nobilis* and Fraser River Douglas fir certainly justifies the use of these species in North Wales and *Picea omorica* might well receive more attention. The two larch species *L. occidentalis* and *L. americana* would be interesting to try out on a larger scale.

General Remarks.—In an experiment of this kind it is exceedingly difficult to arrive at a correct comparison between species owing to imperceptible variations in soil and exposure. The plantation has, however, been laid out with a sufficient amount of European larch to act as control species for comparison.

Quick-starting species (mainly Japanese larch) have been so placed that they have provided shelter for plots of slow starters. The small groups in particular have benefited to such an extent that a general levelling up in height growth is gradually taking place.

The whole area is being carefully looked after by Mr. Thomas Thomson, and the plots are regularly thinned. All plots and most of the groups have been brashed. Height-growth figures are being taken every five years.

Felled plots have been planted with *Tsuga heterophylla, Pinus insignis, Abies grandis,* Lawson's cypress, *Pinus contorta* and European larch from Tyrol, Poland, Silesia and the Western Alps.

JAPANESE LARCH AS A FIRE-BREAK.

Following what was seen at Gwydyr of the protective value of Japanese larch, the Chairman suggested that the matter should be further investigated. The following notes are the result.

Memorandum from A.C. (Scotland) 27.5.38.

Notes have now been received from Divisional Officers on their experiences in the use of Japanese larch as a fire-break. These indicate that all who have had experience of the effects of Japanese larch in checking fires are in favour of using it.

In the Northern Division Japanese larch has been used for several years to form fire-breaks. The practice started with Mr. Oliver and was based on experience at Culloden.

Divisional Officer (North) reports on this as follows:—" The idea of using Japanese larch as a fire-break occurred to Mr. Oliver and Mr. Peter Stewart before I came to this Division, and Mr. Oliver has already laid down a number of belts of Japanese larch close spaced on margins from which fire is likely to spread. The belts have not been tested by fire in the places where they have had time to smother out the soil vegetation. Japanese larch seems to smother out all the undergrowth almost completely in a ten-year period and at that age forms an effective fire-break."

Mr. Oliver reports in connection with Culloden:—" At Culloden Japanese larch was planted as a fire-belt, partly in mixture with beech, in P. 25. When about 10 ft. high the trees were badly scorched and lost all their needles from a grass fire entering from the railway, and were thought to be dead. These trees recovered almost completely. The same thing happened in exactly the same situation on at least one other occasion, so that this plot of Japanese larch was claimed for and paid for by the railway company more than once. The trees, when I last saw them, were in good health and were vigorous.

My opinion is that in planting Japanese larch in a fire-break, the spacing adopted should be a very close one, *i.e.* 3 ft.; by so doing, a canopy is formed perhaps more quickly than with any other coniferous species, and grass and the less persistent types of undergrowth are quickly subdued. The slow-growing type of fire-break, such as beech, is somewhat useless as the plantation is probably safe from damage by the time the beech has grown enough to provide protection."

Divisional Officer (East) reports as follows:—" Recently while visiting an experiment which I laid down in 1915 on the Scone estate I found that the Japanese larch plantation in which it was situated had suffered from a fire some five or six years ago. The Forester informed me that, but for the presence of patches of gorse and broom, the damage would have been negligible and the fire would have been

easily stopped. As it was, the damage was not very serious and only in the patches referred to did actual death occur.

"There is no doubt that Japanese larch has an excellent suppressing effect upon ground vegetation and this in itself must greatly reduce the progress of a fire. The so-called hybrid variety has an even greater effect in this way."

I have no doubt that Japanese larch can be used successfully on suitable sites as a fire-break and I agree with Divisional Officer (East) that the hybrid larch is even better. I consider, also, that spacing closer than normal will be advantageous. The closeness of spacing should vary with the quality of the soil.

It would seem that any fast-growing tree that will kill down the vegetation and not retard the natural decay of that vegetation would be suitable for fire-breaks. Japanese larch is less particular as to soil conditions than some other species and this is to its advantage. But where the soil is suitable variation might be made.

Memorandum from A.C. (England and Wales) 27.5.38.

Notes have now been received from Divisional Officers on their experiences in the use of Japanese larch as a fire-break. These indicate that the two who have had experience of the effects of Japanese larch in checking fires are in favour of using it.

In the N.E. (E.) Division the District Officer (Mr. Fossey) reports concerning a fire of 26 acres (P. 22) :—"It is interesting to observe that the fire stopped dead along the edge of the Japanese larch to the west under which all heather had been killed out and the outside branches are nearly all still living." He also states that "the Japanese larch was 14 years planted, the canopy averaging 20-22 ft. high. It was not brashed. There was no undergrowth or ground vegetation left, all pre-existing heather, and a small amount of gorse being smothered out;" also "it appears that whether a plantation is brashed or not is not significant. Japanese larch has the advantage over European larch because in almost any given conditions it forms a much earlier canopy and, being less exacting, it will grow in conditions where European larch will not grow. Also its canopy is normally taller as well as more dense."

In the N. (W.) Division the District Officer (Mr. Best) reported in connection with the Gwydyr fire of 11.5.38, as follows :—"The southern point of the Japanese larch is on thin, exposed soil and the trees are 5 to 15 ft. and very gappy ; the gorse-heather vegetation and the condition of the crop are similar to the adjoining P. 21 Norway spruce. The fire roared over the Norway spruce, the cut ride and the Japanese larch. The fire burnt through the larch which was unbrashed at the south end and recently brashed farther along but it burnt more slowly than in the Norway spruce. In the brashed Japanese larch the fire was on the ground only and was easily beaten out. The Japanese larch were 25 ft. high and canopy

complete, but were killed by the ground fire. Vegetation is thin bracken, brambles, ivy and grass."

"In C. 34 the fire travelled for the most part slowly and tended to leave unburnt, or partly burnt, groups of spruce. The adjoining Pen y Parc (spruce?) are 30 ft. high and canopy complete, brashing has been done and vegetation is thin grass. Fire was left to burn itself out and stopped dead on the Japanese larch over a distance of about 100 yds. without even causing a ground fire."

"Planting of Japanese larch belts on ride sides may be very helpful but only on suitable ground."

In District Area S.W. (E.) Mr. Broadwood reports: "I have had two fires in Japanese larch plantations:—Brendon, 27.8.37, Japanese larch 18-36 in. in height; the stage of development of the Japanese larch had made no effect on the vegetation and the fire travelled somewhat quicker through the Japanese larch area than in an adjoining Corsican pine area of the same age. Wilsey Down, 6.3.38; this area was in bad check and no different reaction to fire was noted. There was however about 1 sq. chain of Japanese larch, 10-16 ft., with a vegetation of molinia, not brashed, through which the fire travelled. Trees up to 10 ft. have been killed out, while some trees have produced needles above this height."

In New Forest the Deputy Surveyor states that he has had difficulty in getting evidence. Regarding Japanese larch he says "as to its resistance to damage by scorchings of the bark I can find no satisfactory evidence. The most recent fire was in Rhinefield Sandys in an area we had recently thinned and there was a good deal of brash lying about. Some of the trees were badly scorched and some died, but the fire in this case though it never actually entered the earth was a ground fire in the sense that it burnt the brash on the ground and I think this affected the shallow roots of the trees. This is a factor which has to be taken into account."

On the 20th May last the Divisional Officers were circularised as follows:—"Cases have recently been observed in which serious fires have stopped (or have been readily stopped) on reaching Japanese larch in the thicket stage. It will be advisable to bear this in mind, particularly in extensive spruce areas and where conditions are suitable, to plant a few rows of this species along compartment boundaries and fire traces."

COMMISSION'S LIBRARY: NEW BOOKS.

The following books were acquired during the past year:—

"The Training of a Forester" (pp. 129), Gifford Pinchot.
"The Scenery of England" (pp. 144), Vaughan Cornish.
"A Dictionary of Wood" (pp. 205), E. H. B. Boulton.
"The Observer's Book of Trees and Shrubs of the British Isles" (pp. 240), W. J. Stokoe.
"The Observer's Book of British Wild Flowers" (pp. 224), W. J. Stokoe.
"The Observer's Book of British Birds" (pp. 222), S. Vere Benson.
"Timber Products and Industries" (pp. 316), Nelson Courtlandt Brown.
"German Forestry" (pp. 342), Franz Heske.
"Forest Pathology" (pp. 600), John Shaw Boyce.
The First and Second Reports of the Commissioners of His Majesty's Woods, Forests and Land Revenues, 1812 and 1816 (pp. 312).
"Plant Growth Substances" (pp. 108), Hugh Nicol.
"Mother Earth" (pp. 202), G. W. Robinson.
"History of British Forest Trees" (pp. 540), Prideaux J. Selby.
"British Butterflies and Moths" (pp. 468), W. Egmont Kirby.
"An Introduction to Botany" (pp. 615), J. H. Priestley and Lorna J. Scott.
"Forestry and State Control" (pp. 87), R. S. Troup.
"The Climate of the British Isles" (pp. 347), E. G. Bilham.
"The Principles of Soil Science" (pp. 362), Alexius A. J. de Sigmond.
"Silva, or a Discourse on Forest Trees and the Propagation of Timber" (pp. 811), John Evelyn (3rd Edn., 1801).
"Animal Life in Scotland" (pp. 550), James Ritchie.
"An Introduction to American Forestry" (pp. 402), Shirley Walter Allen.
"Forest Insects" (pp. 463), Doane, Van Dyke, Chamberlin and Burke.
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THE RAISING OF POPLARS.

By D. F. Stileman.

In the past, considerable difficulty has been experienced in getting black Italian poplars established on heavy clay soil in Northamptonshire. Fairly extensive areas in old woodland at Westhay, in the Rockingham Forest have been planted with black Italian poplar from P.23 to P.31. The method has been to notch-plant rather spindly 1-yr. or 2-yr. rooted cuttings, taken from very closely lined-out nursery cuttings. Generally speaking, the plants have remained in check for 6 years before any appreciable growth has been made.

At Yardley Chase in P.32, under similar conditions to those mentioned above, various methods of planting were adopted as an experiment ; 1-yr. and 2-yr. rooted cuttings were (1) notched, (2) pitted and (3) planted on mounds.

There appears to be very little difference in growth between the various methods. The leaves of the plants present a typically checked appearance, remaining small, and no appreciable shoot growth has so far been made.

An experiment was made in P.35 at Yardley Chase of using unrooted cuttings. The cuttings, 18 in. long, were taken from 1- and 2-yr. stool shoots, soaked in water for one week and then 4 cuttings were inserted, in March, in mounds 2 ft. × 2 ft. × 2 ft., leaving 1 in. above the ground level. Twenty acres were treated in this way. At the end of P.35, shoots varying from 6 in. to 1 ft. resulted on all except three mounds. Losses of approximately 15 per cent. have since occurred, due to damage by voles and fallow deer. The shoots now average 2 ft. 6 in. to 3 ft. The advantage of this method is that nursery treatment is eliminated and there is no disturbance of the root system. Weeding is, however, necessary for the first two years, but this is not an expensive item, being 5*s*. to 6*s*. per acre per annum. It is too early yet to compare this method of culture with other methods.

In P.38 an experiment was tried with 2-yr. sets 6 ft. 10 in. taken from healthy stool shoots (in old woodland areas on heavy clay soils) at Hazelborough, Salcey and Fineshade. After the sets were cut in March, they were soaked for two to three weeks in water and then planted in the following manner :—All the side branches were pruned to within 3 in. of the stem ; the end of the set was split up for 6 in. and a small wedge inserted to keep the split open and encourage the sap to run up. Two spits of earth were removed and a hole was made with a crow bar as deeply as possible. The set was then inserted in the hole 2 to 3 ft. in the ground and the spits replaced.

There was a prolonged drought after planting (in April) followed by a comparatively dry summer but, in spite of this, results have been uniformly good, with losses not exceeding 2 per cent. on all

areas. The plants have a healthy appearance and in some cases have put on a shoot of 1 ft. If subsequent growth proves to be satisfactory, there is much to be said in favour of this method of raising poplar. Nursery culture is eliminated, planting is cheap, weeding is obviated and plants remain very firm and do not become loose in the ground.

It would probably be more beneficial to plant at the latest in February in order to get the advantage of a long growing season.

BEECH AFFORESTATION ON CHALK DOWNLAND AT FRISTON.

By T. H. Aston.

Friston Forest is composed of bare grass downland chiefly, with large and small areas of gorse and thorns—affording little shelter ; the climate is dry (average annual rainfall 32 in.), the soil is shallow over an unlimited depth of chalk and subjected to salt spray. Unfortunately the rainfall is mainly in the non-growing season and the salty winds are more or less usual. Friston is therefore not an "ideal" place for the growing of beech. When this fact is fully realised the worst is over.

It remains to make the best of things as they are ; there are now twelve years' plantations in proof of the statement that "given good treatment, suitable plants and normal fortune," beech will not only establish itself but do reasonably well.

A discussion of the following four main factors should materially help the main object, *i.e.* beech afforestation on chalk downland, especially if others criticise these views and have something better to offer.

(1) In our early days the planting method was by Schlich spade notching which, in a flinty soil, is no good to the root. In P.31 planting by use of a garden fork was standardised. In P.32 variations in the amount of soil disturbance were tried ; these are now becoming an object lesson and have led to further experiments.

(2) Another factor of great importance in the early days was the supply of unsatisfactory plants ; generally they were poor both as regards grade and condition.

(3) The lack of shelter (nurses) has been a great problem ; the need was obvious and several species have been tried, *viz.* S.P., C.P., alders, etc., and the results are extremely varied.

(4) Finally, weeding has been an important factor both in the establishment and care of the plantations.

To deal with these four factors in detail :

(i) *Planting Methods.*—(*a*) Schlich spade notching has many points to recommend it for the cheap and easy planting of the better, looser and less stony soils, but at Friston we had to realise that first cost is not the main point ; our soil is very flinty and dry, which may mean bruised roots leading possibly to death. This lesson has been accentuated for us in that plants introduced 3 to 8 years later in beating-up are already taking the lead.

(*b*) Garden spade cannot be used because of the flints ; a small "graft" might be usable, but not at piece-rates.

(*c*) Mattock notching has been tried only on one occasion; our grass is generally too thick and the combination of a flinty soil renders it unworkable.

(*d*) Garden fork, suggested in order to obtain greater soil disturbance, was tried out first in P.30, and being found very workable and sound in practice has been retained for general use. Whichever method of disturbance is used in soil preparation, it is considered that the fork is the best planting tool.

Our method in unworked soil, following screefing, is to insert the fork vertically across the centre of the screef to a depth of 3 to 5 in., wrench sharply towards the planter, remove, and re-insert as deeply as possible in the near side of the screef at an angle of 45° from the vertical, and raise. Usually this gives a nicely broken patch which, by lowering the handle, allows of the whole root being well inserted under the tines which hold up the broken soil. Then raise the handle of the fork, meanwhile pulling up the tree to original nursery level, and firm.

(*e*) Single-furrow ploughing, as an alternative to mattock screefing, and again combined with subsoiling, have been tried together with full ploughing.

Plain single-furrow ploughing has not materially helped us; its weed-controlling effect is greater than screefing. In damp seasons it might save a weeding but in our normal droughts it tends to be harmful. On a definitely heavy soil its water-collecting effect combined with freezing is apt to cause the lifting of plants. Single-furrow ploughing with subsoiling, tried first in P.32, was unfortunately done just prior to planting and the soil being a "heavy" one the result was a lack of weathering, air pockets being left beneath the roots so that the plants suffered check or death. Tried again in P.38 on a large scale on a variety of soils, the result appears encouraging in spite of the long drought, local rainfall up to September 1938, being 10 in. below the annual average, but it is too early to assess results as yet.

Full ploughing was tried in P.33 in September and October. The soil was mainly a heavy one, the turf was ploughed in and no rolling or harrowing was done. There was no apparent weathering so the plants could not be firmed. The ground was a mass of air pockets, and the result could not be other than a heavy failure, 18 per cent. on the lighter and up to 60 per cent. on the heavier ground. It is probable that the P.38 sample, ploughed, subsoiled and planted with the garden fork will prove to be a strong contrast.

(ii) *Plant Supply.*—In the early days the right type of plant was difficult to obtain. This is not now the case. It is possible to specify requirements by both age and size and usually to get them; this is extremely helpful as "size at age" is a fair indication of the vigour of the stock.

The following plant descriptions indicate general experience :—

(*a*) 1 + 0. Best quality seedlings only should be used, *viz.* 9 to 12 in. Large-scale trials of beech seedlings have demonstrated the value of the good, and the futility of using the low-grade, seedlings on certain of the higher and less densely grass-covered areas. Such plantations, where good, will have cost a very low figure for establishment.

(*b*) 1 + 1. This is not usually a good plant, its root fibre is generally little in quantity and poor in quality, and naturally it appears to feel its nursery treatment too much to become quickly established.

(*c*) 1 + 2. If stocky and well-rooted, is the best adapted to our shallow, flinty soil conditions ; experience has shown that much depends on the vigour of the seedling used for lining-out.

(*d*) 2 + 0. This plant has not commended itself to us. Too much root is lost in raising and planting and the result has been check ; this is not surprising as this plant is always large. The cause of failure is due to the disturbance of the ratio of " root-as-to-shoot."

(*e*) 2 + 1. This usually has shoot height without root fibre.

(*f*) 2 + 2. Generally a larger plant than 1 + 2, therefore better on deeper soils and in denser vegetation, but under our normal conditions is at a disadvantage as compared with 1 + 2.

(iii) *The Introduction of Shelter—Nurse Crops.*—After soil disturbance, this is Friston's greatest need. Many attempts have been made both on a large and small scale. Nurse crops tried include rye, sea buckthorn, elder cuttings and Spanish broom. Rye was devoured by pigeons. Sea buckthorn germinated but disappeared very early—probably eaten by the omnipresent and omniverous snail. Elder cuttings did not take kindly to transplanting, seedlings might have done but were not tried. Spanish broom is too slow in growth, probably its only fault, for plants, even 1-yr. beech seedlings, will grow in belts of it unweeded but unsuppressed. It is not considered that any density of sowing between 5 and 10 lb. per acre, or possibly up to 12 lb., would prove too dense. Of trees, *Alnus incana, Alnus oregona, Alnus cordata* and Scots pine have been tried as well as broom and gorse. The alders have only established themselves readily where beech would grow un-nursed ; *A. oregona* and *A. cordata* are not suitable at Friston. Scots pine has, wherever planted, grown well to date. An inspection of stems showed uniformly good first year's growth and good annual increment since (8 years). A good nursing size is attained from 3 years onward.

Broom sowings have been successful in places and have failed in others, due probably to lack of soil preparation, drought, snails and frost. With 1-yr. seedlings of broom success is very variable. Gorse 2-yr. seedlings have succeeded but take 4 to 5 years to attain nursing proportions. Broom and gorse cost money to control and

give no cash return ; it is therefore considered that Scots pine is, on the whole, the best proposition.

(iv) *Weeding.*—In beech plantations on grass downland it is usual to consider that screefing or single-furrow ploughing renders it unnecessary to weed during the first growing season unless the weed is abnormal. When the weed is clearly abnormal, care should be taken that it is kept in control from the start, *i.e.* it must never " draw " and render the crop too tender to be safely weeded nor must it overcome the crop.

If for any reason weeds get out of hand there are two alternatives, both dangerous—(1) to weed, risking leaf and shoot damage from cold winds or hot sun ; (2) not to weed, risking extreme drawing of crop or even smothering. Experience over eleven seasons shows that the latter alternative is the lesser risk. A dull spell of 3 to 4 days would enable the weeding to be done with comparative safety, although with our low rainfall the chance of such a spell is not great. At the worst, if a normal weeding cannot be done, it should be possible to retain the leading buds in sight and if this is done no great harm will occur. Whatever success one has during the dry, *i.e.* growing, season, it is vital to open up all plantations under weed for ripening of shoots and to allow strong and healthy terminal buds to form. From mid-August onwards is normally safe if drought continues, but with the advent of the first rains all other work is dropped and weeding completed.

In older plantations overhead light is also necessary, but here we retain all side protection, making it as thick as possible.

In the " cold-salty " gale of ten days' duration in May-June, 1938, small plants in deep screefs and larger ones in the densest south-west shelter suffered little. Whereas in normal weed, whether dense grass or scattered nurses, they received no protection whatever. The result was, in P.37 and P.38 plantations, a general failure to re-flush ; among older plants there was a re-flush but little growth. The season's growth was therefore definitely poor, whereas plants in dense shelter were practically normal in growth. In the oldest plantations it is instructive to notice the difference between those in weed (bushes, etc.) and those in the open—shelter of any kind is precious.

From inspections made of existing small areas of well-grown woodland on the east Sussex Downs, some of which are now in the early stages of the second rotation, it would appear that Friston also is capable of carrying a good crop of timber but that the process of establishment must necessarily be slow.

THE USEFUL CHIFF-CHAFF.

By J. K. Massey.

Little imagination is required to realise the prodigious benefit to foresters as well as to mankind in general, by birds devouring millions of insects, larvae, etc., and so preventing the destruction of vegetation. For instance, looking at the devastation left behind by a swarm of locusts in some countries, we are truly favoured with our insular position in Britain.

The following notes and observations on the chiff-chaff are taken from my note-book.

The nest is made of dried grasses, bents, moss and lichen, with a roof similar to the wren's, but the chiff-chaff lines its nest with feathers; it builds 2 ft. 6 in. from the ground in branches near the stem of Sitka spruce about 4 to 5 ft. in height. A nest was seen completed except for the lining of feathers. On the 16th day six eggs hatched out and very soon began the arduous task of stoking six young mouths, at intervals of no longer than four minutes.

