JOURNAL

OF THE

FORESTRY COMMISSION.

No. 12: APRIL, 1933.

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EDITORIAL.

Personnel of the Commission.

SINCE the last Journal was issued Mr. J. H. Alpass has resigned from the Commission and two new members have been appointed, namely, Major S. Strang Steel and Sir Alexander Rodger.

Lord Lovat.

Universal and deep regret has been occasioned by the death of Lord Lovat. He was a tower of strength during his chairmanship of the Commission and will always be remembered as largely instrumental in establishing the Forestry Commission on a sound and permanent basis. An appreciation of Lord Lovat appears elsewhere in this Journal.

Changes in the Commission.

The sudden death of Mr. H. A. Pritchard in November last naturally resulted in several changes; Mr. W. L. Taylor, who had not been long at Parkend, was appointed Assistant Commissioner for England and Wales, and Mr. A. H. Popert became Acting Deputy Surveyor of the Forest of Dean. The following tribute communicated to the press by our Chairman shortly after the death of Mr. Pritchard is quoted as showing the regard in which the late Assistant Commissioner was held:—

> "In the late Mr. H. A. Pritchard the youthful Forest Service of Great Britain has lost one of its most energetic and forceful personalities. Originally engaged in the practice and teaching of forestry and land-agency, his natural abilities found a broader outlet during the War in the organization and supply of pitwood and timber under the Timber Supply Department. When the Forestry Commission was set up in 1919 he was appointed Technical Adviser, and in 1924 Assistant Commissioner for England and Wales. He was thus intimately concerned with the acquisition, management, and development for forest purposes of some 450,000 acres of land. His devotion to his work (he took practically no leave in the last 13 years) no doubt contributed to his death at the early age of 54.
>
> Pritchard loved work for its own sake and was always eager for more. Direct in his methods and acutely conscious of the fact that he

was the trustee of the State property committed to his management, he was by nature intolerant of slackness or inertia in others. Beneath it all lay a very kindly and lovable character which gained him a wide circle of friends both within the Forest Service and in the countryside generally."

The deaths of Mr. J. F. Annand and Mr. George Home also occurred within the year. Their passing is deplored and the esteem in which they were held has been demonstrated in obituary notices which have appeared in the forestry journals.

Mr. R. G. Forbes was transferred to the North-Eastern Division in Scotland in succession to the late Mr. Annand and Mr. L. A. Newton to the South-Western Division. We have also to record the transfer of Mr. G. Lowe to Division 4 and the appointment of Mr. N. A. Wylie as Probationer District Officer, Division 7. Mr. R. G. Broadwood and Mr. G. B. Ryle have been promoted as Higher Grade District Officers. In the Research Branch, following the resignation of Dr. M. L. Anderson, Mr. James Macdonald was posted to Oxford and Mr. J. A B Macdonald took his place in Edinburgh The Research staff at Oxford was strengthened by the appointment of Mr. R. E. Fossey as Assistant Research Officer.

In consequence of the curtailment of the Forestry Fund, very few openings have recently been available in the staff of the Commission for the considerable body of graduates who have passed out of the British Universities. Some of these men are working in the Commission's forests and will no doubt benefit from the practical experience thus obtained. The outlook for them, however, is anything but promising, and those who have already secured posts may congratulate themselves upon their good fortune.

Sports at the Apprentices' Schools.

During recent years sports clubs at both Dean and Benmore Schools have distinguished themselves, particularly in association football. The Dean School football team now plays in the First Division of the Forest of Dean League, having been promoted from the Second Division after having won the Cup in 1928. As might be expected their successes in this Division are not so outstanding because they are competing against established teams and their numbers are getting smaller which limits the choice of players, but even so they put up very spirited play. They also take part in the Dilke Hospital Cup, the proceeds of collections going to the hospital.

Their record over the past three seasons is as follows :—

Year.	Played.	Won.	Lost.	Drawn.
1930–31	22	5	14	3
1931–32	22	6	10	6
1932–33 (to date)	11	2	7	2

The School has also players in the local hockey and rugby football teams. Cricket enjoys a certain popularity but the short summer term and the lack of local facilities militate against securing a really good team. In addition to these activities an annual dance is held in aid of the Dilke Hospital and in the past this has raised on the average £10 per annum.