It always interested me to know how some birds kept their homes so marvellously clean, and how one or two youngsters did not get more than their share of food. Here are the answers. The parent birds continually bring food so long as there is an open mouth to feed. During the continual stoking a youngster in front will stand up, eject a pellet of excrement on the front ledge of the nest and the parent bird, which has been standing by meanwhile, will pick it up and fly off to drop it some distance away. The youngster meanwhile will have retired to the back of the nest and one in the rear will have edged forward during the reshuffle. It is not always the case to feed the bird in front, however, as I have seen the parent reach to the back of the nest and feed a young one there. This constant stoking goes on until late in the evening. Even at a very early age the youngsters show signs of excitement and eagerly watch for the parent birds long before they alight near the nest with a beak full of grubs, etc. The parent may perch in a nearby tree for a few seconds but all heads are turned that way, without wavering, in one solid stare. On the 32nd day the young birds left their nest and flew off into the taller surrounding trees. When the brooding of the young commenced the familiar call was heard no more, only the plaintive "hoo-it," or on the approach of danger, the more rapid "hwit." It would be impossible to calculate the number of aphids, small larvae, flies, etc., collected by even one family during the continual stoking.

I may add that a pair of field glasses is essential in the observation of bird and animal life in order to note the more exact details, as it is impossible to get near enough to see these things with the

naked eye, and even if we could do this the creatures would resent our approach. Much can be accomplished, however, if one has the ability to remain perfectly still and then slowly to walk forward erect and a step at a time until within reasonable distance ; it is under such conditions that a great deal is seen of our woodland friends, and if the watcher possesses a camera to record what he sees, his pleasure is increased.

CHARCOAL.

By D. W. YOUNG.

Imports of charcoal into this country, though small when compared with certain other imports, amount to a considerable total and if the money paid for this quantity could be diverted to British woodlands, much benefit would accrue to forestry in the country. There is to be considered also the ever-present risk of war. In a national emergency, not only would present users have to turn to home producers, but there would be a greatly increased demand for charcoal for munitions and other defence purposes and the probability—in the difficult situation in which shipping would find itself—that users of internal combustion engines would have to turn to charcoal as a source of power. As at present placed, such an emergency would find the country quite unprepared.

With this matter in view experiments have been carried out in the New Forest on the manufacture of charcoal in a portable outfit known as the Dunker kiln.

The best provision for a national emergency is to have a number of kilns quietly supply the country's normal needs. By this means we should have plant and experienced workers as a nucleus organisation for sudden expansion. That is only possible if such a nucleus organisation can at least pay its way. Unfortunately the price fixed by imports and by manufacturers in large distillation factories makes that a doubtfully attainable goal. One object of the experiments has been to try to attain it.

There was a considerable demand for charcoal during the Great War but it never reached the intensity that is probable in any future emergency either in quantity or quality. The question of its use in internal combustion engines did not arise then. It was not practical politics. Charcoal was required for certain manufactures and in large quantities as a smokeless fuel for use in the trenches. That this should contain a residue of volatile carbon did not matter much. Volatile carbon in charcoal used for making producer gas for running internal combustion engines is fatal—pipes and carburettors become choked with tar-like deposits.

The demand in the Great War was met, so far as it was met in this country at all, by digging out the old charcoal burners from their retirement and giving them the assistance of other men who had no experience of this kind of work. The latter picked up some knowledge and as an improvisation the scheme worked, but though full reports as to the average quality of the charcoal produced are not available it is a matter of certainty that a large percentage of it would have been no use for producer gas.

Twenty years after the Great War most of the old burners will have died out and those who helped them will have forgotten all that they imperfectly learned. As practised by the old burners, charcoal

burning was an art. They got their results by rules of thumb which could only be picked up by long experience and practice.

The alternatives to the old hearth kilns are :—

1. Portable kilns.
2. Distillation factories.

The last named mean very heavy capital outlay and unless they are very numerous in the country they involve heavy cost in carting the bulky raw material to them.

There has been a good deal of experimentation with various designs of portable kilns since the War. They cannot be said to have reached finality but the Dunker kiln can be fairly described as one of the most suitable.

The requirements of such a kiln are, broadly, four-fold, *viz.* that it should be :—

1. Reasonably portable.
2. Effective in producing perfect carbonisation.
3. Foolproof in inexperienced hands.
4. Economical to run.

So far as the writer is aware no design yet has met these requirements in their entirety. It is doubtful whether any design ever will. At best we can only expect close approximation to them.

Before describing the Dunker kiln it is, perhaps, as well to go into the principles on which all portable kilns must work.

The funny, hoary old charcoal burners made a great mystery of their craft. There was a good deal of charlatanism in their make-up, but it was not all charlatanism. Post-war study has revealed that there were real scientific principles behind it all. Intuitively they had got hold of something which was handed down from father to son without understanding its scientific import. One cannot let these old fellows shuffle from the country scene without a word of regret. They were picturesque characters, rogues though many might have been. No doubt many of them were first-class poachers, but they knew the woods as few foresters ever will. Shunning their fellow men except when money in their pockets offered satisfaction to the demand for alcohol, they were friends with all the furtive creatures which we seldom see in our forests. They knew their ways and studied them with a real affection and only when the stockpot needed replenishing put their knowledge to good use to supply a meal. Out and about at all times they knew the weather signs and like the wild creatures they lived with, knew how to make themselves comfortable under impossible conditions.

The structure of the old turf kiln is too well known to need description here. It was, however, by no means the most primitive instrument of charcoal manufacture. The charcoal pit preceded it. For this a pit 2 or 3 ft. deep was dug. Light brushwood and furze were thrown into the bottom and lighted. Logs of increasing dimensions were added and when the pit was full and a glowing mass, it

was completely covered with turfs and left till cool. The trouble involved in digging a pit and having to lift the charcoal from it afterwards prompted the idea of a pit at ground level—in other words a bonfire—which could later be covered with turf. From this a turf kiln, which could be lit after it is laid, was a natural development: natural, but unwittingly introducing a new principle.

The preparation of charcoal in the pit was a process of suppressed burning. When the wood was well alight and practically all volatile carbon had been driven off, it was covered with turf, excluding air and checking the burning process. The method produced good enough charcoal but was wasteful as more than half the fixed carbon in the wood was burned in the process. In a well-controlled turf kiln little more wood is actually burned than is supplied in the centre for kindling. The walls may cave in without being noticed and wood is burned that way, but a good burner in any but the worst conditions would not allow that.

The secret of what happens in these kilns was revealed in the study of temperatures in retorts of wood distillation factories. External heat is supplied to these, of course. No material in the kilns is actually burned. After the retort has been charged with wood the furnaces are stoked up and the temperature mounts gradually in the retorts to a critical figure between 580° F. and 600° F. and then the temperature rushes up rapidly to a figure approaching 900° F. This sudden increase obviously does not come from the furnaces and must come from the wood itself. Indeed, after that temperature is reached no further external heat is required. This sudden access of heat does not come from any burning. Any oxygen introduced when loading the wood into the retort would be consumed very early in the process. At a temperature approaching 600° F. all the cellulose in the wood breaks down to volatile substances. The process is an exothermic one like burning itself or the slaking of lime and the heat is sufficient to raise the temperature of the mass 300° F.

Precisely the same thing happens in the turf kilns and, as will be shown, in the portable kilns too, only it is a more gradual process. The kindling wood is lighted and raises the temperature of the wood in its immediate vicinity to the critical temperature. The volatile carbon in the wood is driven off, heat is evolved and the temperature of the wood adjoining is raised to the critical temperature and so on. It will be easily seen, however, that the heat derived from the exothermic action is not sufficient in itself to carry on the process. 100 lb. of wood raised to 900° F. can only raise 80 lb. to the critical temperature and that in turn can only bring 25 lb. to 600° F. There is in these kilns another source of heat. The volatile gases are combustible and into the kilns, unlike the retorts, air is admitted. The combustion of these gases coupled with the heat evolved by breaking down the cellulose is sufficient to carry on the process without burning any more wood. The amount of wood actually burned in a kiln containing a cord of wood is little more than a single cubic

foot. The hot gases absorb all the oxygen that is admitted before it can reach the wood.

The old charcoal burner knew nothing of all this, but he did know that in a wind he had to put more covering on the windward side; that if parts of the covering cracked or glowed he had to add more covering before it caved in. If it smoked too much or burned one-sidedly he had to control the air inlets, and finally, when a blue haze told of burning charcoal and the completion of the process all inlets had to be closed and further soil added to the covering of the kilns to exclude air.

All these operations and the design of the kiln were directed to two objects:—

1. Retaining the heat evolved in the processes described.

2. Admitting enough but only enough air to consume the volatile gases.

The design and operation of a portable kiln must be directed to the same ends. Charcoal users require the charcoal to be free of all volatile carbon and efficiency demands that all the fixed carbon should be preserved.

The amount of fixed carbon varies considerably from species to species and from sample to sample. A rough and ready thermo-chemical calculation gives the yield of 100 lb. of wood with 50 per cent. moisture content as 25 lb. of charcoal. The weight ratio must, however, vary with the moisture content. It is safer to base calculations on the volume. A cubic foot of wood with 10 per cent. moisture content will only give slightly more charcoal than one with 50 per cent. moisture content, the difference being the amount of wood consumed in driving off the extra moisture. Thus a kiln which will hold approximately a ton of wood with 50 per cent. moisture content ought to yield 5 cwt. of charcoal whatever the water content. Intrinsically lighter woods like spruce and pine should yield only 3½-4 cwt.

These very theoretical calculations make no allowance for practical difficulties such as loss of heat and more abstruse difficulties arising from lack of data as to the relative quantities of volatile and fixed carbon in the various woods. They give, therefore, maximum figures which will seldom be obtained in practice. Dunker kilns will hold roughly a cord of wood, rather more if carefully packed, and any yield exceeding 4 cwt. is considered very satisfactory.

As will be seen, the initial cost of the raw material is heavy. Five cords of wood are necessary for a ton of charcoal, and the cost of preparing, stacking and carting to the kiln works out at 42*s*. 6*d*.

The Dunker kiln in outward appearance is like an outsize dust-bin of the familiar galvanised type. It is made in three sections which fit in vertically one above the other; this is for portability. Each section is easily lifted by two men and can be bowled along the ground like a hoop. The whole is crowned with a conical cover

very similar to that of the dust-bin with the difference that the familiar handle is replaced by a socket for a chimney. The kiln stands about 7 ft. high to the top of its conical cover and is 5 ft. 6 in. in diameter. The bottom edges of the two top sections fit into a ring of channel iron in the one below them. This can be filled with loam or sand to make an air-tight seal. The sand is not air-tight in itself, but the volatile tars escaping through it condense there and soon make it so. The lid, when put on, is sealed with sand or loam like the other sections and soon becomes air-tight. Early patterns of this kiln had a grid at the bottom, but this is not necessary and, in any case, soon burns out.

The real secret of design in the kiln lies in the arrangement of vents and air inlets. The kiln is started from a central cone of kindling wood at the bottom of the kiln. The aim is to direct the hot air from this straight up to the domed cover, to spread out there and flow down the sides of the kiln to escape through four vents placed symmetrically round the bottom of the lowest section. This circulation of the gases is secured in three stages. First a short length of chimney pipe is fitted into the socket at the top of the domed cover. The kindling wood is lighted and left to burn until the smoke is rising straight up, showing that it is well alight. The chimney is then removed and the socket is closed. Four small vents round the base of the conical cover are opened. They are left open until smoke is pouring out in considerable volume. These four vents are then closed. The smoke is thus driven against the sides of the kilns and is cooled and drops to the lowest section which has an inner lining spaced about 2 in. from the outer wall. The smoke is led through this space to the four vents already referred to. Four chimneys 8 ft. high are attached to the vents. The smoke rises through these chimneys creating a draught which keeps the circulation of hot gases through the wood in operation.

The necessary air for the combustion of the volatile carbon is admitted by four pipes at ground level which lead from outside halfway to the centre of the kiln. The wood is thus bathed in hot burning gases which after the kindling wood has raised the heart of the kiln to the desired temperature keep carbonisation in progress and absorb all the air admitted and prevent any more fixed carbon being burned.

To load the kiln the cover and top sections are removed. One man gets inside and a second remains outside to hand the wood to him. The loader first arranges the kindling wood conical fashion round an iron support driven into the ground in the centre of the kiln and then proceeds to build up in precisely the same way as the turf kilns were built up. Good packing is essential and to secure this the wood has to be broken up a good deal. This is done in the New Forest with a saw driven by a petrol engine and is a considerable item of expense. When the first section is filled the second is lifted on top of it and the building is continued. When this section is

filled the top section is put in place and filled in turn. The cover is then put on, all junctions filled with sand and the chimneys placed in position.

For lighting, a stick wrapped in sacking and dipped in paraffin is used. This is lighted and pushed through a lighting tunnel which leads to the base of the kindling wood at ground level and incidentally provides a fifth air inlet. After lighting and leading the smoke to the four outside chimneys in the manner described above, the kiln needs little or no attention. It is merely a question of watching the smoke emitted by the four chimneys. It is at first light brown in colour and it gradually turns through white to a hazy blue and falls off in volume. This stage shows that carbonisation is complete. The four chimneys are removed and the air inlets and four vents are sealed by piling light loam on them and the whole is left to smother itself and cool.

The time of burning varies from 18 hours to 24 hours, but it may take much longer. Cooling takes another 10 hours so that with unloading and reloading there can only be a complete turn round in 48 hours.

Some space has been devoted to this description because the design of any portable kiln must be based on the same principles. Actually the design of this particular kiln is not yet perfect. The provision for air inlet is not sufficient. We had a great deal of trouble at first from incomplete carbonisation. As an improvisation to meet this we have lifted the whole of the kiln on to half-a-dozen bricks so that air can be admitted all round. It is only an improvisation ; we have little control of the air intake in this way and there is little doubt there is some loss of fixed carbon on that account. We do, however, get complete carbonisation.

The economic problems are much more easily stated but far more difficult to solve.

It will be clear from the description that a single kiln cannot be worked economically. Two or three men are engaged for three hours or so loading a kiln and lighting it and then have to wait 36 hours before the charcoal is cool enough to rake out. We had hoped that with a staff of four men, which proves the most practical unit, we could contrive the burning of 24 kiln loads a week. This requires 8 kilns. Actually we have found it difficult to achieve on the average more than 15 burnings per week with this staff.

As already mentioned we have a petrol-driven sawmill for breaking the wood down to convenient packing lengths. This proves cheaper than hand work with axe and saw. The saw bench is roofed over and a short length of tramline runs straight out from it. The kilns are arranged four on each side of this short line. Incidentally we have a small gantry with a roof which slides along it and enables the kilns to be loaded and unloaded in wet weather.

The balance sheet for a week's operation giving an output of 3 tons of charcoal on the lines described here does not make a rosy picture :—

Expenditure.	£	*s.*	*d.*	*Receipts.*
Cording 15 cords @ 5s. ..	3	15	0	If price £5 10*s.* per ton £16 10*s.*
Haulage 15 cords @ 3*s.* ..	2	5	0	Deficit £2 6*s.*
Wages 4 men	7	11	0	If price £6 10*s.* per ton £19 10*s*
Delivery 3 tons @ £1 per ton charcoal	3	0	0	Surplus 14*s.* or 11½*d.* per cord.
Depreciation plant 10*s.* per ton charcoal	1	10	0	
Moving kilns 2*s.* 6*d.* per ton charcoal		7	6	
Petrol, oil, bags, etc. 2*s.* 6*d.* per ton charcoal		7	6	
	£18	16	0	

As will be seen price is all important and makes all the difference between small profit and loss. We have sold at both prices but the lower one is the more usual, and success depends on working to that figure. It becomes, therefore, a question of analysing the various items of expenditure.

Cording.—This is a vexatious matter. The money spent on stacking when cording seems wasteful but it is the only way of measuring the work done. To do it daywork would mean no saving. If we can take the wood into the kiln green the men can be paid 2*s.* 6*d.* per kiln load and this item would be halved.

Haulage.—This is horse haulage, largely a matter of time spent in loading and cannot be substantially reduced.

Wages.—These are fixed but if the work could be contrived so that there were 20 burnings a week instead of 15 it would reduce the deficit at £5 10*s.* per ton to a total of 11*s.* per week and increase the profit at £6 10*s.* per ton to 3*s.* 6*d.* per cord. This is the most hopeful line of attack but proves very difficult.

Delivery.—Offers little scope for reduction, though it depends where the market is.

Depreciation.—This is a very doubtful figure. It is questionable whether it is enough. It was hoped the kilns would last four years. Actually the thin sheet iron of which they are made tends to burn through in half that time.

Moving Kilns.—Another doubtful figure. The cost of carting, reconstructing sheds and loss of time may amount to £10. 2*s.* 6*d.* allows for making 80 tons or consuming 400 cords of wood in one stance. With a less quantity the cost would be higher and with a greater quantity proportionately less. The making of 80 tons with the present organisation would take about 28 weeks.

Taken all in all it is a tough problem but, in view of the questions at stake, it is one with which we must persevere.

Personally I am inclined to think that, at least in a forest like the New, permanent kilns in brick or concrete capable of dealing with much larger quantities than these little portables will afford the best solution. As will be seen from the figures, labour is the big item. A large kiln could be designed so that the wood might be barrowed into it. Much larger pieces of wood could be used moreover and possibly the mill dispensed with. Depreciation, though a relatively small item, would be much lower and removal expenses disposed of altogether. We would, on the other hand, have to allow for collecting the wood from a much greater radius and haulage would be greater in consequence but not proportionately. The design would have to be carefully thought out with due regard to the principles I have endeavoured to set out here.

SALES OF PRODUCE—ANCIENT AND MODERN.

By G. L. Cole.

The preparation and disposal of produce in the New Forest Division give a striking example of the present *modus operandi* compared with pre-war. The writer of this article is in the position to outline the procedure followed in the "good old days" when the early summer felling of hardwoods and autumn felling of softwoods was an institution. In each case the parcels marked for felling in the various enclosures were duly felled and measured, and a draft catalogue prepared in the first instance. Subsequently the different lots were valued—by the Deputy Surveyor or his Assistant—the catalogue, giving details, printed and circulated to likely buyers. The sale was effected by auction; the hardwoods in July and the softwoods in November, and was quite an event.

On the appointed day of the sale there was the customary gathering of "the clans"—timber merchants in this case, and about noon the Auctioneer came along to the office to go through the catalogue with the Deputy Surveyor and primarily to take a note of the valuation figure placed against the various lots. At two o'clock or thereabouts the prospective buyers were entertained to lunch at the Crown Hotel at which the Deputy Surveyor presided, supported by the Auctioneer and various Crown officials. This part of the ceremony was certainly a good prelude to the business side of the proceedings to follow, and invariably the timber merchants were in good humour when the Auctioneer commenced the sale—held in the Verderers' Hall at the King's House. By the way, the Auctioneer or his predecessor had carried out the sales since inception.

The sale commenced with a recitation of the conditions of sale as printed in the catalogue, and afterwards the respective lots were offered in sequence. The tacit understanding between the Deputy Surveyor and the Auctioneer was that if the bidding for any particular lot did not reach the valuation figure it would be withdrawn and subsequently sold by private treaty. Generally, when trade was good, the bidding was fairly brisk; but it invariably happened that the leading buyers had compared notes prior to the sale and arranged between themselves who was to bid for the various lots—knowing full well that a reserve figure had been placed on each. Consequently the Auctioneer frequently experienced difficulty in helping them along to the required amount, and one particular buyer, a Yorkshireman by the way, caused some merriment at one of the sales by glancing up at one of the antlers which hung in the Hall and remarking "All right old sport, I saw you give him the nod!"

The "ring" of buyers previously referred to frequently had their plans upset by someone not in the select circle, and on occasion prices soared to a figure decidedly higher than anticipated.

Naturally, such a happening was especially gratifying to the Auctioneer, as his scale of charges was based on the total amount of the sale ; and, of course, the Crown likewise benefited. Needless to say such an intervention livened up the proceedings and incidentally spared the Auctioneer the rather doleful task of working up to the valuation figure set against the various parcels. It had its entertaining side also, especially when a bidder outside the circle had reached his limit and would remark—" Let the poor man have it ! ", the position actually being that the " poor man " belonged to the prosperous side of the assembly !

The effect of the foregoing from an accountancy point of view was that the peak period affecting preparation of produce was practically confined to a month or so prior to and immediately following the auction sales ; the disposals otherwise being restricted to cordwood, firewood and the like.

As is generally known the preparation and disposal of produce have of recent years been a striking feature in the New Forest Division, and " reflections " prompted me to pen this article. The accountancy side of this subject is now a big factor in the Division, and there is no easing-off period throughout the forest year. Full details of the actual workings being brought out in the Annual Report, it is not proposed to weary the reader with chapter and verse. To my mind the marked change-over in this connection is most striking. Under the procedure outlined in the opening paragraphs the actual requirements of the timber merchants were a secondary consideration: now, in common with the modern trend of affairs generally, it is necessary to anticipate possible demands and arrange felling programmes accordingly; and, further, to be prepared for an emergent output of a particular class of produce to meet trade requirements. An example of this kind during recent years has been the sale of piles in connection with the Southampton Docks' extension scheme. A contract was placed with the Department to supply piles of specified sizes during a stated period " as and when required " and on several occasions a 'phone message has reached the Divisional Office from the contractor to deliver a number of certain length within, say, twenty-four hours! This, naturally, creates an atmosphere of full speed all round, and at such times one is reminded of the auction sales (and lunch!) era—and seasonal fellings only!

It will I think be realised that the present-day activities relevant to preparation and disposal of produce are not comparable with the auction sale period. During that time beyond payment for actual felling there were few etceteras, as the logs were sold lying on the ground and once the felling was completed there was practically no further expense to the Crown. Nowadays a felling operation frequently entails peeling, sawing and the like, road haulage and rail freightage, involving extensive checking of pay-sheets, haulage accounts, railway accounts, etc. Further, a thousand logs which

might have been bought in various lots by one buyer in the old days would now be cut—some to pitprops and some to dock piles, telephone poles and stay-props, with all the preparation, cross-cutting, peeling, etc., and possibly some would be sawn. Practically all have to be delivered.