At Benmore a sports club was formed by the trainees shortly after the transference of the School from Beaufort. Keen interest is taken locally in "soccer" and an association with headquarters in Dunoon controls the Esson League in which eleven teams play. Two Cup-tie competitions are arranged annually, one of them for charity. In season 1929-30, the School team won both cups, and finished second place in the League. In the following year the team again won both cups and held second place in the League. In 1931-32, they topped the League and also won all the cups. "Friendly" games have also been played—one of them in aid of the Dunoon Burgh Hospital and the other against the Glasgow University botany students while the latter were staying in the Benmore Hostel.

The match records for the past three seasons are as follows:—

Year.	Matches played.	Won.	Lost.	Drawn.
1929-30 ...	21	17	3	1
1930-31 ...	22	16	4	2
1931-32 ...	24	17	3	4

Contributors to the Journal.

As in the case of recent issues of the Journal certain Divisions have been called upon to furnish the bulk of the contributions. We have on the present occasion to acknowledge special assistance from Divisions 4, 6 and 7 in England and Wales and the South-Western Division in Scotland. Reports, articles and notes have also been received, however, from other sources. Divisions 1 and 3 and Scotland North have been requested to undertake the task for the coming year.

LORD LOVAT: AN APPRECIATION.

By W. L. TAYLOR.

Simon Joseph Fraser, 14th Baron Lovat in the Peerage of Scotland and 3rd Baron in the Peerage of the United Kingdom, our first Chairman, died at Chipping Norton on the 18th of February. To everyone who had the privilege of knowing him, and especially to those who have had the great fortune to have worked under him the sad tidings must have come with feelings of the deepest sorrow and regret.

Lord Lovat was possessed of a rare personal influence and genius for leadership which none in contact with him could fail to recognize. The keynote of his life was a large-hearted devotion to each of the many causes he took up. The scope of his activities was Empire wide and few have given clearer proofs of practical patriotism. His raising and leadership of Lovat's Scouts in the South African War of 1900-1902 are matters of history, also his distinguished services in the Great War in command of the Highland Mounted Brigade in Gallipoli, France and Flanders. Subsequently he was made Director of Forestry in France, a post for which none was more suited and which he filled with conspicuous success so long as the war continued. Among the many honours conferred upon him by British and Foreign Governments, he was made a Knight of the Thistle in 1915 and more recently received the Grand Cross of the Victorian Order.

Lord Lovat was interested in all the manifold problems arising out of the ownership and management of land and his interest in forestry can be said to have been life long. He was an active advocate of systematic forestry with all the eagerness and zeal which characterized his every action and long before the devastation wrought by the war in the woodlands of Great Britain spurred Parliament to adopt a national forest policy, his advocacy was stamped with the authority of an extensive knowledge and experience of the problems involved. He was included in the membership of the Forestry Sub-Committee of the Reconstruction Committee set up by the Prime Minister in 1916 and known to foresters as the Acland Committee, and was a member of the Interim Forest Authority from its inception in 1918. On the passing of the Forestry Act of 1919 he was appointed the first Chairman of the Forestry Commission over which he presided from November 1919 until March 1927, when he resigned to take up the appointments of Parliamentary Under-Secretary of the Dominions Office and Chairman of the Overseas Settlement Committee. It was in connection with the latter appointment that he undertook a particularly onerous tour of the Dominions in support of emigration from this country, an exacting duty which, it is thought, contributed largely to his breakdown in health.

Lord Lovat acted as Chairman of the first Empire Forestry Conference in London in 1920, also of the second of these important meetings which was held in Canada in 1923 and he headed the British delegation to the World Forestry Conference in Rome in 1926.

As Chairman throughout the strenuous and often trying days of the birth and early infancy of our Department, Lord Lovat was at once our leader and our inspiration. His remarkable influence and powers as a leader of men in every station in life and every degree of temperament, were at once manifest. His wise counsel steered us past the difficulties inseparable from a work of which the like had never previously been attempted on the same scale by any other nation : the creation of forests where no forests stood and the fostering of a forest sense in which our nation, despite its inherent love of the countryside, had become so sadly deficient. He gave himself without stint both in the office and in the field, and his vitality and example, his ready sympathy with all ranks in the service in their endeavours and difficulties, his humour and kindliness and, above all, his courtly personality and charming smile gave him a place in our esteem and affections which time will not fade. Forestry and foresters have lost a friend. *Requiescat in pace.*

FAREWELL DINNER TO SIR JOHN STIRLING-MAXWELL.