In the old days so far as the Accountant was concerned it was only a question of a few documents, *i.e.* the pay-sheet, invoice, and a delivery order to the woodman. Today, there are innumerable pay-sheets, a number of local hauliers' accounts, sawyers' bills, railway freight charges, advice notes, delivery notes, etc., and all the little disputes to settle that arise out of the preparation and disposal of produce.

NEW FOREST DEER.

In the New Forest we have four species of deer, *viz.* fallow, roe, Japanese and red. They exist in numbers in the order stated; all species are declining in numbers owing to destruction by shooting.

The deer do damage by browsing on most of the broadleaved trees and shrubs (ivy, bramble, holly, acorns and chestnuts when available, being their chief foods in the forest). Little damage is done to coniferous species by browsing except perhaps by red deer during the severe weather when they will nibble the bark of young trees (usually from 8 to 15 years old), but most damage is done by the male deer when burnishing (the cleaning of the antlers of the "velvet" when the antlers have hardened off) and later for sheer mischief. Seldom is a tree attacked unless the deer can move it, except by the Japanese stag; he is undoubtedly the worst in this respect, ripping up the bark of trees of almost any size.

For those who may not be well acquainted with deer I might state that the red is the largest of the four species, then the fallow, the Japanese, and the roe the smallest. In colour all species alter quite a lot from summer to winter, their coat getting darker and thicker as winter approaches, especially in the case of the fallow and Japanese. I have often been told by the less well informed that they have seen a red deer when it has been a fallow in its summer coat.

The male of the fallow differs from the other species by developing a patch on its antlers from about the fifth year, and the little roe buck has no brow antlers. All species shed their antlers annually, the red stag from the end of February, the fallow and Japanese from the middle of April, and the roe from late November. Normally, of course, the females have no antlers but by a strange freak of nature one that was recently killed had seven spikes from 2 to 5 in. in length, which were covered with "velvet" at a time when the antlers of the male should have been shed.

The fawns are born from the beginning of June when the undergrowth becomes dense with bracken, etc., but are seldom seen with their mothers until some six weeks later.

The most favoured time for killing deer is from early November (after the mating season) till the end of February when the females are forward in young; during this period the undergrowth is less dense. The mating season of the roe is reputed to be June-July, but fawns taken from roe does, killed during winter, appear no further advanced than other species, but often the roe bears twins. The roe does not frequent the open spaces during good weather to the same extent as the other species but prefers the thickets of woodlands.

The method of destroying favoured here is by forming a shooting party of keepers using 12-bore shot guns with a couple of labourers to assist as beaters ; as many guns as are necessary surround the area to be driven, the remainder walk through the covert, the idea being to drive the deer to the forward guns but often it doubles back. When the deer has been moved, one or more hounds (according to the number available) are led on to the line, but it is advisable to keep one hound on the leash in case it is needed to " lay on " to a wounded deer, for occasionally the hounds are lost by the party for several hours especially during windy weather.

Great care is needed when deer shooting, particularly in the woodlands; it is better to let a deer pass than to take the slightest risk, for the buckshot used spreads considerably. Use the best cartridges obtainable, it pays in the end, for when inferior ammunition is used a deer may be wounded and a lot of time lost in getting it ; naturally this occurs occasionally with the best of ammunition but to a much less extent. Ammunition favoured here is the Eley Maximum, long-range, heavy load, loaded with Neoflak smokeless powder and T.T.G. shot.

W. G. BLAKE.

Fallow deer, perhaps because they are more numerous than roe deer and red deer, are found in all parts of the forest, except on the east side of the Southern Railway line leading from Bournemouth to London, where they are rarely seen, the only known occasion being when they are driven by buck hounds. The reason is not known, for there are many bridges and arches over and under the railway. The breeding season is during October and November and the does drop their fawns in May and June.

The roe deer are next in number, being found now in many parts of the forest, but little is known of their habits, except that they do not herd in such numbers as the fallow. The bucks cast their antlers in the autumn, and fallow buck do so in the late spring.

The red deer, very few in number, are only found in the North Forest and East Forest, and their habits and breeding are similar to the fallow.

The Japanese deer, small in number, are only found on the east side of the Southern Railway line. These together with the red deer in that district, originated from the Beaulieu Estate, which borders the forest ; some of each were liberated a number of years ago by the late Lord Montague. The Japanese deer do not cross over to the west side of the railway.

The method of killing all deer is the same throughout the forest. The use of rifles is not allowed ; shotguns are used and cartridges charged with buckshot, otherwise known as grapeshot, are specially loaded.

To find deer, plantations and other likely places are driven by keepers, beaters and dogs. The dogs used are not of the deer hound breed. Amongst keepers the most popular are beagles and crossbred dogs; these are not too fast, but generally give plenty of sound when running, and, but for this, deer would be much more difficult to find and kill.

L. B. WREN.

The four kinds of deer in the New Forest do not herd up together or associate at all in the breeding season. This, for red, fallow and Japanese deer, begins in October and lasts about three weeks to a month. The roe deer mating time is in July or near that date. Anyone can tell when it begins because the male deer of the red and fallow species keep roaring and the Japanese deer have a call more like a whistle.

When shooting deer, you must have the guns lined facing the wind, or side wind; also it is advisable to keep out of sight if possible as the deer are very alert. When driving young plantations it is as well to leave someone behind the beaters, as the deer may turn back.

T. CUTLER.

FIRELINES.

By W. D. RUSSELL.

While it is generally admitted that even a 30-ft. cleared fireline will seldom stop a crown fire, the utility of the fireline is so great that "cleaning firelines" is normal practice on most forests. To be of use in stopping a ground fire, providing a base for counter-firing or acting as a point of attack in beating, a fireline should be clear of trees to a width of 25 to 30 ft. and either partially or completely clear of surface vegetation. This is also the usual width of compartment boundaries and generally the latter are laid out with a view to their use as firelines. But, as compartments are usually from 20 to 40 acres in extent, the 30-ft. boundaries are numerous and if all are kept clean the annual cost is very high. More use might be made of a system whereby four or five compartments are grouped together in a strategic block and the compartment boundaries surrounding the block kept clean every year, the interior boundaries receiving treatment only every second or third year according to the degree of fire hazard. This principle of grouping is sound policy and the size of the blocks can be regulated to the known risk. Advantages would accrue from keeping this system in mind when designing compartments on new afforestation estates.

The main advantage of the block system is, of course, economy in annual expenditure on fire protection, but it does give an opportunity of regulating expenditure on cleaning firelines so that this bears some relationship to the premium which may justifiably be expended as insurance against fire. Experience has shown this plan to be workable when laid out on the ground with full knowledge of the terrain and a proper appreciation of the fire danger points.

Even with a system in force such as is briefly outlined above large sums are spent annually in removing growth from firelines by cutting and burning, ploughing and harrowing, screefing, turfing and so on. During, and following, periods of extreme fire danger there is a tendency to extend the cleaning operations with the very natural desire to secure additional safety. Such activity may, and probably does, lead to a greater expenditure on protective measures of this purely temporary type than is justified by the fire hazard and the value of the plantations. From time to time implements have been introduced to cheapen the cost of getting rid of fireline vegetation and have proved useful under certain conditions, as for instance, pressure lamps of the Hauck type in controlled burning, the Autoscythe for mowing bracken and grass-covered rides, or tractor-ploughing as opposed to horse-ploughing on heath and moorland. The aim in each case has been towards increased economy and efficiency in a form of treatment which has to be repeated at shorter or longer intervals. Is it only a Utopian dream that some form

of treatment could be evolved which would have a more lasting effect? As compartment boundaries and firelines have been laid down to serve as such for one rotation, if not for ever, there can be no objection to rendering the ground permanently unfit to support growth of any kind.

It is possible that a substance could be found, either in liquid or powder form, which would lend itself to application on a large scale by mechanical means. Such a dressing would be fairly cheap to apply to the most common type of fireline, which has been regularly cut and burned, particularly if it was applied immediately after the normal treatment, when the vegetation was short—the period when the chemical would have the best chance of making early contact with weed and grass roots. On a surface of this kind the mechanical spreader for a weed-killer in powder form might very well be on the lines of the agricultural manure-distributor, which has been adapted already by the Research Officer for Scotland for applying seedbed-covering materials. While for a liquid of reasonable viscosity an ordinary water-cart, with a low-set sprayer, should not prove over-difficult to adapt. It is agreed there are many firelines which it would be nearly impossible to traverse either with horse- or tractor-drawn implements. But there are as many, or more, which could be treated easily and it should not be beyond the ingenuity of man to evolve a means of dealing with such of the others as formed an essential part of a fire protection plan. The benefit gained by killing off all growth for a period of years needs no stressing, either from the view points of economy in management or of fire protection.

The use of chemical weed-destroyers on firelines is by no means a new suggestion. Work of an experimental character appears to have been done with such substances as solutions of zinc sulphate, copper sulphate, sodium chlorate, common salt, dilute hydrochloric and sulphuric acid and in the JOURNAL there have been occasional references to the use of arsenical compounds. In " The problem of fire in British forests," published in 1930 in " Forestry " (Vol. IV, No. 2), Mr. Taylor, briefly referring to this question, stated that sodium chlorate in a 5 per cent. solution had given the best results to date. But there do not appear to be any readily available records of an exhaustive attempt to discover a chemical with the necessary requirements to make its use an economic proposition. It is suggested that a liquid or powder, which could be used without dilution with water, would be a desirable addition to our fire-protection equipment. The essential requirements of such a chemical appear to be:—

(i) That it should not make vegetation more inflammable.
(ii) Low initial cost.
(iii) Ease of application.
(iv) Adaptability to application by mechanical means.
(v) Comparative rapidity of action.
(vi) Prolonged effect.

Such local experience as has been gained with arsenical compounds and sodium chlorate on nursery roads and similar sites has been useful in establishing the practicability of this method of destroying weeds for longer or shorter periods on relatively small areas. Neither of the substances mentioned could, however, be used on a large scale in woods. The former, because of the danger to animals and the prohibitive cost ; the latter because the initial cost although lower is still too high considering the effect would not be permanent. No comprehensive series of experiments has been carried out with sodium chlorate, which costs locally about 45*s*. per cwt., but an application of 1 lb. dissolved in 1 gallon of water and sprayed over about 50 sq. yds. of light weed growth, while effectively destroying the weeds, usually permits their recurrence in from two to three months. Doubtless, it would be cheaper if bought in quantity, but the rather temporary results obtained would seem to suggest a search for a more effective, and possibly even cheaper, substance. Moreover, there is a tendency on the part of the higher concentrations to make dying vegetation very inflammable until such time as the salt has been washed into the soil.

Chloride of sodium, used, not in solution, but in the form of crushed rock salt, might prove a useful subject for experiment. It is an effective deterrent of weed growth on nursery paths when applied at the rate of 1 lb. to 2 sq. yds. or so, killing off annuals, perennials and grass within about 10 days and keeping the paths free from weed growth for at least a year. A series of experiments might well be started to determine the minimum amount of salt which would kill the dense growth on firelines and give the longest period of freedom from weed growth.

Used lubricating oil from a car sump, while messy to use wherever there is much traffic, definitely kills grass and weeds and prevents growth recurring for about two years. Nor does it appear to create additional fire hazard (not, at any rate, after the dead vegetation has disappeared), dropped matches, lighted cigarettes, etc., having failed completely to ignite the treated areas. This point has been pursued no farther than the one simple test, but it is suggested that the use of a cheap, crude oil might be worth investigating. From the oil-producing countries comes ample evidence that leaks in oil pipe-lines cause the death of any vegetation in the immediate neighbourhood. As the higher products of the distillation of petroleum appear to have no detrimental effect on coarse vegetation it is reasonable to assume the toxic effect is in the lower and less volatile fractions. The action of crude or lubricating oil may be to bring about a drought condition and generally immobilise the nutritive organs, but the possibility of additional caustic effect should not be overlooked. It is not improbable that the same effect could be obtained by the use of the waste by-products of distillation and if the present search for marketable quantities of petroleum proves successful these may become obtainable cheaply.

In the course of time we may be able to tractor-plough selected firelines, harrow out the weeds, then spray the levelled-off surface with some chemical or other substance which will prevent the re-growth of vegetation for a great number of years. This would be a very desirable state of affairs considering the large sums annually spent at present in some form of cleaning firelines.

Concurrently, the opposite form of treatment may be worth some consideration—the cultivation of a hardy, dense-growing, easily propagated herbaceous plant or dwarf shrub not readily destroyed by fire. It is generally accepted now that all plants are inflammable to a greater or less extent, but there are species which have a damping effect or which are slow to ignite. Such a plant might be well worth establishing at specially dangerous points or on fire traces alongside railways. Some years ago a fire on one of our Hampshire areas swept out of control on to an adjoining estate and was extinguished only when it spread to an area on which the surface vegetation was principally a *Hypericum*, which I believe to have been *Hypericum calycinum*. There the fire, while not extinguished by the shrub, was so reduced in volume and heat that it was beaten out rapidly and easily. This plant, commonly known as rose of Sharon or Aaron's beard is a low, nearly evergreen shrub with numerous oval, stalkless leaves some 2-3 in. long. It seldom exceeds 12 in. in height, has a creeping root-stalk, spreads rapidly and is easily propagated by sub-division. Although a native of the East, it is well adapted to our somewhat uncertain climate and has become naturalised in different parts of the country. There may be other species of equal or greater value about which something is known.

In conclusion I should like to suggest, as this subject is of considerable importance to the Department and its technical staff, that the results of any known work on chemical weed-destroyers for firelines in this or other countries be summarised and published in the JOURNAL. At the same time expression of the views of other officers together with any information they may have on fire-resistant herbaceous or dwarf plants, might lead to an improvement in technique and increased economy and efficiency in the treatment of firelines.

NURSERY SOWINGS OF SYCAMORE.

By W. D. Russell.

Sycamore is one of our most prolific seed-bearers, producing almost annually large quantities of seeds which germinate readily under natural conditions. Seed ripens about October and is cast then and in the following month, according to the weather prevailing. The seed lies dormant in the soil until the following spring and given a fairly open season the first signs of germination are observable at the end of February or early March. Under woodland conditions a very high percentage of the seeds germinates. That mortality is considerable under unprotected natural conditions has no bearing on the point that natural regeneration apparently gives a much higher yield than nursery sowings.

A summary of the yields obtained in the Dean Divisional nurseries during the six years for which figures were available, produced the following:—

Year.	*Yield per lb.*
1930	422
1931	496
1932	500
1934	97
1935	250
1936	50

This is an average of 305 seedlings 1-yr. old and fit to line-out from each pound of seed sown. It is believed that the minimum size for lining-out was 3 in., except in 1934 and 1936 when the abnormally poor yield led to lining-out of seedlings down to 2 in. in height.

So far as could be ascertained in 1937, when the summary was made, all the seed had been treated in the same way—stored in sacks or boxes in nursery sheds exposed to a wide range of temperatures and considerable variations in humidity. In due season the seed was sown in 1-ft. wide bands at a density regulated by a cut test made immediately before sowing but averaging about 1 lb. to 4 sq. yds. (excluding alleys).

In an effort to effect improvement in yield most of the seed available for sowing in 1937 was stratified in the same way as for D.F.-and ash, using ¼ in. screened limestone chippings, which had been found quite suitable for the purpose, as the stratifying medium. There was insufficient time or seed to make a complete series of tests. The available seed had been stored by normal methods from collection ; so three weeks prior to the estimated sowing date 10 lb. were stratified, one week later a further 10 lb. were similarly treated and the process repeated with a like quantity after the lapse of another week. 10 lb. were kept in store under the usual conditions as a control.

In due course the four lots were sown under as nearly as possible comparable conditions of weather and seedbed tilth. No record was kept of rate of germination. When stocktaking in August the seedlings were graded to the following specification :—

Grade I : Good seedlings 8 in. and over.
Grade II : Up to 8 in., minimum 3 in.

The results per lb. of seed were as follows :—

	Yield per lb.	Gr.I Seedlings.			Gr.II Seedlings.		Gr.I as Per cent. of Yield.
		No.	Maximum Height.	Average Height.	No.	Average Height.	
	Thous.	*Thous.*	*In.*	*In.*	*Th.*	*In.*	
Stratified 3 weeks	·63	·54	22	15	·09	5	85·7
Stratified 2 weeks	·66	·43	16	12	·23	5	65·2
Stratified 1 week	·43	·22	16	11	·21	4	51·2
Unstratified (control)	·34	·13	16	10	·21	5	38·3

These figures are interesting in that stratifying for the short period of three weeks not only produced a better yield but a much higher outturn of Grade I seedlings. The difference in quality was very apparent in the beds and has been continued in the transplant lines. Each lot was lined-out separately and continued to show the relative qualities indicated above.

For various reasons the experiment could not be extended last season but it has been continued this year on the basis of stratifying for longer periods, including from collection date to sowing. The foregoing results, therefore, are not put forward as definite conclusions but merely as an indication of a treatment which may lead to less wasteful methods of handling sycamore. It may even be unnecessary to stratify where autumn sowing is practicable, for writing of sycamore Evelyn has stated : " It is raised of the keys in the husk, as soon as ripe and they come up the first Spring." It is necessary, however, to observe that spring sowing is dictated almost solely by the liability of damage and losses by spring frost.

OUR EASTER HOLIDAY.

By Lloyd Kenyon.

Easter Sunday ! In the garden of " The Firs " the scene is one of comparative peace, though a slight spirit of rivalry prevails as we pursue each other round the miniature putting course. The standard is not high—possibly because it's too soon after lunch, but more probably because we've got one eye on those white clouds scudding overhead, and both ears wide open for the telephone. With this wind, the Forest dry as tinder and masses of people about—it only needs a match . . . .

" What's that ? Down in one ? Nice work ! Now watch this—hullo ! there goes the 'phone—that can only mean one thing. Birchwood, eh ? That's a danger spot if ever there was one ! "

Into our oldest clothes like a flash, and off down the hill with engine spluttering and no time to spare for warming up. The students are waiting outside the School :" That's right—two in the back and the shovels in front—mind the paint ! All set ? Right, we're off ! "

Up the hill, tyres screaming on the bends ; the look-out on the fancy tip waves us on as we hurtle past—something rather dramatic about his urgent gestures up there on the sky line : looks as if we're in for a warmer job than he's got, anyway. Confound these sheep ! There's a couple of precious minutes gone west.

Here we are at Cinderford—the old bus can shift when she has to ; but we've spoken too soon, for suddenly the engine falters and dies. Frantic jabs on the throttle—no response ! This would happen at this of all moments : up with the bonnet, and there's the throttle wire in two neat pieces. " Anybody got a bit of string ? Fine ! that'll do : now you pull this like grim death, and don't let go unless we're going to hit something bigger than ourselves ; I'll look after the brakes and we'll hope for the best. Ready ? Pull ! "

Off we go again, and now we can smell the smoke : ah ! there it is—in the spruce, too. Plenty of people there—looks as if they'd got it pretty well under control. We sprint the last few hundred yards and get busy with the shovels : soon the last flames are out, and nothing but an acrid pall of smoke remains ; might have been worse !

But the Forester, mopping his brow, is staring anxiously at a distant hillside ; we follow his gaze and see a dense brown, ominous column rising into the sky. No peace for the wicked ! It's in the Perch this time, and there's not a moment to lose from the look of it.

Into the cars again, leaving a handful of men to guard the danger zone, and soon we're doing another sprint to where wicked red tongues of flame are leaping thirty feet high, and the air is filled with an awe-inspiring roar and crackle. It's 15-yr.-old spruce and Corsican this time, and it's well and truly alight. The wind hurls the flames

along at an appalling rate ; clouds of sparks shoot into the air on the crest of billowing waves of smoke, and the noise is deafening.

We plunge in and do what we can, but are driven back time and again by the heat and choking smoke-clouds : we're fighting a losing battle and the wind and flames are our masters. Hours seem to pass . . . . our eyes are streaming and we feel we've swallowed all the smoke in the world, and still the flames sweep on. They're practically up to the ride now—if you can call it a ride when it's only a couple of feet wide and the branches meet across it—but it's our only hope. A fresh gust hurls the blaze towards us, and—" Come out of there ! " the order is shouted, " come out, it isn't safe ! "

Reluctantly we retreat—and then the miracle happens ! The wind dies, veers round, and for a moment the flames cease their advance. It's now or never—" Come on, you chaps ! Everyone up here quick ! Give it everything you've got ! " Stumbling, swearing, fighting our way through the blackened branches that tear our faces and send showers of hot needles down our backs, we beat and beat and beat again till the last flame dies and all is momentarily peace.

But the wind is up again, and glowing embers are leaping into life on every side. Someone will have to keep watch all night, and the Forester's face looks white and strained in the gathering dusk. So home for a quick meal and clean-up, and back we come to relieve him with a thermos flask, sandwiches, tea, kettle and stove—and we needed them, for it was a bitter night, with a frost which kept us ceaselessly on the move through those long dark hours : It was almost a relief when each fresh outbreak brought us rushing to the scene and our numbed hands were restored to life as we swung the heavy shovels.

Came the dawn—as they say in the films—and with it a touch of comedy to lighten our vigil, as patrols arrived, at intervals and at the double, intent on extinguishing the fire which we'd built with loving care to warm our frozen selves : reassured that " it wasn't that sort of a fire " they returned to their posts, and so the long night passed and we found ourselves basking gratefully in the bright morning sun.

The arrival of our relief-party at 8 o'clock was—to say the least of it—a welcome sight, and even more welcome were the hot bath, shave and unlimited supplies of breakfast awaiting the two blackened and dishevelled District Officers who returned to " The Firs."

PLANTING AND WEEDING OF OAK.

By A. E. Walker.

Planting.—During the last ten years about 130 acres of oak have been planted at Dymock and the question as to which is the best spacing for planting oak has often been discussed. Here we have quite a variety of spacings in the Experimental Plots and the Forest, such as 3 ft. × 2 ft., 4 ft. × 1 ft., 4 ft. × 2 ft., 5 ft. × 1 ft. and 5 ft. × 2 ft., and as some of these areas have been planted ten years, one is now able to express an opinion as to which is the best spacing.

All the P.28 oak were planted 3 ft. × 2 ft. and in 1929 in Queens Wood we started planting oak seedlings 3 ft. × 2 ft., but owing to the expense and the large number of plants per acre the spacing was increased to 4 ft. × 2 ft. About 1½ acres had been planted when these instructions were given and it is interesting to note the difference on this area between the two spacings; those planted 3 ft. × 2 ft. are about 2 ft. higher and are entering the thicket stage; the plants are of a better type and the area will not require any more weeding, whereas the 4 ft. × 2 ft. spacing will require two or even three more weedings and the trees are not so good. The plants used for both spacings were from the same batch in the nursery and the soil is about the same throughout the compartment, and from observations made I have come to the conclusion that the 3 ft. × 2 ft. spacing is certainly the best for oak seedlings. We get better growth and the thicket stage is reached much sooner, thus saving two or three years' weeding, and I am of the opinion that the results warrant the additional expenditure.

Weeding.—The weeding of oak plantations is rather a difficult subject to comment upon, as methods adopted in one place are open to criticism in others, owing to the varying conditions such as dense coppice growth, brambles and bracken, and the cost of weeding varies considerably on different areas.

Several methods of weeding have been carried out here, some areas are fully weeded, others partially weeded and others have only the heads of the plants opened out, but where one has a dense growth of coppice it is essential to weed fully, cutting all coppice shoots down to ground level for the first three years and then to thin; often one may miss the fourth year and weed again the next.

Weeding, of course, always depends upon the growth of the plants and one cannot lay down any hard and fast rule about this work, and one must use discretion whether to weed or not. But in my opinion it is a wrong policy to allow the coppice growth to come between the rows of plants and only up the plants in the rows; it is much cheaper to cut the coppice back each year to ground level when it can all be done with the hook than to allow it to grow two or three years, when hackers will be necessary and the operation much more expensive. It

is obvious that where you have a lot of coppice stools in the ground, the growth from these will be far more vigorous than that of a seedling just planted and, unless the coppice is kept under control, there is very little chance of getting a good crop of oak. On some of the areas one coppice shoot has been allowed to grow on some of the stools, the idea being that this would absorb a good deal of the sap from the stool and so retard the bottom growth around the stool. It has not been altogether successful from this point of view, but it does afford a certain amount of shelter over the area for the crop.

CONIFER AND BEECH MIXTURES.

By F. Watson.

Many of the Commission's earliest conifer-with-beech plantations will now have reached the point in their development when careful treatment of the beech is essential if their fullest effect on soil improvement is to be maintained throughout the rotation.

Here in Dean Forest most of our Norway spruce plantations contain approximately 24 groups of beech per acre, each group consisting originally of nine trees. These groups are spread evenly over the plantations, whilst in many areas of E.L., and in some S.P. areas beech were planted only in alternate rows and in the same proportions as the conifers in these rows. In each case, planting of both species was carried out together. The development of the beech during the last 12 to 18 yrs. under conditions of close planting, together with suitable soil conditions, is interesting. On the N.S. areas beech, being a slower starter than the spruce, made very rapid height growth when once it got away, but poor development of side branches ; both species have kept fairly level after 6 or 8 years.

In 12- to 15-yr.-old plantations very few of the groups contain trees with uniform development of their crowns, many of the beech after having been drawn up 8 or 10 ft. have become suppressed, so that many groups contain only three or four well-developed trees. The treatment of these groups should be undertaken long before the plantations have reached the stage when first thinning is necessary, or the side branches will have been killed off, and the work of lopping will have become more costly as the trees will have to be climbed. During brashing operations, much good can be done by topping or cutting down the outside trees in the groups where they are too drawn up ; as conditions will vary in all groups, the trees should be marked beforehand so that the men will know whether a tree has to be topped or felled or passed by. Only about one tree (if it is in or near the centre of the original group) should be necessary when a plantation has reached 20 years as the adjacent spruce will be only 9 ft. away at the 4½ ft. planting distance, and adjacent beech will be only 40 ft. away. If treatment is too long delayed most of the groups will contain only very drawn up clean stems, and topping then would result in very little branch being left on the trees.

In E.L. areas now nearing the first thinning stage, conditions vary ; in some the beech have been left behind right from the start. Only in a few places where larch failures have occurred are the beech keeping anything like level with the larch. The average height of the larch in P.20 plantations is now 45 ft.; most of the beech have their heads in the lowest live branches of the larch, 12 to 15 ft. up. These larch branches are now touching, having closed right over the 10 ft. wide gap where the beech are planted, the planting distance being 5 ft. × 5 ft. It appears now that any further active growth of

the beech will be dependant upon the thinning of the larch (more particularly the second or third thinning), the pure larch rows requiring most attention during first thinning. Many of the beech would get very little benefit from extra light or room, and unless a very different type of thinning from that carried out in pure larch is undertaken, many of the beech will do no more than just keep alive until the larch crop has been opened out by subsequent thinnings. In most of the E.L. and beech plantations, after about 15 years, the beech out-grow the larch with the result that unless the beech are topped very few larch survive.

THOUGHTS ON AFFORESTATION.

By F. Oliver.

Forestry is a charming occupation. It is, we are told, an applied science. Its main charm, however, is that it is not a science at all. In spite of the elaborate calculations and tables of statistics imposingly set out in text books of great dignity, forestry remains a thing of speculation and guess work, ideal for those who, though outwardly stolid, yet pursue an ideal.

Only recently an advertisement—admittedly in a very provincial newspaper—offered for the modest sum of 15*s*. (post free) to supply an instrument which, in 10 seconds, will tell you what is wrong with your soil, and how to put it right. It can't be done. Even should a civil action result, one must maintain that it can't be done. This is an extreme case. Our highest respect, tempered with sympathy, must be accorded to those of us who seek, with the utmost diligence and with some idealism, to harness forestry to mathematics, but forestry (praise be) must remain an empirical science.

The reason, of course, is that the ingredients of forestry are, in brief, the raw materials of nature and the ingenuity or ingenuousness of man. Among these raw materials are soil, rain, sun, wind, fires, floods and pestilence. They cannot be separately studied, accurately assessed, and labelled ; and their interactions must remain, in the present development of science and human understanding, the subject of conjecture rather than of science. For this, again, one should be grateful. In forestry we so often are charmed by what is unexpected.

Forest knowledge must, however, continue to advance, aided by sciences but never led by them. The advance must come from observation of nature, the most industrious experimenter of all.

Here, to make this confused discourse still more confusing, one must start another argument. One is often advised in forestry to "imitate nature." This is a ruinous policy. As a forester, nature is everything that is bad : she is slothful, wasteful, careless, extravagant, and the results she obtains are often deplorably poor. The reason, of course, though it is not always clearly stated, is that nature is no forester and her aims are a multitude of individual aims. When she produces, as frequently happens, single stems or large tracts of timber of fine quality, it is purely accidental, an incidental result in the pursuit of quite other aims. How very different is afforestation, as in general practice in the Forestry Commission. On the one hand we have the formless, careless tangle that is the so-called "natural wood" in this country with here and there groups and patches of splendid timber trees, or the promise of such. On the other the disciplined rows and unrelieved masses of Commission

plantations, each species keeping snobbishly to itself, more than a little monotonous in regularity, the aim being to reach the greatest size in the shortest possible time. Such plantations have been well-named " pole factories." Quality at present has largely been subordinated to quantity. In other words forestry, which with some justice has been regarded as a contemplative occupation, has inevitably become (not only in the Forestry Commission) something resembling a mass production business, engaged in the production of huge quantities of timber of a somewhat low standard. (A reference to Yield Tables bears this out. They are graded entirely on quantitative output).

We must admit, with humility, that we are not yet foresters. We are afforesters, and as such are efficient in the mere mechanics of planting. We are able to take large tracts of landscape and clothe them, in a comparatively short time, with garments of conifers of somewhat sombre hue. Nineteen years have passed and many such woods have become well established, and are reaching the thinning stage. Their original composition and type have not changed, and it is likely that they will remain somewhat sombre till the end of the chapter, or at least till the end of the rotation. Nature, if given the same task of afforestation to do, might require 500 or more years to carry it out, and would produce a forest having little in common with the man-made one, either in appearance or in composition. The nature-stocked area would be infinitely more varied. It would be uneven, patchy and blanky, with much variation of species ; with many rough and uncouth trees, but with many fine, clean, small-crowned trees containing timber of a very high class. Such trees would be produced incidentally, as the result perhaps of very profuse regeneration, or as the outcome of a childhood and early growth in the restraining side shade of surrounding larger trees. When the finest of conifer woods are examined, grown in conditions as nearly natural as may be, it is rare to find them pure. They may be dominated by one species but do not exclude many others.

This leads us to a plea for two things, better quality of timber and improved amenity. Quality may be partly obtained by restraining the upward rush of a stand, by the ruthless removal of the upper layer of strong stems, so as to foster the weaker-crowned poles of small diameter, but natural conditions limit the efficacy of this method. One prefers a compromise. This would suggest a closer study of nature's methods and the borrowing from nature of what is best for our purpose. It would require the introduction of a proportion of the so-called weed species ; often they are already present and only some mercy towards them is required. Tidiness may in forestry become a vice, and the standard head " Preparation of Ground " may cover many crimes. One has on more than one occasion seen the complete removal or girdling, before planting, of a healthy birch wood, followed by the careful and methodical planting of " nurses " for the main conifer crop ! A measure of untidiness may be good

forestry, and may be sound both silviculturally and economically. It would certainly be an improvement in amenity.

In summing up, the foregoing is intended mainly to be provocative, and does not presume to suggest definite methods of altering the character of some of our future forests. There are many methods which occur to one, not necessarily more expensive than straightforward afforestation ; most certainly of absorbing interest ; and not least—what a field for argument !

TREATMENT OF PEAT A HUNDRED YEARS AGO.

By R. F. Wood.

Peat is a topic on which much has been written in recent years. It may, however, be of interest to examine the views of a writer on the subject over 120 years ago.

Aiton's Treatise was published in 1811 " at the desire, and under the patronage of the Highland Society." The author appears to have been something of a pioneer in the study of peat, and was extremely anxious that the importance of his subject should be brought home to the public. While his outlook was naturally that of an agriculturist, much of his treatise is of quite general importance.

Aiton commences by emphasising the importance of peat. " A very large proportion of the surface of Scotland, and many thousands of acres in different counties in England, which were at some former period rich and fertile, or at least were as capable of being rendered so as any other land in their neighbourhood, are now unfortunately covered with moss-earth, which has hitherto been considered of little or no value as a soil . . . . Yet, though that substance is increasing in depth . . . . and continuing to extend itself . . . . very little attention has ever been paid to that intruder. Many are so ignorant of its nature as not to know that it has increased . . . . ; and of those who have noticed its accumulation, few have made the least attempt to intercept its growth." Aiton gives much attention to the area of the country under peat ; he mentions a Board of Agriculture estimate that 14,000,000 acres of Scotland were under peat. Aiton's view was that a great deal of the peat area could be made productive. Before presenting Aiton's views on peat itself, it may be as well to examine the economic motives necessitating the full utilisation of land in Aiton's time. The country was engaged in the struggle against Napoleon.

" The enemy we now have to cope with, carries on his plans with the rapidity of lightning, and he is as busy in scheming and preparing for the overthrow of other States, when at peace, as when he is at open hostilities." Continental and American ports were barred to British shipping. It was necessary for the country to rely on its own resources, and in Aiton's opinion the Government of his day did not realise the importance of increasing the productivity of waste lands, and more particularly, peat soils. Aiton advocated a State land reclamation policy, which must surely have been a very advanced view at this period. He deplored the depopulation of the Highlands, then proceeding apace. " How lamentable it is to see these unhappy people compelled to leave their native glens . . . . and to seek refuge in a foreign land . . . . Good God! is there no land in Scotland that these poor people could be employed to reclaim? These (reclamations) would be conquests worthy of men. Happy

had it been for the inhabitants of Europe, if their sovereigns had never led them forth to any other species of warfare."

These were the views that led Aiton to advocate the study and improvement of peat soils.

Aiton makes a full study of the origins of peat. He finds it necessary to refute the apparently popular belief that peat was the sediment and detritus of the Flood. His view is that " moss-earth is nothing else than immense collections of the successive crops of aquatic vegetables, which have grown from year to year on the surface, in humid situations, and in a low temperature . . . . Peat formation may be promoted on fertile soil. In the temperate regions, stagnant soil water is the predisposing condition. Kincardine moss is an ideal example of a fertile area growing heavy timber, turned into a moss, by felling the trees and leaving them on the ground, water detained on the surface to such a degree as to . . . . introduce the aquatic plants . . . ."

While Aiton is satisfied that cold and wet climatic conditions give rise to peat accumulation, he also suggests that peat accumulation gives rise to a cold and wet climate ; in fact a vicious circle. " The climate of Britain was colder now than at the time the Romans held dominion in this Island : and that the change in the temperature was chiefly owing to the accumulation of moss over so much of the original soil." In support of his contention that the climate had changed for the worse since Roman times, he quotes Roman historians who agree that the climate " was mild, though not serene." The country produced grapes and wine ; Aiton considers this impossible in his time. Also " trees of enormous dimensions have grown spontaneously in many parts of Britain, where it would baffle the ingenuity of man to rear a tree to the tenth part of the size." Aiton gives many examples and dimensions.

Having discussed the causes of moss accumulation, Aiton proceeds with an attempt to classify the various types. In search for a practical classification, he discards those based on colour, density and material. With regard to the last, " I am also humbly of opinion that the plants which grow on the surface of moss-earth, afford no proper data for the classification of that substance. These plants are by far too numerous to be capable of answering that end . . . ."

Aiton classifies his peat, he says, on the basis of utility ; however, it appears rather that he is classifying his peat from the conditions under which it is formed. Aiton distinguishes " Hill moss, bent moss, and flow moss." " Hill moss " is found " in every elevated situation, in cold and temperate climates, where the declivity of the ground, or the permeable nature of the sub-soil, prevents that stagnation of moisture which is necessary to the formation of more complete moss-earth." The most common plant on this type of peat is calluna. Aiton's " bent moss " appears to be the well-known molinia type. He considers that it generally differs from hill moss by overlying a more retentive soil. Aiton's " flow moss " is the worst type he recognises, and his description would cover the scirpus climax type, as well

as less objectionable peat formations due to local stagnant conditions. Aiton considers that the majority of flow mosses arose over felled wood, the great part of the felling in his opinion having been carried out by the Romans. Stagnation following the blocking of the natural drainage by felled timber then apparently gave rise to the flow mosses. Aiton also describes how " lakes are filled up and converted into mosses by plants growing from the bottom," in considerable length and detail.

Having dealt with the origin and types of peat, Aiton passes to its cultivation and improvement. Aiton emphasises the need for drainage as the first essential. " Wherever much moisture is detained, all the rich grasses die, and the fogs (mosses) grow up. Wherever . . . . drains are opened in proper number and form, the soil becomes much more solid ; the sphagnum or moss-fog ceases to grow. The proper size of these drains is about twelve or sixteen inches broad above, near a foot in depth, and slanting on both sides, to about three inches at bottom."

Realising the absence of plant-feeding values in peat, Aiton advocates the use of manures. Slaked lime is of great value. The addition of dung, or other animal matter is beneficial. " I can assert, that from the body, blood and intestines, of one dead horse, properly mixed with moss, and fermented by it, with the aid of some weeds . . . . all twice or thrice turned over, no less than eighteen or twenty tons of rich manure may be formed in the space of seven or eight months . . . . How commendable would it be to dispose of dead horses in this way, in comparison with throwing them into a ditch." Slaughterhouse offals and dried blood, too, are valuable ; Aiton regrets the serious wastage at his time as " the dogs soon scatter them over every street and lane ; an intolerable nuisance, which gives but an unfavourable idea of the police of the place, and the manners and taste of the people."

Another method of improvement is by " flooding of clay, sand or earth over moss." An interesting example is cited. " The Bishop of Landaff has improved a small field of moss near Colgarth House . . . . Windermere . . . . The moss was level, wet and deep. Ditches were cut round it, to take off the springs ; one was carried through the middle of the moss to relieve it of surface water . . . . His Lordship carried a small rill from the mountains over the moss, and by it, in times of rain, washed a considerable quantity of earth, sand or other substance to the moss. This, without any other manure, converted the flow moss to a rich meadow . . . . I saw this field in February, 1807, and found that during the preceding summer, five very large milk cows had been grazed the whole season . . . . on this moss . . . . which a few years before could not have supported three sheep. How many thousands of acres in . . . . Scotland might be reclaimed by the same means, if the proprietors were possessed of the patriotic industry which has actuated this worthy Prelate ! " I wonder whether the site of this experiment could be located ?

Aiton is not interested in forestry for its own sake, but emphasises the value of shelter breaks on hill grazings. He does not envisage much difficulty in establishing trees on peat. " That trees may be raised and attain considerable perfection on a moss soil, is a matter that can admit of no doubt." However, careful study of the conditions must be made before choosing the species for any peat. Aiton's confidence with regard to tree-planting on peat seems rather surprising, when it is remembered that he, of course, had no knowledge of the species that we now regard as essential for the afforestation of peat soils.

Suitable species mentioned by Aiton for a well-drained peat are alders, birch, rowan, poplars, pine, willows, larch and " all other species of aquatic trees ! " Aiton is satisfied that many of the stumps of pine found in peat were grown in the peat itself, not on the mineral soil below. He mentions several successive strata in certain bogs.

His method of draining before planting is somewhat drastic. " It will be proper to cut open drains, four or five feet deep, at the distance of every twenty yards or so, and to form the space between these ditches like a ridge, or in such a way that no water can at any time rest on the surface."

Some " objects of management " other than profit are stated. " Plantations on moss and moor ground would be of unspeakable advantage in screening the land, ornamenting the face of the country, hiding from the eye the unsightly and gloomy aspect of these wastes, and sheltering the helpless animal that is doomed to spend its life in such exposed and stormy regions." We may conclude that Aiton would have approved highly of Kielder.

FORESTRY AND THE " TALKIES."

By B. KINNAIRD.

Rarely does one hear much talk on forestry—rather the contrary —and yet nowadays propaganda and publicity are, as one might say, all talk. In fact, talk can set the world on edge, raise our hopes, or damn our aspirations. Nevertheless, what a tremendous amount can be accomplished by the sane use of it. My proposal is to use it in the latter sense with a view to making the British public much more " forest conscious."

Much has been done and is still being done in an honest endeavour to educate " the man in the street ; " talks are held, and sometimes illustrated ; an occasional debate is heard on the radio ; an odd article appears in the Press ; and sometimes a mention of forestry may be heard in Parliament, but with it all, does this bring home to the hearers, the listener, or the reader, the work of the Commission ? I very much doubt it.

The following may illustrate what one individual thinks is the work of the Forestry Commission. The nameplate attracted the attention of a lady passing the office, who decided to call to ascertain what could be done with regard to her pension. She stated that she was a member of the " Forestry Society," and after enquiries, explained that the " Ancient Foresters " had been of very great assistance to her brother-in-law, and she had called to see what could be done for her ! I do not suggest that public opinion in general is similar to the instance quoted, but there is no doubt the public as a whole know little or nothing of the work of the Department.

How, then, can the man in the street become forest conscious ? How can his interest be stimulated, and the public spirit aroused ? The one sure way of getting at the man in the street is to go into the picture house. By publicly proclaiming the Department, and British forests as a whole, the use of talkies must hold great possibilities. To show successfully such a talkie picture, it would presumably require to be interesting, entertaining, educative, with behind it all a moral. Cannot the history of the Commission supply all these essentials ? Whether or not the Treasury would agree to such expenditure is, perhaps, a different matter, but the money so spent would, I feel sure, do more to arouse public interest and favour than any other form of publicity.

Let us have a good forestry talkie, and introduce it to the cinemas—most cinemas will, I feel sure, be glad to show such a film for " packing " with a star film—and so arouse a live interest in the country's woodlands.

FIRE PROTECTION AT GLENTRESS.

By A. GRAHAM.

I do not intend to deal here with fire-fighting methods, types of brooms and implements used for extinguishing forest fires. The usual dumps are provided at strategic points, and the main question for the Forester is, and always will be, how to assemble and convey a sufficient number of men to the scene of a blaze in time to prevent the fire obtaining a good hold and causing extensive damage to his plantations. One man actually on the spot is worth a dozen later, provided he keeps his head and does the right thing. In the first place the whole fire system should be explained to every man employed in the forest, and each man told what is expected from him in an emergency.

For some years now at Glentress a fire system has been built up and has been added to each year as the planted area increased. Weak points have been eradicated and vulnerable areas protected by moor burning. The Forest, situated between the towns of Peebles and Innerleithen, in a fairly populous area, which with its hydropathic, golf courses, hiking facilities and fishing on the River Tweed, is a Mecca for visitors, and with main roads and a railway touching part of it, is not an easy one to protect. It is divided into four separate blocks, namely, Glentress, Shieldgreen, Venlaw (situated just above the town of Peebles) and Cardrona. From one end of the Forest to the other by road is nearly eleven miles.

In the Forester's office at Cardrona a two-line telephone switch is installed, and one line from there is connected to an observation tower on Cardrona Hill. A second line crosses the River Tweed and is carried on the Railway Company's poles for over a mile until the railway enters our ground at Glentress. From there it is carried on our own poles to the gamekeeper's house at Glentress where there is a testing station, the keeper's wife being paid for testing the lines twice daily. There is also a subsidiary station in the toolshed which can be used if the house happens to be empty. From here the line passes, by permission of the Department of Agriculture, through their ground until it again reaches our own areas on Shieldgreen, where a telephone is installed in a forest worker's holding—the holder's wife also being paid for line testing. Here again plugging-in points are provided in the holder's byre for use in case of necessity. A branch of this line is carried to a second observation tower in the old forest of Glentress. In all there is a length of nearly eight miles of telephone line, and seven stations from which telephones could be operated if necessary. Thus a fire alarm can be transferred very quickly from any part of the forest to the Forester's office, where the Post Office telephone is placed for calling outside help, which at present is obtained from the Ministry of Labour Instructional Centre at Glentress.