Sir John Stirling-Maxwell was entertained at an informal Club Dinner at the House of Commons on 20th April last year, following his resignation of the Chairmanship of the Commission. The guests included the Rt. Hon. Stanley Baldwin, Lord President of the Council; Sir John Gilmour, Minister of Agriculture and Sir Edward Hilton Young, Minister of Health; while among others present were two former Chairmen of the Commission, Lord Lovat and Lord Clinton.

Sir Roy Robinson presided and among the speakers of the evening were Mr. Baldwin and Sir Francis Acland. The latter proposed the toast of the evening, and his speech is given below.

"I believe that the best thing I can say of our late Chairman is that he has worthily carried on the traditions laid down for him by previous Chairmen. We have done very well in Chairmen—since my time. Lord Lovat, Lord Clinton, Sir John and now Sir Roy. And one great thing they have done is to establish a tradition of good relations with everybody else—with Government Departments, including the Treasury, with Governments of many different sorts, with landowners, with the inhabitants of the New Forest who are difficult people—even with the ancient Universities. Sir John has worthily developed that tradition, which is very valuable to us. We admire him too as a forester. All our Chairmen have been great foresters, including Sir Roy whose forests are the biggest of all. But we admire Sir John most, for he starts where the others leave off. Abraham Lincoln said that his navy went wherever the ground was a little damp. Our late Chairman makes trees grow wherever the ground is wholly unsuitable for tree-planting. Credit has been given to men who make a tree grow where a blade of grass grew before, or words to that effect. If so, greater credit is surely due to one who makes trees grow where no self-respecting blade of grass would think of growing. In his misty hills the mountain hares turn not white but a rich dark green in winter to match his spruces and the ptarmigan have taken to nesting in the tree-tops.

"But we admire Sir John Stirling-Maxwell not only as an administrator and as a forester, but even more as a man. There is something about him which makes me and, I think, very many others who know him, want him more than anyone else to be there in our best moments. I do not know quite what it is, charm, sympathy, selflessness, wisdom and understanding, the results of an active life of many interests, considerateness to our failings and appreciation of our successes, all these and something more. Whatever it is it has made Johnny Maxwell the great public man and the supreme private friend that we know him to be. We lose much now that he is going.

"As to our first ten years' work, what strikes me most as I look back is not what we have done, but that we still exist. I think of four special crises—the first, ante-natal, when the then Secretary of Scotland and one of the Geddes tried to secure that the Report which brought us into existence should be pigeon-holed. From that we were saved by the

industry of the late Lord Curzon to whom we should ever be grateful. Then came the first ' economy ' report, which recommended our abolition. From that we were saved by Lloyd George who refused to repeal any further Acts of Parliament which he had passed dealing with a subject which he found so useful in perorations. Then came the second and recent ' economy ' report, which would have reduced us to the position of caretakers of what we already have, and from that danger we were saved by the good sense of the present Chancellor of the Exchequer, and, I suspect, by some other Ministers who are our guests this evening.

" Now we are threatened by the Treasury with the withdrawal of our right of personal access to Ministers, secured by Cabinet Minute. It is vital to us—without it we should not have survived any of the previous crises in our history. Thanks to the good relationships which Sir John Stirling-Maxwell has established we shall, I am sure, survive this crisis also.

" Mindful of our motto—*ligna non verba*—timber not talk, I will add only that it has been a great pleasure and honour to be associated with our late Chairman in the work that we have done, and that I look forward with certainty to that work bearing fruit in the future to the great advantage of our country."

USE OF SEEDLINGS FOR TURF PLANTING.

By W. H. GUILLEBAUD.

A preliminary report on the results of planting experiments with seedlings in P. 32 has already been issued as Silvicultural Circular No. 11. The following notes supplement and in some respects amend the information already given.

The experiments carried out in P. 31 and reported upon in the last number of the Journal were in large measure successful and it was decided to follow up the work on a more extensive as well as more systematic basis. In Silvicultural Circular No. 9 " Planting Methods with special reference to Turf Planting and Use of Seedlings " it was laid down that in each operation where seedlings could be used blocks were to be planted with adjacent blocks of transplants for comparison. The instructions were that selected seedlings were to be used, that they were to be planted on sites which were not obviously unfavourable (too exposed or too poor soil) and that they should be put in in the spring, *i.e.*, after the chief risk of severe and prolonged frost was over. Where the Belgian system was the standard method employed, experiments on deep planting and planting on a step cut out on the sheltered side of the turf were suggested.