For the summoning of our own men, who naturally would be the backbone of any fire-fighting squad and on whom we would have to depend entirely in the absence of the Instructional Centre, deck sockets for firing sound signals have been placed at Cardrona fire tower, and at Venlaw. The maroons proved effective on being tested, but as blasting operations are almost continually going on around Peebles a maroon might quite conceivably be mistaken for a blast, so, in conjunction with the sound signals, flag poles were erected on the observation towers and a system of flag signalling arranged. Now, when a man hears a maroon explode, or thinks he does, he is in duty bound to go to a position where he can see one of the towers. The colour or number of the flags or pennants flying tells him where the fire is situated, and he at once proceeds to the scene.

As most of our men live in Peebles, something had to be done to turn them out in case of an alarm after working hours, or during week-ends. A garage owner in Peebles is given a list of the men's addresses and, on being called by the Forester, he sends out a car to collect all these men if they are available, and convey them to the nearest point possible to the scene of the fire.

FIRE-FIGHTING.

By A. GRAHAM.

It is often found by experience that implements suitable for extinguishing a fire in one part of a forest are of little use in another. For instance, we found birch brooms and sacks quite efficient in ordinary grass or heather but nearly useless in an area of coarse grass and dead stems of *Epilobium*. On a rough and hummocky surface strong weed growth prevented the brooms and sacks from reaching the ground and failed to smother the flames. This fire was very quickly extinguished by a man using the Canadian water-pack.

In cases where the flames are high and fierce the water-pack is very effective when used in conjunction with brooms and sacks. If there is water in the vicinity, men should be sent with buckets to carry it to the men with water-packs who attack the fire first, the men with brooms following. Even if the water does not extinguish the flames, it usually damps them sufficiently to permit of attack with the brooms. While fighting a fire, we have always found it best to keep our jackets on. Even if they are uncomfortably hot they prevent the blistering heat of the flames from scorching the arms and body and permit of nearer approach to the fire.

For preparing emergency fire traces, the rutting spade and planting mattock have been found very useful. The method is to rut both sides and, if time permits, also the middle of a trace three feet wide and to tear the turf off with the mattock.

For making emergency fire-breaks in young plantations or widening existing ones, if the trees are not too large, bill hooks and two-pound hand axes are better than long-handled hedge bills and the heavier type of axe, which are very apt to catch on low branches and be a menace to the users. If gorse (whin) is present heavy pruning gloves are essential although gorse may be quickly grubbed up with the planting mattock if kept sharp.

Men should always follow one another along the side of a fire, and not act separately at different points, and advantage should be taken of all drains, small streams, rocks, patches of sparse vegetation, and any natural aid however small, to make a concentrated attack ; anything which serves to gain a few yards is an advantage. If the fire is a very large one and sufficient men are available, a suitable place should be chosen and cleared for counter-firing as a last resort.

If counter-firing is decided on, it should not be left too late. Sufficient time should be allowed to start the counter fire away from the cleared ride and to put out all fires on the wrong side before the heat and smoke of the approaching big fire drives the men away. There can be no rule for this ; it must depend on the speed at which the main fire is travelling.

GIRDLING (RINGING) OF SCRUB.

By I. McKenzie.

As there appears to be considerable difference of opinion regarding the effect of ringing on scrub at different times of the year, an experiment was carried out in Achaglachgach Forest. Operations were commenced in October, 1935, and continued monthly to July, 1936, February, March and April excluded. Groups of one hundred trees were ringed during the first week of each month.

The scrub dealt with was previously thinned to a degree suitable for underplanting with spruce, and consisted of approximately 90 per cent. oak and 10 per cent. ash, birch, rowan, etc. Groups listed from 1 to 5 in the table below contained a good type of scrub, girth over the ringed portion ranging from 10 in. to 38 in. (average 17 in.) at an elevation of approximately 200 ft., and exposed on the E., S. and S.W. Groups 6 and 7 contained a very much poorer quality, girth over ringed portion ranging from 7 in. to 36 in. (average 11 in.) at the same elevation as the foregoing, but exposed on the N. and W.

Ringing was carried out in the usual way, the tool used being a bill hook. The same man carried out all the work.

The results to date are tabulated below :—

Group No.	Date and Cost of Ringing per 100 Trees.	Deaths recorded in Sept. 1936.	Deaths recorded Oct. 1936 to Sept. 1937.	Deaths recorded Oct. 1937 to Sept. 1938.	Total Deaths.
1	1st week of Oct. 1935 .. Cost 7*s.* 8*d.*	24	27	20	71
2	1st week of Nov. 1935 .. Cost 7*s.* 9*d.*	21	42	20	83
3	1st week of Dec. 1935 .. Cost 8*s.* 1*d.*	33	40	14	87
4	1st week of Jan. 1936 .. Cost 7*s.* 11*d.*	17	40	25	82
5	1st week of May 1936 .. Cost 4*s.* 8*d.*	—	—	31	31
6	1st week of June 1936 .. Cost 4*s.* 3*d.*	—	—	47	47
7	1st week of July 1936 .. Cost 4*s.* 3*d.*	—	—	55	55

It is rather unfortunate that it was found impracticable to continue the experiment for a period of twelve months as the foregoing figures appear to justify the assumption—an interesting one—that

the resultant death-rate would vary according to the month in which ringing was carried out, but would fall into four groups, representative of the four seasons. For example, winter-ringing (November, December and January) has resulted, after a period of approximately 3 years, in an average seasonal death-rate little different from that of any month in the winter group taken separately. The fact, previously mentioned, that the June and July groups were of inferior quality to the May group, accounts, in my opinion, for the fluctuating death-rate in the months representing summer-ringing.

It will be seen from a glance at the table that winter-ringing has proved much more quickly effective than summer-ringing and thus raises an important issue, economical as much as silvicultural. Are we at present ringing at the right time of the year ? So far as scrub of small dimensions is concerned under which spruce may be planted, we appear to be on safe ground and the answer is definitely in the affirmative. Immediately we have to deal with larger-sized scrub, however, under which, *e.g.* it is decided to plant Douglas fir, real difficulties present themselves. If the scrub has not been ringed well in advance of planting we run very definite risks of having to remove many of the lower, still living, scrub branches, perhaps 3 to 4 years after ringing has been carried out. This is a costly and perhaps damaging operation which winter-ringing would, to a considerable extent, have prevented.

In conclusion, this would seem to be a job well worth keeping in hand for spells of bad weather during the winter months, when draining, etc., could not be attempted.

MISCELLANEOUS NOTES.

Salesmanship.

From time to time there is a spate of correspondence in the Press about training for salesmanship. It is stated that on the productive side of industry Great Britain for the best part of a century led the world, and for that very reason has never until lately been compelled to concentrate upon the art of salesmanship. Her goods in the last century sold themselves. Now that she is faced with productive competition from all over the world, she is realising for the first time the importance of efficient selling.

The same truth is beginning to apply to the Forestry Commission. In going about the country and interviewing a great variety of people —county and borough surveyors, nursery gardeners, fencing contractors and others—who use the smaller products of the forests such as posts and stakes, one is astonished to find what an absolutely new idea it is to most of them to learn that the Commission has anything to sell and is prepared to quote prices and arrange for deliveries and generally behave like any other producer who has a commodity he desires to market. Some know vaguely that afforestation is going on, that waste places are being reclaimed and bare hills clothed with trees, but the annually increasing output of marketable underwood and thinnings is a revelation to them. Every other commodity that they can use is brought to their notice by persistent canvassers, representing either the producer or the middleman, but the Forestry Commission, the largest producer of forest produce in the country, in spite of its antipathy to rabbits, emulates the immortal member of that race by " lyin' low and sayin' nuthin'."

Two of the most important factors in salesmanship, apart from being able to deliver the goods, are probably imagination—applied to the possible uses of the product—and the maintenance—not merely the making but the persistent maintenance—of personal contact with potential customers.

Privately-owned woodlands differ immensely from one another in the financial success of their administration, largely because the estate agents and foresters in charge of them are in some cases able to combine the above characteristics with efficient silviculture, and in others either do not possess this flair for the commercial aspect of their work or else are not allowed the time and opportunity to use it.

Whether any more could be done than is already being done by the Commission's officers and foresters throughout the country, or whether in the near future a definite selling organisation on a fairly wide basis, kept distinct from silviculture, will need to be developed, it is not for the writer to do more than speculate.

D. Maitland.

Germinative Power of Robinia.

In the spring of 1935 I sowed a pinch of *Robinia pseudacacia* in a 6-ft. drill an inch deep on sandy loam overlying greensand ; all that came up were pulled out except two, one at each end of the row. In December of 1937 the two remaining trees were dug out, these being then about 8-10 ft. in height. In the spring of 1938 I was rewarded with another crop from the same pinch of dormant seed ; that year's plants ranged from 2-4½ ft. in height.

J. Harper.

Large Corsican Pine at Thetford.

In the Lakes Plantation at Hockham, the north-eastern extremity of Thetford Forest, there are several large Corsican pines in a small hardwood area. One of the largest of these pines was blown down in a recent gale and the opportunity was taken to obtain some measurements. The tree was a little over 90 yrs. of age and measured 100 ft. to the tip, but at 57 ft. from the ground the stem forked into four erect branches which were all of about equal length. At breast height the quarter-girth was 27½ in. and at 28½ ft., 22 in. which made the content of the stem, up to the point at which it forked, to be 191 cu. ft. In the four upright limbs there were about 40 cu. ft. more, making the total content 230 cu. ft. Leading shoots were measured as far back as possible along the stem from the tip. These measurements showed that in the last 10 years the tree had grown 6½ ft. and in the preceding 10 years' periods before that, 6 ft., 7¼ ft., 8¾ ft., 9¾ ft., 12 ft. and 18¼ ft., respectively. The longest shoot recorded was 36 in. somewhere between 15 and 20 years of age.

This tree was growing on rather better land than the average Thetford soil, as there is an admixture of clay with the sand.

J. Macdonald.

Thirsty Nature of Breckland Sand.

Adjoining the Commission's property at Mildenhall Forest, a firm of well borers was engaged during the summer in providing a substantial supply of water for the neighbouring community. Part of the contract stated that a 14-days' continuous full-bore test must be satisfactorily carried out.

By arrangement, the water so pumped was sent down a ditch on our land. This ditch, from the point at which the pump hose was fixed, to a large soak-away pit measured 400 yards. Pumping for 24 hours per day was started and continued for the 14 days, the quantity of water reaching 10,000 gallons per hour and never falling below 7,000 gallons per hour. The sandy soil, overlying

pure sand which goes down 25-30 ft., absorbed this water so greedily that even at the maximum pumping effort water did not flow beyond 200 yards down the ditch.

H. JOHNSON.

FOREST FIRES.

During the last 10 years fires have cost the Commission £300,000. Plantations valued at £150,000 have been destroyed and £150,000 has been expended in preventing further destruction.

More than 5,000 fires occurred, burning altogether a planted area exceeding 17 square miles. This area is equal to half of the planting programme of 1938 and to 5 per cent. of the total area planted during the decade. It is estimated that more than 11,000,000 trees were destroyed.

Although fires occurred at 167 forests most of the damage was confined to 10 units. Four units, Cannock, Gwydyr, Margam and Thetford, suffered a loss between them of 4,000 acres valued at £56,000; while if the losses at Bramshill, Woolmer, Rheola, Tintern, Ferndown and New Forest are included there is a total of approximately £100,000 (6,750 acres) at these 10 areas. New, Thetford, Dean and Gwydyr forests had between them 2,500 fires.

Railways caused the greatest number of outbreaks with an aggregate of 2,200 of which the L.N.E.R. were responsible for 1,700. Of 1,100 reported as being of unknown origin it is probable that most were caused by the general public. Fires numbering 500 spread to Commission property from adjoining land causing a loss of £40,000. Most of these also are attributed to the public. It is no exaggeration to say that during the last 10 years carelessness and ignorance on the part of the general public have caused more than 2,000 fires in State Forests with a loss to public funds approaching £100,000.

Nearly 1,500 claims for compensation have been made and the Commission have to date succeeded in recovering £15,000.

How many fires the Commission's standard fire notices have prevented it is impossible to say. It is suggested that the notices would be more effective if couched in sterner language.

H. CHARTERS.

TRAPPING OF OTIORRHYNCHUS PICIPES.

In an area where these weevils normally destroy 90 per cent. of newly planted trees, a clear felled area of about ¼ acre was replanted with Japanese larch (the most susceptible species) on screefed sites, and various types of traps laid. All the traps were moderately effective, but one type only was retained and increased in numbers, being efficient under all circumstances, as many as 30 weevils having been found under one trap. This type of trap was a chip, preferably

dry, laid at the base of and touching each tree. The weevils come to rest under this chip during the day after feeding at night.

Weevils first appeared on 22nd April, but in no great numbers, and as trapping was then in the experimental stage recording did not commence until 2nd May when 160 were caught. The numbers increased daily until 16th May when 730 were caught. The decline was even more rapid, falling to 60 on 20th May. The total number recorded was 3,500. Daily inspection and recording were abandoned, as occasional checks showed further reductions in numbers and no signs of a second brood.

Failures on this area amount to 12 per cent., most of which can be ascribed to clay weevil. Several of the surviving plants have lost their leading buds, which is to be expected as this is the first point of attack, and the weevils feed at least once before retiring to the trap.

The following points of interest have emerged :—

(1) During the whole of the period of trapping, no more than a dozen weevils were found feeding, showing the extent to which the pest may go unnoticed or unidentified.

(2) It is important that the screefed sites are kept clear of any scrap of humus under which the weevils can hide.

(3) If the trap is not actually touching the tree the weevils seem to prefer other cover and none was found under chips lying all over the area.

(4) Traces of the remains of weevils show that spiders have been at work under the chips. Having seen a spider tackle a weevil, which is a soft-bodied species, there seems no doubt that spiders help to reduce the numbers, and the chip traps afford them dry cover.

(5) As the season advanced, magpies discovered the food supply under the traps, and would systematically turn them over, presumably collecting the occupants as none was found afterwards.

In view of the shortness of the season the burning of brushwood during the period seems to suggest itself as a remedy. Dry conifer humus seems to be the insect's natural cover and as much as possible of this should be burnt. It is doubtful if this pest would become serious, where pheasants are present. As already mentioned the weevil hides during the day and can only be found by birds which scratch the soil.

B. GALE.

OAK ON HEAVY ARABLE LAND.

Much has been learned during the past few years about sowing and planting oak on heavy clay. It has been noted that sowings flourish the first season and then seem at a standstill and even appear to get smaller ; this, of course, is owing to the leaves' being

much smaller after the first season. Transplants also seem almost at a standstill for several years in some cases, whereas on old woodland both seedlings and transplants get away much more quickly. The roots seem unable to penetrate the clay below the depth of about 7-9 in., this being the depth the old arable land has been cultivated for years. Gradually one sees a plant or seedling here and there commence to make headway, often right in the open with neither nurse nor shelter of any kind.

In dry seasons the clay pan has a tendency to crack, sometimes to a depth of several feet; this of course takes some time to close up, consequently a certain amount of weathered soil filters into these fissures. Once a root gets into one of these filled-up cracks it can make a downward trend, hence we get an uneven crop from the start. This, I am sure, goes to prove that heavy clay soils should be broken up to a good depth before sowing or planting. This could be done for about thirty shillings per acre with a gyro-tiller and would be more than saved in weeding costs as one would get a more vigorous growth and plants would soon be out of the weeding stage. I trust that our experience and the anxiety of waiting and searching for seedlings and plants in rank dense grass and wondering if they will ever get away, will be of some assistance to other planters of oak on clay land. Experience is a bitter school, but one minds less if one's experience means gain to someone else.

During the summer of 1938 the Royal English Forestry Society paid a visit to the Apethorpe oak areas; the members were all agreed on one point, that it was the clay pan that had retarded the growth of oak in the early stages. I had soil pits dug showing the pan quite plainly and many agreed that if this was broken up the plants would stand a far better chance. The only nurse I have found that has made any marked difference in getting oak away is alder and unfortunately it was rather late in the day before they were put in. They were planted four years ago at a distance of 9 ft. by 9 ft., both grey and common alder being used. A marked difference in height has been made during the last two seasons.

W. COTTENHAM.

KEEPING A NURSERY CLEAN.

One of the greatest difficulties experienced in most nurseries is the keeping down of weeds, more especially as our nurseries are often kept fully stocked and very little ground is available for fallow. Summer fallow is the most effective means of cleaning dirty ground however bad it may be, and of destroying cockchafer grubs at the same time, but as this method can only be applied to a limited area other methods have to be resorted to.

The worst weeds I find to deal with in my nursery are sheep's sorrel, couch grass, and yarrow. All these weeds have under-

ground runners and the ground cannot be cleaned thoroughly once it is planted or sown. The best way to deal with weeds of this type is to have the soil forked over as soon as possible after the plants have been lifted, and all the roots removed by hand-picking. A spade should not be used for this job as it cuts the roots up into numerous small pieces, thus making the process of cleaning more difficult.

Weeds of the dock and dandelion type are best dealt with as they appear in the spring by pulling them out by the roots even at the sacrifice of a few seedlings as, if they are only broken off, they spring up again with renewed vigour.

Where nursery ground is infested with weeds of the annuals, such as groundsel and chickweed, they are best dealt with as they make their appearance. This is easy in the case of lines as a run through periodically with a wheeled hoe on a sunny day will destroy all in between the lines. Those actually in the lines can be pulled out when they get bigger, but in no case should they be allowed to seed. In seedbeds, of course, they will need to be hand-weeded.

It is essential to start weeding as early as possible, especially where large areas have to be gone over, otherwise before the weeding is done some of them will have had time to seed. Care should also be taken to prevent their seeding on the paths, or in hedgerows bordering the nursery. All weeds are very prolific, and it is surprising the number of seeds given off by a single plant. It is necessary therefore to pull out all weeds and not merely the large ones.

Care should be taken when applying farmyard manure to see that it has been "heated" before it is put on the ground. This is done by leaving it in a heap for a few weeks, which causes it to warm up inside and most of the seeds germinate and consequently die.

I have found these methods most successful, and weeding costs have been reduced to a minimum.

W. F. C. Middleton.

Making Culverts on Forest Rides.

It is often necessary for drains to cross extraction rides when new draining is in progress, and pipes are not always obtainable in the vicinity. Even if they are, unless they can be put to a depth of at least 2 ft. 6 in., they will not stand the weight of a heavy load. I find that a good serviceable culvert can be made without pipes by using stout timber, preferably oak or chestnut.

First of all, the drains should be dug through the ride at the correct depth, at right-angles to the ride if possible as this ensures that vehicles pass over evenly, because there is bound to be a slight rise in the ground when the culvert is complete. Next, dig out a strip of soil on either side of the drain about 12 in. wide by 12 in.

deep. This should be finished off level so as to form a shelf on either side. At the ends of the culvert the shelf should be cut about a foot wider on each side.

The timber used ought not to be less than 12 in. diameter. It should be split in two and laid with the flat side downwards on the shelves, and across the drain. Smaller timber can be used in the round but is not so satisfactory as the weight is not so well distributed over the shelves.

Two longer pieces are needed to act as " keeps " ; they should be firmly bedded in on the wider shelves at the ends. The shorter pieces can then be fitted firmly in between. If the sides of the billets have been trimmed up with an axe a specially good fit can be obtained. Chips and trimmings can be used to fill up crevices after the floor has been laid. About 6 in. is then left which should be filled with soil and stones, rammed tight. The culvert is now complete.

The approximate costs of preparing such a culvert, assuming the width of the drain to be 2 ft. where it is crossed and the width of the culvert about 9 ft., are :—

Cutting of shelves		5*s.*	0*d.*
Felling and preparing timber :			
2 pieces 5 ft. 6 in. long and 7 pieces 4 ft. long		12*s.*	6*d.*
Fining timber and covering in		7*s.*	6*d.*
Total cost ..	£1	5*s.*	0*d.*

W.F.C.M.

Trapping of Deer.

The damage done by roe and fallow deer in Forestry Commission areas is extensive, especially so in some particular areas. Apart from damage such as the rubbing of Scots pine, larch and oak, ash can never be grown successfully while these animals are roaming the area. There seems, however, small hope of reducing their numbers permanently while they are allowed to escape from preserves in surrounding private parks.

The wiring of runs seems to be the most effective method of trapping, and the best time is during the hottest period of the year when the deer, being tormented by flies, are racing madly from place to place. The wire, with a running loop, should be placed in a part of the deer run where the brush is fairly thick on both sides. A little disguising of the wire is necessary, and the loop should be about 18 in. in diameter and the bottom of the loop about 2 ft. 6 in. from the ground. Drains through coppice areas are used extensively as a highway by deer, and these drains can be wired with success.

Out of a total of thirty-two deer killed at Chiddingfold Forest during the year just ended, twelve of them were caught in wires

during two weeks of the hottest weather. Had intense wiring of runs been carried out during this hot spell I am sure that we should have caught many more, and we intend doing this another year.

Periodic drives, with plenty of guns, a few beaters, and especially a good dog or two, can help to reduce the number of deer. The yapping of the dog, or dogs, gives the guns warning of the direction in which the deer are travelling.

S. H. Williams.

Keeping Dry.

Many foresters have at one time or another been concerned with "keeping dry," especially during the winter months ! I have tried innumerable makes of garments, often at some considerable expense, only to find that few will stand up to hard wear and wet weather. They are sometimes unsuitable in that they restrict freedom of movement or fail to give that length of service which we hope to get from something dearly bought.

For the past two winters, others as well as myself have managed, to our utmost satisfaction, to attain the almost impossible condition of being impervious to storms. The material known as Beacon Green Thornproof certainly lives up to its name, for what a revelation to those of us who have to weed amongst blackthorn and briars to find these garments really foolproof, not only just for a few weeks, but ready for a second year's wear. It has only to be tried to be appreciated. With regard to individual requirements and costs, I favour the outfit consisting of hat, pullover-leggings and coat (price £2 17*s*.). The leggings should be wide enough to slip on easily over rubber boots ; they should be 28 in. wide at the thigh and 26 in. wide at the ankle where the legging is fastened with strap and buckle, which I consider to be almost essential, especially whilst tramping through high vegetation.

J. K. Massey.

Flushing of Second-year Oak Seedlings.

It may be of interest to know the different months in which some acorns were sown and the time of flushing in the second year when left in the beds to become 2-yr. seedlings. The acorns were all of the same consignment—ex-Chiddingfold. As the soil of the nursery in my charge is a rather stiff clay, the sowing has to be done over a period of four to five months when the weather and soil conditions are suitable.

The first batch of acorns was sown in December, 1936, and other batches in February, March and April, 1937. The first spring they came up in the order of sowing, and in the second year one would think they would flush more or less at the same time, but I noticed

this was not the case. The acorns that were sown in December and February had flushed by the 16th May but on the 21st May there was a sharp frost and the plants were damaged rather badly. The acorns sown during March and April did not flush until approximately the 30th May, therefore escaping the late spring frost, and as they were not checked were the best plants. I cannot say if it is the general rule for oak seedlings to do this as I only noticed it during the spring of 1938.

H. R. HALSEY.

CROOKED ROOTS OF ASH SEEDLINGS.

I have found that one of the causes of crooked roots of ash seedlings is the use of pre-germinated seed. By sowing two or three bands with pre-germinated seed it was found on lifting the seedlings that approximately 25 per cent. had crooked roots, compared with 5 per cent. found in the other bands sown without any pre-germinated seed.

H.R.H.

HIDING TOOLS.

Hiding tools when the men cease work each day appears to be a general rule where the toolshed is not within a reasonable distance of the work. I should like to suggest having a long tool chest constructed similar to the type used by the County Councils. If not already in existence, it could be made out of ¼ in. or 1 in. floor board to a size which would be easy for two men to carry when empty. When the tools are inside the chest it could be fixed to a tree or large root by a chain and padlock, and the charge-hand could hold a key as well as the Forester. On an area where a permanent cart is maintained a much larger chest could be used.

Such a chest would be essential on areas consisting of downland with public footpaths.

R. DIBDEN.

FIRE NOTICES.

I have observed that the general public pay much more attention to notices displayed in the following form than they do of the general fire notices:—

"NO ADMITTANCE,
PLANTED
YOUNG TREES."

Such notices have been displayed in prominent places at the gate entrances to young plantations adjoining the main roadsides.

I should like to suggest that when new fire notices are prepared the words "No smoking allowed" and "No oil stoves allowed" are added and "Don't drop matches or cigarette ends" deleted, as it should not then be necessary. I feel convinced that the suggested alteration in wording would be an improvement.

H. C. DYER.

TIMBER-FELLING.

As one who has had a good deal to do with the felling of large timber I have often wondered where the Forestry Commission will get their skilled woodcutters in the future. Speaking for High-meadow, where some of the largest oak in the country grows, it seems to me the foresters of the future will be up against it to find men capable of dealing with this class of timber.

Years ago the son of an old woodcutter was brought into the wood, as soon as he left school, to help his father, and by the time he was in his late teens he was capable of carrying on alone. In these days there is no one learning the job; we have men doing thinning and it may be thought they will be able to take the place of the present cutters, but I have my doubts.

Felling large timber is a skilled job, takes years of experience and is much more difficult on hillsides than on flat ground. It is a very easy matter to spoil valuable timber by throwing it the wrong way, or by failing to key it. Cutting keys is also a very skilled job and must be done with leaning trees, otherwise the pull of the tree will cause the trunk to split when the saw may be only half way through. The key should, if possible, be on the opposite side to where the tree has to fall and a strong root should be chosen; it has a hole cut through it large enough to insert a saw, leaving enough of the root to hold the tree after the sawing has been done; the saw is taken out and a man with an axe cuts the key through and the tree falls of its own accord.

In some cases there may not be a root in which to cut a key. In this case it is necessary to "backsaw" the log, that is to start sawing in the opposite direction to which the tree has to fall. The principle is the same as keying but no spurring-in is done where the key should be, this being left to hold the tree until sawing is completed. Where this method has to be adopted sawing is rather difficult as the weight of the tree is on the saw, but it can be eased after sawing has proceeded far enough to insert a wedge.

Cutting large timber on hillsides is very skilled and dangerous work (especially when trees are thrown at right angles to the hill as is sometimes necessary) and calls for experience and foresight, and unless this is forthcoming serious injury may result.

W. J. HUMPHRIES.

Pruning Douglas Fir in Highmeadow.

During the winter of 1937-38 we pruned about 18 acres of 22-yr.-old D.F. Two men were put to do the job at day-work rates, the tools used being a curved hand-saw with pistol grip, a detachable saw fixed to a 10-ft. pole, safety belts and ladders. The method of pruning was as follows. First the pole was used to a height of about 12 to 14 ft., then with the aid of the ladder the man would climb to the desired height and prune the tree down using hand-saw and safety belt. Sometimes when it was raining the men would do all pole-saw work, going back to do the climbing when it was dry.

After they had been at it a few days the men complained to me about the wear and tear of their clothes. I applied for a suit of overalls for each but was informed that these could not be supplied and I had to consider the fixing of a piece-work rate. This was done, the price paid being as follows :—

Average Height pruned.	*Average Q.G. at 4 ft. 6 in.*	*Price paid.*
27 ft.	6¼ in.	3½*d.* per tree.
24 ft.	6 in.	3*d.* per tree.

The men were able to get about 1*s.* per day extra that way, so I heard no more about wear and tear of clothes, but I must say in fairness to the men that pruning D.F. in the dead of winter is a rough, dirty job. During the time the men were at this work we had long spells of fog and rain and often when it was not raining the stems would be running with water. Another big handicap to the men was that, owing to the density of the plantation, it was difficult to see to work after about 3.30 p.m. on some days.

I have seen it suggested that costs can be greatly reduced if boy labour can be employed, but in stands of this size where climbing has to be done I think it is a man's job, as boys are not strong enough.

W.J.H.

Douglas Fir Wolves.

During the last few years I have tried several methods of dealing with wolves in various age stands of D.F., such as cutting them to the ground, ringing and topping. Where the spacing it 5 ft. × 5 ft. or 6 ft. × 6 ft. and the tree is cut out a blank is left 10 ft. × 10 ft. or 12 ft. × 12 ft. as the case may be and the freed trees are liable to be blown or develop into wolves themselves.

I think the best method is topping back well below surrounding trees, leaving as many green branches as possible ; by doing this there is little risk of windfall and the topped tree prevents the others developing side branches, helps to form a canopy and may grow into a

useful pitprop, to be taken out in future thinnings. The best age seems to be 8-10 years, but much depends on the growth of the plantations.

W.J.H.

Forest Fires in established Plantations.

The spring of 1938 must have been a record one for forest fires. The fire danger period in this section of Monmouth and Gloucester was approximately three continuous months. Of the fires recorded, two occurred at Tintern at 9.30 p.m. and midnight. As most foresters know, it is more difficult to deal with a fire at night than it is in the daytime, especially in getting the necessary help promptly.

The 9.30 p.m. fire occurred in P.29 E.L. not quite ready for brashing but in the dangerous stage. Inspection paths about 5 ft. wide had been made ; they were, of course, of no advantage in this class of plantation, with a strong wind blowing.

The midnight fire occurred in Chepstow Park, an area approximately 1,000 acres in one block. The area burnt was a P.22 mixed plantation of Douglas fir, E.L., coppice, with the usual bramble and bracken crop and a very rocky surface. It was situated on a N.E. slope, and with a N.E. wind behind it the fire reached the top of the slope and crossed a 30-ft. ride into a broadleaved belt which proved of great value and a favourable stopping place. Otherwise it would have reached a further conifer plantation which extended for another mile. This fire, luckily, was noticed by a passing motorist and reported to the nearest police station. Patrols and fire station men had left and most people had retired, but fortunately telephonic communications caused little time to be lost, the fire being extinguished at 11 acres. This suggests that in very dangerous periods fire stations should be manned until midnight in certain districts, at the discretion of the local officers. The chief weapons used for extinguishing this fire were young Douglas fir, shovels and birch brooms. The hacker or bill hook was useful in cutting the Douglas fir for beaters.

I would suggest that all plantations should be brashed, if possible, as soon as they reach the thicket or dangerous stage. If the whole area cannot be brashed, then brash ride and roadside belts with additional belts through the plantations at intervals at least one chain wide ; they would form inspection paths and a valuable line for extinguishing a fire. Brashed conifer plantations are still dangerous for a year or two, but they can be dealt with much more easily and a crown fire may be averted if the necessary tools, axes and hackers are at hand. Therefore another essential is the supply of a collection of tools, kept in the most convenient places during fire danger periods where they

can be collected by car or lorry, if necessary, and taken to the fire area without delay. The best tools are axes, hackers, long-handled hooks or brashing hooks, shovels, and hurricane lamps for night work.

T. Lewis.

Enamel Fire Notices.

It may interest others to know that I find the provision of a hood to a fire notice prevents rain from getting between the notice and the board, thereby keeping out rust and prolonging its life. On taking down an old notice it is cut lengthwise into four strips, one of which is nailed at an angle of about 45 degrees on the top of the board upon which the new notice has been fixed. Besides extending the life of the notice it leads to a saving in labour and materials.

One sample of a heavier quality enamel notice was received in 1936, and after two years of wear with the type of hood described it is as good as when erected and looks like lasting another four or five years. The new type is a great improvement upon earlier ones, but the old notices still have one use in that they will supply hoods until the stock is exhausted.

A. E. Walker.

The Wild Life of Dean Forest.

The following are the birds, animals, etc., I have noticed at various times in the Dean Forest :—

Birds.—Bat, barn owl, brown owl, little owl, long-eared owl (not recently), kestrel, sparrow-hawk, forked-tail kite (not of late years), swan, heron, mallard, teal, widgeon, coot, gule, moor-hen, little grebe, dipper, kingfisher, water rail, land rail, carrion crow, rook, jackdaw, jay, magpie, plover, pheasant, partridge, curlew, woodcock, snipe, woodpigeon, dove, cuckoo, nightjar, lark, missel-thrush, song-thrush, blackbird, fieldfare, redstart, grasshopper warbler, wood warbler, yellow-hammer, robin, wren, goldcrest, nightingale, green woodpecker, greater spotted woodpecker, blackcap, chaffinch, hawfinch, bullfinch, goldfinch, sparrow, starling, green linnet, tit, long-tailed tit, gorse-chat, whitethroat, tree-creeper, pied wagtail, yellow wagtail, swallow, swift, marten.

Animals and Reptiles.—Fox, badger, otter, stoat, weasel, mole, vole, shrew, fieldmouse, dormouse, hedgehog, fallow deer, hare, rabbit, red squirrel, grey squirrel, grass snake, adder, slow-worm.

F. Smith.

Trees and Shrubs of Highmeadow Woods.

An interesting feature of the Highmeadow Woods, in the Forest of Dean, with its various geological formations, is the number of species either indigenous or long introduced which may be found there, and it would be interesting to know if any other Division can claim a greater variety than the following :—

Alder, ash, aspen, beech, birch, blackthorn, buckthorn (alder), buckthorn (common), cherry, chestnut, crab, dogwood, elder, elm, guelder rose, guelder rose (mealy), hawthorn, hazel, holly, hornbeam, lime (small leaved), lime (large-leaved), maple (field), mountain ash, oak (pedunculate), oak (sessile), plum (wild), privet, sallow, spindle, sycamore, service, hybrid pyrus, whitebeam, willow (black), wych elm.

F.S.

Snow Damage to Rabbit Fences.

During the last few years we have had several very heavy snowstorms in Peebles-shire and much damage was done to our rabbit fences which were erected with posts six feet apart, and two number 8 wires, one at the top to which the netting was tied, and one 9 in. from the bottom. The damage caused not only a heavy bill for repairs but allowed the ingress of a large number of rabbits to the plantations before repairs could be effected. Fences at high elevations (some of ours are at a height of 1,500 ft.) and those behind old stone dykes where deep drifts collected, suffered most. In some cases the top wire was broken in many places, and the netting torn to pieces. The netting was replaced only to be damaged again by the next storm. The fences were strengthened by adding more posts, but this did not help much. We found, however, that the addition of a third plain wire a foot below the top one, to which the netting also should be laced or tied, took much of the strain off the top wire, and in most cases wholly prevented damage. This naturally increased the initial cost of fencing, but it was well worth while, as the repair bills far exceeded the cost of adding the third wire, and, of course, it is only required in exposed situations at high elevations, or where drifts are to be expected. The stakes also should be driven as nearly home as possible where the fence is exposed to high winds.

A. Graham.

Grant Schemes.

I have found the following form of great value in the oversight of Grant Schemes, and have every confidence in recommending it to other officers. It shows at a glance all the schemes on an estate, and

none can be overlooked. The year when each inspection is due is filled in at the top. When an inspection has been made, a line is drawn through the figures, thus any year's figures not crossed out indicate when further inspections are due. The form is kept in the relative scheme file, and is of foolscap size.

SCHEME No.....

Estate..... County.....

1 in. O.S. Sheet .....

Square.....

INSPECTIONS DUE.

First							
Final							

Proprietor .....

Factor.....

Forester.....

Planting Year.	Location.	Proposed.		Certified.		Payments passed					
		Cf.	Hw.	Cf.	Hw.	First.			Final.		
		Ac.	*Ac.*	*Ac.*	*Ac.*	£	*s.*	*d.*	£	*s.*	*d.*

J. W. MACKAY.

DRAINING.

No doubt many Foresters have difficulty in finding work for a full squad between the completion of the planting programme and the beginning of the weeding. I have overcome this difficulty by postponing the bottoming of drains till the planting is finished ; by that time I find that the soil in the drains has softened a great deal, and is much more easily removed than it is when the drains are first opened. Furthermore, I find that many of the drains have already cleaned themselves.

Quite a lot of money may be saved in this way, with the additional advantage of not having to pay men off at the end of the planting season, and having to look for extra men for the weeding.

M. MACRAE.

VOLES.

In the 1933 JOURNAL, Mr. A. H. Gosling contributed an article on damage by voles as experienced in what I term the " 1931 plague."

In the later months of 1937 and early in 1938 there was a very marked increase in the number of voles on certain sections of Benmore Forest. This increase might have been due to the very mild autumn and winter. About March, 1938, the vole menace on these sections reached plague dimensions and damage similar to that previously described resulted. There is only one point on which I wish to write a few lines regarding voles and that is the relation between the number of voles and quantity of moisture.

In the article referred to it was stated that damage is usually particularly severe on areas with a dense juncus-molinia vegetation. From our experience this year the possibility is that damage is more severe on these areas owing to the retentive nature of the vegetation. Shortly after the very dry period in April commenced, it was very noticeable that the number of voles was decreasing rapidly, first on bracken and heathery areas, then on grass, and lastly on juncus-molinia areas, so it would seem that lack of moisture was a deterrent to the vole. To support the above statement it might be noted that Norway spruce planted on mounds on juncus areas after the dry spell were much less damaged than those planted on similar areas previous to the dry spell. Again, it was noticeable on grazed areas that during the dry period voles increased in number, perhaps owing to the fact that there was more moisture on these grazed areas due to less drainage.

I have often argued as to the possibility of grazing plantations of from 4 to 5 years and upwards during vole plagues, but have been rebuffed by the statement that voles are no less plentiful on grazed areas than on forest areas. Might it not be the case that voles are only markedly plentiful on grazed areas during dry periods when there is an exodus from less moist areas? If such be the case why not let us experiment with the grazing of vole-infested areas in an endeavour to reduce such heartrending damage ?

Mr. Gosling agrees that the grazing of vole-infested plantations 4 to 5 years of age and upwards might prove advantageous in certain cases and is worth a trial, but he thinks the grazing available in such cases is often not attactive, especially when voles are plentiful.

Considerable fencing may also be necessary to confine the sheep to the area required. One such area was offered for grazing this year but it was not taken up.

R. R. DONALD.

ENGINE OIL AS A PRESERVATIVE.

I read a few months ago in a monthly magazine that oil drained from motor car sumps mixed with creosote was an excellent preservative for fence posts, sheds, etc. During the summer I had creosote and old oil mixed in the proportion of 1 to 2 respectively and had byres and poultry houses treated with the mixture. The mixture used was merely an experimental one. From the point of view of appearance the result was very good and in the west of Scotland where we can have 8½ in. of rain in one week the preservative quality will soon be proved. The creosote penetrating into the wood takes a percentage of the oil with it. The oil has the effect of extra waterproofing as well as improving the appearance resultant from the proportion of graphite present in the oil.

It is an excellent way of getting rid of old oil, and buildings can be treated more frequently owing to the lower cost of treatment.

R.R.D.

THE WEATHER DURING 1938 IN ARGYLL.

The year 1938 will be long remembered at Benmore, Glenbranter and Glenfinart as one in which drought, abnormal rainfall, spring gales and late frosts were all experienced. The rainfall figures recorded at the meteorological station at Benmore (46 ft. above sea-level) were :—

1938	*In.*
January	15·64
February	8·36
March	10·42
April ..	1·67
May ..	5·14
June ..	9·07
July ..	6·89
August	5·74
September	8·98
October	16·93
November	17·66
December	10·07
	116·57

From 6th April until 8th May we had a period of drought and only one-tenth of an inch of rain was registered. To add to our troubles this happened at the very time when the rush of transplanting was on and we had to resort to the puddling of the roots before lining-out—an unknown necessity, in my experience, on the west coast.

In contrast to this, from 9th September to 17th December—100 days—we had only 2 days which failed to register rainfall during the 24 hours. The heaviest fall was from 2nd to 4th October. During those three days there was a fall of 5·5 in. This caused about a dozen large landslides on the steep hill-slopes, and necessitated a large amount of drain cleaning, etc.

In May we had on the thermometer, at 1 ft. above ground, the following readings :—

25	deg.	F.	on	the	2nd	May.
24	,,	,,	,,	,,	5th	,,
29	,,	,,	,,	,,	7th	,,
24	,,	,,	,,	,,	8th	,,
28	,,	,,	,,	,,	10th	,,
29	,,	,,	,,	,,	19th	,,
27	,,	,,	,,	,,	20th	,,

This, along with the drought and a fairly early flushing season, caused a good deal of damage to nursery stock.

On 20th June we had a gale and many of the soft immature leading shoots of the Sitka spruce were broken off. In parts of Glenshellish (P.23 and P.25) in Glenbranter Forest, more than 50 per cent. of the trees were affected. However, lateral shoots are already showing signs of assuming the vertical and next season may show that the damage is only temporary.

H. Watson.

Storm Damage at Glenbranter.

The afternoon and night of 3rd October, 1938, was one of the wildest within living memory here. A high S.W. gale accompanied by a torrential downpour of rain was responsible for extensive damage throughout the forest, to F.W. Holdings and to roads. From late afternoon on Monday (3rd October) to 9 a.m. Tuesday morning a record day's rainfall of 3·35 in. was recorded. The bulk of this rainfall fell in the short space of four hours, from 6 p.m. to 10 p.m. on Monday night when the rain fell in sheets. It was, in fact, somewhat of the nature of a prolonged cloudburst and so great was the volume of water carried down off the hills that conduits were unable to cope with the rush of water, and severe damage was done to roads throughout the forest. In one instance about 15 yds. of roadway subsided into the river.

The severest damage occurred in several of the plantations, notably P. 29, where the ground is very steep. Here, extensive landslides swept down the hillsides carrying the trees before them. In P. 30, in one part, about ½ acre of Japanese larch was completely buried under many tons of grey mud and boulders. One mountain burn had a complete new channel carved out for itself; another was considerably deepened by the passage of enormous boulders and silt which were carried down to the bottom of the slope leaving a tide mark of about 10 ft. in height in some parts.

The noise of these landslides could be heard above the roar of the storm and occurring as they did, at a late hour of the night, caused no little alarm to forest holders living in the vicinity.

All the slips originated above the planting line, clearly illustrating the value of afforestation as regards preservation of soil. To minimise the risk of further slips extensive draining will have to be carried out above the planting line.

WILLIAM MACDONALD.

AN IDEAL FOREST AREA.

If you are a motorist you may decide to take a motor tour through the north of Scotland next summer. If you do, then keep a lookout for the Ideal Forest. Perchance you may meet the Forester who, on being questioned, will supply you with the following information.

The forest is one of approximately 6,000 acres, all of which are plantable, with gentle slopes and numerous terraces. The vegetation is mixed, *i.e.* good hill grasses, heather, bracken and fairly large areas of birch, oak and hazel scrub. The forest slopes upwards on either side of the main road which runs through the centre of the forest.

To begin with the entire 6,000 acres were enclosed with a six-foot deer fence. A temporary fence was then erected enclosing approximately 1,500 acres. The planting programme is 200 acres per annum. There is a home nursery which supplies all the requirements of the forest, thereby ensuring the acclimatisation of all transplants.

There are ten F.W. Holdings on the area. Two holdings are at each end of the forest and the remaining six, along with the Forester's house, are situated about the centre of the area. There is an average of two forest workers on each holding. For fire protection purposes each group of holdings is connected to the Forester's house by private telephone. Each holding has sufficient arable ground for the upkeep of one cow and follower and some poultry. The annual rent of each F.W. Holding is £12 and the holders are permitted to cut firewood from the scrub areas, thereby reducing the cost of thinning out the scrub. Each forest worker

receives a steady weekly wage of 45*s.* and the holders and their families live on excellent terms with one another.

In order that the part of the area not enclosed by the temporary fence may not lie idle the Commission have put on a stock of sheep. Each holder has bought himself an equal share in the sheep stock, the holders having formed themselves into a sort of club and each member takes it in turn to look after the sheep.

Rabbits are fairly numerous but are kept well under control by the trapper, at the same time providing a source of income. Blackgame are not very numerous but there are a great many pheasants and at the appropriate season of the year a shooting party, composed of Commissioners, arrives for the pheasant shooting, for the pleasure of which they are charged a nominal sum, thus providing a further source of income.

The Commission have erected a sectional hut in a central spot where the workers and their families meet at intervals for concerts, dances, carpet bowls, etc. There is a railway station about three miles from the forest and a regular 'bus service to the nearest town.

Having read so far you will no doubt wonder where the Ideal Forest is situated? Well, as a matter of fact it does not even exist, but if it did I should like to be the Forester—wouldn't you?

W. F. Stoddart.

LIST OF TECHNICAL STAFF.

Headquarters.

At 25, Savile Row, London, W.1.

Story, Fraser, Education and Publications Officer.
Guillebaud, W. H., Chief Research Officer.
Bird, B. M., Development Assistant.

Census and Plans.

Wynne Jones, E., Divisional Officer.
Chard, J. S. R., District Officer.
Maund, J. E., District Officer.

At Imperial Forestry Institute, 18, Museum Road, Oxford.

Sanzen Baker, R. G., Research Officer, England and Wales.

At 25, Drumsheugh Gardens, Edinburgh.

Macdonald, J. A. B., Research Officer, Scotland.

England and Wales.

Assistant Commissioner's Office (25, *Savile Row, London, W.1*).

Sangar, O. J., Assistant Commissioner.
Edwards, S. W., Chief Estates Officer.
Smith, R. H., District Officer (Acquisitions).
Pearson, F. G. O., District Officer (Utilisation).
Cownie, F., District Officer (Acquisitions).

North-East Division (*Chopwellwood House, Rowlands Gill, Co. Durham*).

Hopkinson, A. D., Divisional Officer.
Batters, G. J. L., District Officer.
Fossey, R. E., District Officer.
Forsyth, W., District Officer.
Portlock, W. J. J ., District Officer (Estate).

North Wales Division (15, *Belmont, Shrewsbury*).

Popert, A. H., Divisional Officer.
Fairchild, C. E. L., District Officer, Higher Grade.
De Uphaugh, F. E. B., District Officer, Higher Grade.
Best, F. C., District Officer.
Cadman, W. A., District Officer.

South-West District Area (59/60, *High Street, Exeter*).

Broadwood, R. G., District Officer, Higher Grade.
Ballance, G. F., District Officer.

South-East Division (*Grand Buildings, Trafalgar Square, London*).

Felton, A. L., Divisional Officer.
Lowe, George, District Officer, Higher Grade.
Muir, W. A., District Officer.
Stileman, D. F., District Officer.
Barrington, C. A. J., District Officer.

Eastern Division (*Llandaff Chambers, Regent Street, Cambridge*).

Macdonald, J., Divisional Officer.
Connell, C. A., District Officer.
Ross, J. M., District Officer.
Rouse, G. D., District Officer.
Williamson, J. Q., District Officer.
Morrish, C. G., District Officer (Estate).
Stocks, J. B., District Officer.

New Division (*The King's House, Lyndhurst, Hants*).

Young, D. W., Deputy Surveyor.
Forbes, R. G., District Officer, Higher Grade.
MacIver, L. E., District Officer, Higher Grade.
Currie, J. H., District Officer.
Yarr, W. J., Assistant to Deputy Surveyor.

Dean Division (*Whitemead Park, Parkend, Lydney, Glos*).

Long, A. P., Deputy Surveyor.
Forster Brown, W., Deputy Gaveller (Mines).
Wylie, N. A., District Officer.
Kenyon, L. G. T., District Officer.
Roper, John, Survey Clerk.

North-West Division (26, *Lowther Street, Carlisle*).

Ross, A. H. H., Divisional Officer.
Thom, J. R., District Officer.
Fitzherbert, J. T. L., District Officer.

South Wales Division (*Graham Buildings, Newport Road, Cardiff*).

Ryle, G. B., Divisional Officer.
Cowell-Smith, R., District Officer.
Backhouse, G. W., District Officer.
Haldane, W. D., District Officer.

School for Forest Apprentices.

Russell, W. D., District Officer (Instructor).—Parkend, Lydney, Glos.

SCOTLAND.

Assistant Commissioner's Office (25, *Drumsheugh Gardens, Edinburgh*).

Murray, J. M., Assistant Commissioner.
Cameron, John, Land Agent.
Mackie Whyte, J.P., District Officer (Acquisitions and Estate).
Webster, John, District Officer (Estate).
Beresford-Peirse, H. C., District Officer (Acquisitions).
Short, W. R., District Officer (Estate).

North Division (51, *Church Street, Inverness*).

Fraser, James, Divisional Officer.
Spraggan, D. S., District Officer.
Gibson, W. N., District Officer.
Robbie, T. A., District Officer.
Fraser, A. M., District Officer.

South Division (52, *Buccleuch Street, Dumfries*).

Oliver, F. W. A., Acting Divisional Officer.
Mackay, J. W., District Officer.
Watt, A., District Officer.
Wood, R. F., District Officer.

East Division (12, *North Silver Street, Aberdeen*).

Scott, Frank, Divisional Officer.
Newton, L. A., District Officer, Higher Grade.
Bird, D. H., District Officer, Higher Grade.
Warren, A., District Officer.
Woolridge, T. H., District Officer.
Stewart, I. J., District Officer.

West Division (53, *Bothwell Street, Glasgow*).

Gosling, A. H., Acting Divisional Officer.
Whellens, W. H., District Officer.
James, J. E., District Officer.
Dier, H. V. S., District Officer.
Waterman, R. J., District Officer.

School for Forest Apprentices.

Watson, Harry, District Officer, Higher Grade (Instructor).—Benmore, Argyll.

Foresters.

England and Wales.

Name.	*Grade.*	*Name.*	*Grade.*
North-East Division.			
Anderson, T. E.	Head	Lewis, A. E.	II
Weir, A. B.	Head	Macdonald, I. A. D.	II
Anderson, J. T.	I	Rowell, James	II
McNab, Colin	I	Scott, J. F.	II
Bewick, W. J.	II	Shaw, J. W.	II
Brown, W. C.	II	Smith, W. T.	II
Everitt, F. W.	II	Wood, William	II
Frank, Harold	II	Woodward, George	II
Gough, W. R.	II	Wray, Norman	II
Jones, Llewelyn	II		
North Wales Division.			
Butter, Robert	Head	Jones, David	II
Shaw, J. L.	Head	Kirkup, J. T.	II
Fraser, Robert	I	Lomas, John	II
Jones, H. W.	I	Pearson, Wilfred	II
Roberts, W. G.	I	Pryce, E. E.	II
Tribe, William	I	Pye, W. E.	II
Brown, G. H.	II	Reese, W. H.	II
Evans, J. E.	II	Smith, Norman	II
Harris, W. A.	II	Tucker, E. J.	II
Harrison, Percy	II	Watkins, Stanley	II
Hughes, Arthur	II	Williams, Humphrey	II
Jones, Alfred	II	Yapp, P. W. C.	II
South-West District Area.			
Wallington, H. J.	I	Pritchard, Roderick	II
Williams, John	I	Smith, R. D.	II
Carnell, Reginald	II	Wellington, C. R.	II
Jones, W. E.	II	Wilkinson, W. E.	II
Laney, Horace	II		
South-East Division.			
Cottenham, W. C.	I	Isles, G. E. R.	II
Dyer, H. C.	I	Lingwood, N. J.	II
Hollis, G. W.	I	Massey, J. K.	II
Nelmes, F. J.	I	McKenzie, Colin	II
Wallington, A. W.	I	Middleton, W. F. C.	II
Aston, T. H.	II	Phelps, S. E.	II
Craft, J. H.	II	Reid, Duncan	II
Halsey, H. R.	II	Salisbury, E. J.	II
Hodgson, William	II	Wild, P. R. S.	II
Hyett, Samuel	II	Williams, L. H.	II

England and Wales—continued.

Name.	*Grade.*	*Name.*	*Grade.*
Eastern Division.			
Anderson, J. W.	I	Hendrie, T. F. ..	II
McGlashan, John	I	Jackson, W. V. ..	II
Beasley, F. G. ..	II	Johnson, Harry ..	II
Bewick, Robert ..	II	Mitchell, A. L. ..	II
Birkett, Albert ..	II	Parry, A. A. ..	II
Bloor, C. A. ..	II	Price, Alfred ..	II
Button, G. H. ..	II	Redford, C. W. ..	II
Clark, J. S. ..	II	Saunders, H. J. ..	II
Davies, D. J. ..	II	Smith, J. J. ..	II
Gilson, R. B. ..	II	Wyatt, Lionel ..	II
Gwilliam, G. T. S.	II		
New Division.			
Aston, O. R. T. ..	I	Adams, J. H. ..	II
Colwill, S. W. ..	I	Longman, F. C. J.	II
Hale, W. J. ..	I	Parker, F. H. ..	II
Kennedy, J. B. ..	I	Parsons, F. F. G.	II
Dean Division.			
Lewis, Tom	Head	Lees, George ..	II
Smith, Frank	Head	Light, T. G. ..	II
Humphries, W. J. ..	I	Morgan, T. R. ..	II
Walker, A. E.	I	Roberts, E. James	II
Williams, D. N. (School)	I	Taylor, G. J. ..	II
Adams, Isaac	II	Watson, Frank ..	II
North-West Division.			
Simpson, G. A. ..	I	Sharp, G. A.	II
Jones, George ..	II	Small, J. R.	II
Liddell, Joseph ..	II		
South Wales Division.			
Cowe, J. F. ..	I	Gunter, A. T. G.	II
Harrison, Phillip	I	Jones, A. H.	II
Pallett, R. E. ..	I	King, B. H.	II
Squires, C. V. ..	I	Lewis, T. H.	II
Adams, Charley ..	II	Little, T. E.	II
Brown, T. N. ..	II	Richards, G. H.	II
Caddy, Thomas ..	II	Saunders, T. G.	II
Cameron, A. H. ..	II	West, S. J. C.	II
Edwards, L. T. ..	II	Young, H. C.	II
Farrance, D. H. ..	II		

Scotland.

Name.	*Grade.*	*Name.*	*Grade.*
North Division.			
Anderson, William	Head	Mackay, William	II
Cameron, Roderick	I	Mackenzie, Alex.	II
Macintosh, William	I	Mackenzie, George	II
Mackay, Kenneth	I	Mackenzie, John	II
Mason, William	I	Mackie, Alexander	II
McClymont, William	I	Mackintosh, Alexander	II
McEwan, James	I	Macpherson, Edward	II
Murray, William	I	Macrae, D. J.	II
Drysdale, Alexander	II	Munro, George	II
Gordon, James	II	Murray, A. R.	II
Gray, A. C.	II	Murray, Robert	II
Gunn, John	II	Pennet, Hugh	II
Macdonald, Charles	II	Stewart, P. C.	II
Macdonald, Donald	II		
South Division.			
Graham, Alexander	I	Mackay, W. H.	II
Macintyre, J. F.	I	Macrae, Murdo	II
Macmillan, Hugh	I	Parley, C. W.	II
Brown, Peter	II	Peddie, A. S.	II
Cameron, D. McA.	II	Steel, R. P.	II
Hunter, John	II	Watson, James	II
East Division.			
Shaw, Robert	Head	McConnell, James	II
Kennedy, J. A. M.	I	McDonald, William	II
Lamb, J. A.	I	McDowall, Charles	II
Robbie, John D.	I	Milne, W. G.	II
Ross, W. L.	I	Mitchell, F. M.	II
Allan, James	II	Murray, G. J. A. M.	II
Allan, Thomas	II	Reid, James	II
Anderson, Frank	II	Ritchie, M. A.	II
Campbell, Robert W.	II	Robbie, James D.	II
Corbett, John	II	Ross, Allan	II
Douglas, W. S.	II	Ross, Archibald	II
Fell, J. B.	II	Russell, J. C.	II
Fraser, John	II	Scott, John	II
Gilbert, George	II	Urquhart, D. J.	II
Kennedy, J. M.	II	Watt, D. M.	II
Mackay, William	II		

Scotland—continued.

Name.	*Grade.*	*Name.*	*Grade.*
West Division.			
Simpson, A. N. ..	.. Head	Mackay, Angus ..	.. II
Cameron, Hugh ..	.. I	Mackenzie, Ian H.	.. II
Donald, R. R. ..	.. I	Maclean, J. D. ..	.. II
Kennedy, John ..	.. I	MacPhee, C. B. ..	.. II
Paterson, S. H. A.	.. I	Macrae, A. D. ..	.. II
Reid, J. M. ..	.. I	McDonald, J. D.	.. II
Calder, J. M. ..	.. II	Munro, Duncan ..	.. II
Cameron, Alistair	.. II	Murray, R. G. ..	.. II
Crozier, Robert ..	.. II	Penny, Thomas ..	.. II
Fairbairn, William	.. II	Ross, D. H. ..	.. II
Ferguson, J. M. ..	.. II	Sinclair, Laurence	.. II
Fergusson, W. S.	.. II	Stoddart, W. F. ..	.. II

Research and Experiment.

Name.	*Grade.*	*Name.*	*Grade.*
Oxford.		*Edinburgh.*	
Gray, W. G. ..	.. I	Dewar, J. D. ..	.. II
Nimmo, Maurice	.. II	Farquhar, James	.. II
Weatherell, John	.. II	Grant, Alexander	.. II

Name.	*Grade.*
Headquarters.	
Mackenzie, A. M. ..	.. I

REGISTER OF IDENTIFICATION NUMBERS.

Forest Year, 1938.

The order of arrangement is as follows :—

Serial numbers (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.

38/1 750 lb.; *Quercus rubra ;* 1937 ; Holland ; Nederlandsche Heidemaatschappij.

38/2 1 lb.; *Quercus conferta ;* 1937 ; Austria ; Grunwald & Co.

38/3 10 lb.; *Betula lutea ;* 1937 ; U.S.A. (North Carolina) ; Barteldes Seed Co.

38/4 5 lb.; *Betula papyrifera ;* 1937 ; U.S.A. (Minnesota) ; F. W. Schumacher.

38/5 10 lb.; *Liriodendron tulipifera ;* 1937 ; U.S.A. (Georgia) ; F. W. Schumacher.

38/6 250 lb.; *Quercus coccinea ;* 1937 ; U.S.A. (New England) ; F. W. Schumacher.

38/7 4 lb.; *Larix europaea ;* 1937 ; Austria (Inn Valley, altitude 2,000-3,000 ft.) ; J. Jenewein.

38/8 20 lb.; *Juglans nigra ;* 1937 ; France (Paris) ; Vilmorin-Andrieux & Co.

38/9 120 lb.; *Quercus coccinea ;* 1937 ; U.S.A.; Herbst Bros.

38/10 10 lb.; *Acer macrophyllum ;* 1937 ; U.S.A.; Herbst Bros.

38/11 5 lb.; *Cornus nuttali ;* 1937 ; U.S.A.; Herbst Bros.

38/12 245 lb.; *Pseudotsuga douglasii ;* 1937 ; U.S.A. (Washington, altitude 1,200-2,000 ft.) ; Manning Seed Co.; 97 ; 80.

38/13 50 lb.; *Abies grandis ;* 1937 ; U.S.A. (Snoqualmie National Forest, altitude 1,000-2,000 ft.) ; Manning Seed Co.; 95.2 ; 27.

38/14 1 lb.; *Pinus contorta ;* 1937 ; U.S.A. (Coast, altitude 50-150 ft.) ; Manning Seed Co.

38/15 15 lb.; *Sequoia sempervirens ;* 1937 ; North Central California (altitude 3,000 ft.) ; Manning Seed Co.

38/16 2½ lb.; *Tsuga heterophylla ;* 1937 ; U.S.A.; Manning Seed Co.

38/17 ¼ lb.; *Pinus monticola ;* 1937 ; U.S.A.; Manning Seed Co.

38/18 2 lb.; *Pinus montana uncinata ;* 1937 ; Denmark ; J. Rafn & Son.

38/19 5 lb.; *Pinus insignis ;* 1937 ; U.S.A.; J. Rafn & Son.

38/20 4 lb.; *Cupressus macrocarpa ;* 1937 ; U.S.A.; J. Rafn & Son.

38/21 5 lb.; *Amelanchier alnifolia ;* 1937 ; Canada ; J. Rafn & Son.

38/22 40 lb.; *Prunus avium ;* 1937 ; Europe ; J. Rafn & Son.

38/23 1,345 lb.; *Pinus laricio* var. *corsicana ;* 1937 ; Corsica (Valdoniello Forest) ; J. Grimaldi ; 99 ; 88.

38/24 109 lb.; *Larix europaea sudetica;* 1936 ; Czechoslovakia (Bohemia, altitude 1,150-1,380 ft.) ; Czechoslovakian Forest Service ; 72 ; 33.

38/25 109 lb.; *Larix europaea sudetica;* 1936 ; Czechoslovakia (Moravia, altitude up to 1,250 ft.) ; Czechoslovakian Forest Service ; 70 ; 27.

38/26 4 lb.; *Larix europaea;* 1937 ; Trentino (altitude 2,000-3,300 ft.) ; Grunwald & Co.

38/27 10 lb.; *Carya alba* (*Hicoria ovata*) ; 1937 ; U.S.A.; Herbst Bros.

38/28 50 lb.; *Pseudotsuga taxifolia;* 1937 ; Canada (Salmon Arm District, altitude 1,160-1,500 ft.) ; C. MacFayden ; 99.1 ; 85 + 6.

38/29 2½ oz.; *Pseudotsuga taxifolia;* 1937 ; Canada (Bella Coola District, sea-level) ; C. MacFayden.

38/30 45 lb.; *Tsuga heterophylla;* 1937 ; Canada (Lower Fraser Valley, altitude 100-500 ft.) ; C. MacFayden ; 99.1 ; 74 + 8.

38/31 1,397 lb.; *Picea sitchensis;* 1937 ; Canada (Queen Charlotte Islands, altitude 0-500 ft.) ; C. MacFayden ; 98 ; 86 + 2.

38/32 6½ oz.; *Picea sitchensis;* 1937 ; Canada (Kitimat district, sea-level) ; C. MacFayden.

38/33 8 lb.; *Picea sitchensis;* 1937 ; Canada (Port Simpson district, sea-level) ; C. MacFayden.

38/34 3 13/16 lb.; *Abies grandis;* 1937 ; Canada (S.W. Vancouver Island, altitude 0-250 ft.) ; C. MacFayden.

38/35 4 lb.; *Pinus monticola;* 1937 ; Canada (S.W. Vancouver Island, altitude 0-250 ft.) ; C. MacFayden.

38/36 40 lb.; *Pinus contorta* var. *latifolia;* 1937 ; Canada (Salmon Arm district, altitude 2,000-3,000 ft.) ; C. MacFayden ; 99.5 ; 98.

38/37 ¾ lb.; *Pinus contorta* var. *latifolia;* 1937 ; Canada (Prince George district, altitude 2,000-2,500 ft.) ; C. MacFayden.

38/38 1¼ lb.; *Pinus contorta* var. *latifolia;* 1937 ; Canada (Smithers district, altitude 1,700-2,200 ft.) ; C. MacFayden.

38/39 15 lb.; *Pinus contorta;* 1937 ; Canada (Fraser River delta, sea-level) ; C. MacFayden ; 99.9 ; 83 + 15.

38/40 30 lb.; *Alnus rubra;* 1937 ; Canada (Lower Fraser Valley) ; C. MacFayden.

38/41 1 lb.; *Rhamnus purshiana;* 1937 ; Canada (S.E. Vancouver Island, altitude 0-250 ft.) ; C. MacFayden.

38/42 12 oz.; *Picea sitchensis;* 1937 ; Canada (British Columbia) ; C. MacFayden.

38/43 1⅜ lb.; *Picea sitchensis;* 1937 ; Canada (Bella Coola district, sea-level) ; C. MacFayden.

38/44 440 lb.; *Pinus laricio;* 1937 ; Corsica ; Rossi ; 98 ; 73.

38/45 500 lb.; *Larix leptolepis;* 1937 ; Japan ; S. Ando ; 98.9 ; 75.

38/46 2 lb.; *Cryptomeria japonica;* 1937 ; Japan ; J. Rafn & Son.

38/47 2 lb.; *Ailanthus glandulosa;* 1937 ; Italy ; J. Rafn & Son.

38/48 2 lb.; *Chamaecyparis lawsoniana;* 1937; Denmark; J. Rafn & Son.
38/49 3½ lb.; *Betula pubescens;* 1937; Denmark; J. Rafn & Son.
38/50 11 lb.; *Alnus incana;* 1937; Swiss Alps; J. Rafn & Son.
38/51 2 lb.; *Rhamnus frangula;* 1937; Europe; J. Rafn & Son.
38/52 10 lb.; *Acer dasycarpum;* 1938; U.S.A.; Herbst Bros.
38/53 48 lb.; *Juglans nigra;* 1938; Canada; gift from Mr. Blanchet.
38/54 22 lb.; *Acer rubrum;* 1938; U.S.A.; Herbst Bros.
38/55 530 lb.; *Pinus sylvestris;* 1937; England (East); own collection; 98; 90.
38/56 11 lb.; *Pinus sylvestris;* 1937; England (North); own collection.
38/57 1½ lb.; *Pinus sylvestris;* 1937; England (South); own collection.
38/58 2 lb.; *Larix europaea;* 1937; England (West); own collection.
38/59 6 bushels cones; *Larix europaea;* 1937; England (South); own collection.
38/60 3 lb.; *Abies pectinata;* 1937; England (South-west); own collection.
38/61 20 lb.; *Cupressus nootkatensis;* 1937; Wales (South); own collection.
38/62 ¾ bushel cones; *Chamaecyparis lawsoniana;* 1937; England (South); own collection.
38/63 1 lb.; *Chamaecyparis lawsoniana;* 1937; England (South-west); own collection.
38/64 25 lb.; *Chamaecyparis lawsoniana;* 1937; Wales (South); own collection.
38/65 1¼ lb.; *Chamaecyparis lawsoniana;* 1937; England (East); own collection.
38/66 1½ bushels cones; *Chamaecyparis lawsoniana;* 1937; England (South); own collection.
38/67 3 lb.; *Alnus glutinosa;* 1937; England (North); own collection.
38/68 2 lb.; *Alnus glutinosa;* 1937; England (South); own collection.
38/69 4 lb.; *Alnus glutinosa;* 1937; England (East); own collection.
38/70 6¼ lb.; *Alnus glutinosa;* 1937; England (West); own collection.
38/71 2 lb.; *Alnus glutinosa;* 1937; England (South-west); own collection.
38/72 16 lb.; *Alnus glutinosa;* 1937; Wales (South); own collection.
38/73 2¼ lb.; *Alnus incana;* 1937; England (South); own collection.
38/74 4 lb.; *Alnus incana;* 1937; England (West); own collection.

38/75 83 lb.; *Acer platanoides;* 1937; England (South); own collection.

38/76 6 lb.; *Acer platanoides;* 1937; England (West); own collection.

38/77 20 lb.; *Acer pseudoplatanus;* 1937; England (South); own collection.

38/78 11 lb.; *Acer pseudoplatanus;* 1937; England (East); own collection.

38/79 64 lb.; *Acer pseudoplatanus;* 1937; England (West); own collection.

38/80 16 lb.; *Acer pseudoplatanus;* 1937; England (South-west); own collection.

38/81 94 lb.; *Acer pseudoplatanus;* 1937; Wales (South); own collection.

38/82 10 lb.; *Betula verrucosa;* 1937; England (East); own collection.

38/83 6 lb.; *Betula verrucosa;* 1937; England (South-west); own collection.

38/84 2,588 lb.; *Castanea sativa;* 1937; England (South); own collection.

38/85 367 lb.; *Castanea sativa;* 1937; England (East); own collection.

38/86 250 lb.; *Castanea sativa;* 1937; England (West); own collection.

38/87 70 lb.; *Castanea sativa;* 1937; England (Midlands); own collection.

38/88 3 lb.; *Fagus sylvatica;* 1937; England (South); own collection.

38/89 115 lb.; *Fraxinus excelsior;* 1937; England (North); own collection.

38/90 347 lb.; *Fraxinus excelsior;* 1937; England (South); own collection.

38/91 5 lb.; *Fraxinus excelsior;* 1937; England (East); own collection.

38/92 209 lb.; *Fraxinus excelsior;* 1937; England (West); own collection.

38/93 65 lb.; *Fraxinus excelsior;* 1937; England (Midlands); own collection.

38/94 50 lb.; *Fraxinus excelsior;* 1937; England (South-west); own collection.

38/95 60 lb.; *Fraxinus excelsior;* 1937; Wales (South); own collection.

38/96 19 lb.; *Aesculus hippocastanum;* 1937; England (North); own collection.

38/97 36 lb.; *Aesculus hippocastanum;* 1937; England (East); own collection.

38/98 56 lb.; *Aesculus hippocastanum;* 1937; England (West); own collection.

38/99 12 lb.; *Juglans regia;* 1937; England (East); own collection.

38/100 14 lb.; *Quercus pedunculata;* 1937; England (North); own collection.

38/101 4,678 lb.; *Quercus pedunculata;* 1937; England (South); own collection.

38/102 4,864 lb.; *Quercus pedunculata;* 1937; England (East); own collection.

38/103 694 lb.; *Quercus pedunculata;* 1937; England (West); own collection.

38/104 20 lb. *Quercus pedunculata;* 1937; England (South-west); own collection.

38/105 86 lb. *Quercus sessiliflora;* 1937; England (South); own collection.

38/106 400 lb.; *Quercus sessiliflora;* 1937; England (East); own collection.

38/107 736 lb.; *Quercus sessiliflora;* 1937; England (West); own collection.

38/108 490 lb.; *Quercus sessiliflora;* 1937; England (South-west); own collection.

38/109 54,068 lb.; *Quercus robur;* 1937; England (South); own collection.

38/110 34,041 lb.; *Quercus robur;* 1937; England (West); own collection.

38/111 3,068 lb.; *Quercus robur;* 1937; England (Midlands); own collection.

38/112 1,000 2-yr. seedlings; *Alnus glutinosa;* crop year unknown; England (East); own collection.

38/113 2,000 3-yr. seedlings; *Acer pseudoplatanus;* crop year unknown; England (East); own collection.

38/114 113,000 plants (various); *Betula verrucosa;* crop year unknown; England (East); own collection.

38/115 72,000 plants (10-24 in.); *Betula verrucosa;* crop year unknown; origin unknown; Stapleford Wood.

38/116 2,000,000 1-yr. seedlings; *Fagus sylvatica;* crop year unknown; origin unknown; English Forestry Association.

38/117 175,000 transplants; *Fagus sylvatica;* crop year unknown; origin unknown; English Forestry Association.

38/118 10,000 plants (18-30 in.); *Fagus sylvatica;* crop year unknown; origin unknown; Chambers Green Nurseries.

38/119 10,000 cuttings; *Platanus acerifolia;* crop year unknown; origin unknown; Kensington Borough.

38/120 10,000 cuttings; *Platanus acerifolia;* crop year unknown; origin unknown; Bristol Corporation.

38/121 13½ lb.; *Pinus sylvestris;* 1937; Glengarry, Inverness-shire; own collection.

38/122 1¼ lb.; *Pinus sylvestris;* 1937; Puitechan, Glenloy, Inverness-shire; own collection.

38/123 ¼ lb.; *Pinus sylvestris;* 1937; Roybridge, Glenloy, Inverness-shire; own collection.

38/124 1 lb.; *Pinus sylvestris;* 1937; Glenrigh, Inverness-shire; own collection.

38/125 3 lb.; *Pinus sylvestris;* 1937; Guisachan, Inverness-shire; own collection.

38/126 3 lb.; *Pinus sylvestris;* 1937; Portclair, Inverness-shire; own collection.

38/127 3 lb.; *Pinus sylvestris;* 1937; Findon, Ross-shire; own collection.

38/128 1½ lb.; *Pinus sylvestris;* 1937; Rhumore, Slattadale, Ross-shire; own collection.

38/129 3 lb.; *Pinus sylvestris;* 1937; Rory Island, Slattadale, Ross-shire; own collection.

38/130 4½ lb.; *Pinus sylvestris;* 1937; Brahan, Ross-shire; own collection.

38/131 1¼ lb.; *Pinus sylvestris;* 1937; South Strome, Ross-shire; own collection.

38/132 ¾ lb.; *Pinus sylvestris;* 1937; Achnashellach, Ross-shire; own collection.

38/133 5¾ lb.; *Pinus sylvestris;* 1937; Castle Leod, Ross-shire; own collection.

38/134 16 lb.; *Pinus sylvestris;* 1937; Beaufort, Inverness-shire; own collection.

38/135 10 lb.; *Pinus sylvestris;* 1937; Pluscarden, Elginshire; own collection.

38/136 1½ lb.; *Pinus sylvestris;* 1937; Asknish, Argyllshire; own collection.

38/137 17 lb.; *Pinus sylvestris;* 1937; Auchlunkart, Morayshire; own collection.

38/138 121 lb.; *Pinus sylvestris;* 1937; Lethen and Kinsteary, Morayshire; own collection.

38/139 6 lb.; *Pinus sylvestris;* 1937; Achaglachgach, Argyllshire; own collection.

38/140 1½ lb.; *Pinus sylvestris;* 1937; Loch Ard, Perthshire; own collection.

38/141 92 lb.; *Pinus sylvestris;* 1937; Culbin, Morayshire; own collection.

38/142 11 lb.; *Pinus sylvestris;* 1937; Drummuir, Banffshire; own collection.

38/143 ¼ lb.; *Pinus sylvestris;* 1937; Kenmure, Kirkcudbrightshire; own collection.

38/144 8½ lb.; *Pinus sylvestris;* 1937; Dalbeattie, Kirkcudbrightshire; own collection.

38/145 24 lb.; *Pinus sylvestris;* 1937; Brodie, Elginshire; own collection.

38/146 3½ lb.; *Pinus sylvestris;* 1937; Raehills, Dumfriesshire; own collection.

38/147 4 lb.; *Pinus sylvestris;* 1937 ; Carron, Stirlingshire ; own collection.

38/148 11 lb.; *Pinus sylvestris;* 1937 ; Orton, Morayshire ; own collection.

38/149 12 lb.; *Pinus sylvestris;* 1937 ; Teindland, Morayshire ; own collection.

38/150 40 lb.; *Pinus sylvestris;* 1937 ; Seafield, Morayshire ; own collection.

38/151 ¼ lb.; *Pinus sylvestris;* 1937 ; Benmore, Argyllshire ; own collection.

38/152 4 lb.; *Pinus sylvestris;* 1937 ; Inshriach, Inverness-shire ; own collection.

38/153 60 lb.; *Larix europaea;* 1937 ; Pluscarden, Elginshire ; own collection.

38/154 40 lb.; *Larix europaea;* 1937 ; Auchlunkart, Morayshire ; own collection.

38/155 133 lb.; *Larix europaea;* 1937 ; Lethen and Kinsteary, Morayshire ; own collection.

38/156 94 lb.; *Larix europaea;* 1937 ; Seafield, Morayshire ; own collection.

38/157 207 lb.; *Larix europaea;* 1937 ; Kirkhill, Elgin ; own collection.

38/158 15 lb.; *Larix europaea;* 1937 ; Newton, Morayshire ; own collection.

38/159 129 lb.; *Larix europaea;* 1937 ; Drummuir, Banffshire ; own collection.

38/160 110 lb.; *Larix europaea;* 1937 ; Monaughty, Morayshire ; own collection.

38/161 3 lb.; *Larix europaea;* 1937 ; Brodie, Elginshire ; own collection.

38/162 12 lb.; *Larix europaea;* 1937 ; Carron, Stirlingshire ; own collection.

38/163 20 lb.; *Larix europaea;* 1937 ; Blervie, Elginshire ; own collection.

38/164 25 lb.; *Larix europaea;* 1937 ; Orton, Morayshire ; own collection.

38/165 ¾ lb.; *Larix europaea;* 1937 ; Benmore, Argyllshire ; own collection.

38/166 5 lb.; *Larix eurolepis;* 1937 ; Murthly, Perthshire ; Murthly Estate.

38/167 3 lb.; *Larix eurolepis;* 1937 ; Forest of Ae, Dumfriesshire ; own collection.

38/168 2 lb.; *Larix leptolepis;* 1937 ; Loch Ard, Perthshire ; own collection.

38/169 31½ lb.; *Picea excelsa;* 1937 ; Glengarry, Inverness-shire ; own collection.

38/170 21 lb.; *Picea excelsa;* 1937 ; South Laggan, Inverness-shire ; own collection.

38/173 ½ lb.; *Picea excelsa;* 1937; Raehills, Dumfriesshire; own collection.

38/174 2 oz.; *Picea excelsa;* 1937; Murrayfield, Dumfriesshire; own collection.

38/175 7 lb.; *Picea excelsa;* 1937; Dundeugh, Kirkcudbrightshire; own collection.

38/176 7 lb.; *Picea excelsa;* 1937; Bennan, Kirkcudbrightshire; own collection.

38/177 ½ lb.; *Picea sitchensis;* 1937; Forest of Ae, Dumfriesshire; own collection.

38/178 ¼ lb.; *Picea sitchensis;* 1937; Barcaldine, Argyllshire; own collection.

38/179 ¾ lb.; *Pseudotsuga douglasii;* 1937; Guisachan, Inverness-shire; own collection.

38/180 ¾ lb.; *Pseudotsuga douglasii;* 1937; Kilsture, Wigtownshire; own collection.

38/181 2 lb.; *Chamaecyparis lawsoniana;* 1937; South Laggan, Inverness-shire; own collection.

38/182 1 lb.; *Chamaecyparis lawsoniana;* 1937; Durris, Kincardine-shire; own collection.

38/183 2½ lb.; *Thuya plicata;* 1937; Glengarry, Inverness-shire; own collection.

38/184 1½ lb.; *Thuya plicata;* 1937; Inchnacardoch, Inverness-shire; own collection.

38/185 3 lb.; *Thuya plicata;* 1937; Inverliever, Argyllshire; own collection.

38/186 12½ lb.; *Thuya plicata;* 1937; Benmore, Argyllshire; own collection.

38/187 ½ lb.; *Thuya plicata;* 1937; Fleet, Kirkcudbrightshire; own collection.

38/188 ½ lb.; *Thuya plicata;* 1937; Kilsture, Wigtownshire; own collection.

38/189 3¼ lb.; *Tsuga heterophylla;* 1937; Glengarry, Inverness-shire; own collection.

38/190 5 lb.; *Tsuga heterophylla;* 1937; Murthly, Perthshire; Murthly Estate.

38/191 7 lb.; *Tsuga heterophylla;* 1937; Benmore, Argyllshire; own collection.

38/192 ¾ lb.; *Tsuga heterophylla;* 1937; Inverinan, Argyllshire; own collection.

38/193 ½ lb.; *Tsuga heterophylla;* 1937; Auchenroddan, Dumfries-shire; own collection.

38/194 2 oz.; *Tsuga heterophylla;* 1937; Inverliever, Argyllshire; own collection.

38/195 6 oz.; *Sequoia gigantea;* 1937; Portclair, Inverness-shire; own collection.

38/196 2 oz.; *Sequoia wellingtonia;* 1937; Inverliever, Argyllshire; own collection.

38/197 2 oz.; *Chamaecyparis lawsoniana ;* 1937 ; Inverliever, Argyllshire ; own collection.

38/198 6½ lb.; *Chamaecyparis lawsoniana ;* 1937 ; Benmore, Argyllshire ; own collection.

38/199 ¼ lb.; *Pinus contorta ;* 1937 ; Dalbeattie, Kirkcudbrightshire ; own collection.

38/200 5 oz.; *Pinus insignis ;* 1937 ; Kilsture, Wigtownshire ; own collection.

38/202 5¾ lb.; *Abies nobilis ;* 1937 ; Loch Ard, Perthshire ; own collection.

38/203 2½ lb.; *Abies nobilis ;* 1937 ; Inverliever, Argyllshire ; own collection.

38/204 2½ lb.; *Abies nobilis ;* 1937 ; Inverinan, Argyllshire ; own collection.

38/205 12 lb.; *Abies nobilis ;* 1937 ; Fleet, Kirkcudbrightshire ; own collection.

38/206 9 lb.; *Abies nobilis ;* 1937 ; Kilsture, Wigtownshire ; own collection.

38/207 82 lb.; *Abies pectinata ;* 1937 ; Kilsture, Wigtownshire ; own collection.

38/208 9 oz.; *Picea orientalis ;* 1937 ; Marchbank, Dumfriesshire ; own collection.

38/209 3½ lb.; *Alnus glutinosa ;* 1937 ; Achnashellach, Ross-shire ; own collection.

38/210 2 lb.; *Alnus glutinosa ;* 1937 ; Glenloy, Inverness-shire ; own collection.

38/211 5½ lb.; *Alnus glutinosa ;* 1937 ; Nevis, Inverness-shire ; own collection.

38/212 3½ lb.; *Alnus glutinosa ;* 1937 ; South Laggan, Inverness-shire ; own collection.

38/213 5 lb.; *Alnus glutinosa ;* 1937 ; South Strome, Ross-shire ; own collection.

38/214 ½ lb.; *Alnus glutinosa ;* 1937 ; Fleet, Kirkcudbrightshire ; own collection.

38/215 6 lb.; *Alnus incana ;* 1937 ; Barcaldine, Argyllshire ; own collection.

38/216 1 lb.; *Alnus incana ;* 1937 ; Glenduror, Argyllshire ; own collection.

38/217 ½ lb.; *Alnus incana ;* 1937 ; Fleet, Kirkcudbrightshire ; own collection.

38/218 1 lb.; *Alnus oregona ;* 1937 ; Glenfinart, Argyllshire ; own collection.

38/219 1 lb.; *Betula verrucosa ;* 1937 ; Achnashellach, Ross-shire ; own collection.

38/220 12 lb.; *Betula verrucosa ;* 1937 ; Glenloy, Inverness-shire ; own collection.

38/221 22 lb.; *Betula verrucosa ;* 1937 ; Guisachan, Inverness-shire ; own collection.

38/222 24 lb.; *Betula verrucosa ;* 1937 ; Nevis, Inverness-shire ; own collection.

38/223 11 lb.; *Betula verrucosa ;* 1937 ; South Laggan, Inverness-shire ; own collection.

38/224 1 lb.; *Betula verrucosa ;* 1937 ; South Strome, Ross-shire ; own collection.

38/225 44 lb.; *Fagus sylvatica ;* 1937 ; Glengarry, Inverness-shire ; own collection.

38/226 12 lb.; *Fagus sylvatica ;* 1937 ; Portclair, Inverness-shire ; own collection.

38/227 7 lb.; *Fagus sylvatica ;* 1937 ; Ardgartan, Argyllshire ; own collection.

38/228 12 lb.; *Fagus sylvatica ;* 1937 ; Benmore, Argyllshire ; own collection.

38/229 76 lb.; *Fagus sylvatica ;* 1937 ; Loch Ard, Perthshire ; own collection.

38/230 9 lb.; *Fagus sylvatica ;* 1937 ; Inverliever, Argyllshire ; own collection.

38/231 250 lb.; *Fagus sylvatica ;* 1937 ; Fleet, Kirkcudbrightshire ; own collection.

38/232 39 lb.; *Fagus sylvatica ;* 1937 ; Aberfoyle, Perthshire ; own collection.

38/233 10 lb.; *Fraxinus excelsior ;* 1937 ; Scotland (North) ; own collection.

38/234 9 lb.; *Fraxinus excelsior ;* 1937 ; Inverliever, Argyllshire ; own collection.

38/235 30 lb.; *Fraxinus excelsior ;* 1937 ; Benmore, Argyllshire ; own collection.

38/236 40 lb.; *Fraxinus excelsior ;* 1937 ; Glenbranter, Argyllshire ; own collection.

38/237 19 lb.; *Fraxinus excelsior ;* 1937 ; Kirroughtree, Wigtownshire ; own collection.

38/238 37 lb.; *Fraxinus excelsior ;* 1937 ; Kilsture, Wigtownshire ; own collection.

38/239 200 lb.; *Fraxinus excelsior ;* 1937 ; Fleet, Kirkcudbrightshire ; own collection.

38/240 10 lb.; *Acer pseudoplatanus ;* 1937 ; Inchnacardoch, Inverness-shire ; own collection.

38/241 41 lb.; *Acer pseudoplatanus ;* 1937 ; Craibstone, Aberdeenshire ; own collection.

38/242 7 lb.; *Acer pseudoplatanus ;* 1937 ; Ardgartan, Argyllshire ; own collection.

38/243 15 lb.; *Acer pseudoplatanus ;* 1937 ; Benmore, Argyllshire ; own collection.

38/244 40 lb.; *Acer pseudoplatanus ;* 1937 ; Inverliever, Argyllshire ; own collection.

38/245 40 lb.; *Acer pseudoplatanus ;* 1937 ; Glenfinart, Argyllshire ; own collection.

38/246 10 lb.; *Acer pseudoplatanus;* 1937 ; Auchenroddan, Dumfriesshire ; own collection.

38/247 8 lb.; *Acer pseudoplatanus;* 1937 ; Kames, Argyllshire ; own collection.

38/248 36 lb.; *Aesculus hippocastanum;* 1937 ; Carden, Fifeshire ; own collection.

38/249 93 lb.; *Aesculus hippocastanum;* 1937 ; Ae, Dumfriesshire ; own collection.

38/250 16 lb.; *Aesculus hippocastanum;* 1937 ; Inverliever, Argyllshire ; own collection.

38/251 8 lb.; *Aesculus hippocastanum;* 1937 ; Kilsture, Wigtownshire ; own collection.

38/252 85 lb.; *Aesculus hippocastanum;* 1937 ; Galloway, Wigtownshire ; own collection.

38/253 56 lb.; *Aesculus hippocastanum;* 1937 ; Kirroughtree, Wigtownshire ; own collection.

38/254 149 lb.; *Quercus robur;* 1937 ; Loch Ard, Perthshire ; own collection.

38/255 123 lb.; *Quercus pedunculata;* 1937 ; Aberfoyle, Perthshire ; own collection.

38/256 134 lb.; *Quercus pedunculata;* 1937 ; Newbyth, Haddington ; own collection.

38/257 177 lb.; *Quercus pedunculata;* 1937 ; Kirroughtree, Wigtownshire ; own collection.

38/258 106 lb.; *Quercus pedunculata;* 1937 ; Lennoxlove, Haddington ; own collection.

38/259 22 lb.; *Quercus pedunculata;* 1937 ; Fleet, Kirkcudbrightshire ; own collection.

38/260 ½ bushel ; *Acer platanoides;* 1937 ; Guisachan, Invernessshire ; own collection.

38/261 40 lb.; *Platanus occidentalis;* 1937 ; Galloway, Wigtownshire ; own collection.

38/262 70 lb.; *Platanus occidentalis;* 1937 ; Fleet, Kirkcudbrightshire ; own collection.

38/263 160,000 1-yr. seedlings ; *Fagus sylvatica;* crop year unknown ; origin unknown ; W. Duff, Forfar.

38/264 5,000 2-yr. seedlings ; *Picea excelsa;* crop year unknown ; Pitgaveny, Morayshire ; Capt. J. B. Dunbar.

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