The weather conditions during and after planting were, if not exceptionally favourable, at least good enough to give excellent results with almost all the transplants used as controls to the seedling plots. There was no severe frost during the planting season such as had in the past caused severe losses to seedlings, but there was a long period of drought covering, in different districts, the months of May, June and July, which evidently tried the seedlings severely and caused somewhat heavy losses, especially among the larches.

The main facts have been stated in the interim report, but the following points of interest emerge from a closer study of the data.

The Spruces.

Norway spruce seedlings planted on Dartmoor Forest early in December suffered 60 per cent. losses (frost and easterly winds after planting), while Sitka spruce seedlings planted in the same Forest at a higher elevation at the end of January lost only 2½ per cent. in spite of eight weeks drought, frost and easterly wind following planting. Soil conditions were similar (*Molinia-Juncus* peat).

Apart from Dartmoor the only other areas in England where Norway spruce suffered heavy losses were Caio (65 per cent.) and Rockingham (60 per cent.). Both these were mineral soil areas. Caio was planted on plough ridges on *Calluna-Vaccinium* and it is worth noting that transplants put in in the same way also did badly, losing 40 per cent. On the other hand the same type of transplants notched in direct after screefing suffered only 15 per cent. of casualties. At Rockingham the spruce seedlings were also planted on plough ridges. Soil a stiff clay with strong growth of *Calamagrostis* and *Aira caespitosa.*

In Scotland failures in Norway spruce seedlings exceeding 25 per cent. occurred at Clashindarroch (40 per cent.), Forest of Deer (30 per cent.) and Clunes (31 per cent.). In all three cases the soil was mineral, not peat, and in two out of the three, planting was on plough ridges. Almost all the successful work with Norway spruce seedlings was on peat.

One of the very small number of relatively poor results with Sitka spruce seedlings was at Newcastleton where losses amounted to 39 per cent. It is curious that across the Border, in Kershope, the same type of seedling and of the same origin was planted on closely similar soil and vegetation conditions. Planting was done about the same date (May) in both forests and yet at Kershope the losses barely amounted to 1 per cent. At Salen on the Isle of Mull Sitka spruce failures averaged 40 per cent.; the spring drought was exceptionally prolonged in this district.

The following table gives a list of the forests in which the use of seedlings was particularly successful :—

Species.	Forest.	No. of Seedlings planted.	Soil.*	Percentage No. of Failures.
Sitka spruce ...	Blackcraig ...	3,500	Mineral ...	3
	Glenloy	5,000	Peat ...	2
	Glenrigh	3,800	,, ...	0
	Nevis	900	,, ...	4
	South Strome ...	12,000	,, ...	4
	Glenhurich ...	16,000	,, ...	3
	Benmore	4,000	,, ...	1
	Closeburn ...	6,000	,, ...	2
	Glenduror ...	4,000	,, ...	1
	Inverinan ...	22,200	Mineral ...	2
	North Tyne ...	8,700	Peat ...	3
	Kershope	8,700	,, ...	1
	Ennerdale ...	1,800	,, ...	1
	Harwood	3,500	,, ...	2
	Tarenig	4,000	,, ...	4
	Cwmcinion ...	1,000	,, ...	3
	Dartmoor ...	30,000	,, ...	3
	Halwill	9,000	,, ...	2
	Laughton	22,400	,, ...	4
Norway spruce ...	Blackcraig ...	3,000	,, ...	4
	Glengarry ...	3,000	,, ...	2
	Glenloy	5,000	,, ...	3
	Benmore	4,000	,, ...	4
	Inverinan ...	8,000	,, ...	0
	Kershope	8,700	,, ...	1
	Ennerdale ...	1,800	,, ...	1
	Harwood	3,500	Mineral ...	2
	Total	203,500	Average ...	2·5

* The terms mineral and peat refer to the material of which the turf was composed. In most cases the peat was of the shallow, slope type.

Japanese Larch.

Owing to the failure of the seed crop there were no 2-year seedlings available and the experiments had to be confined to 1-year seedlings. Seedlings were planted in 14 forests, but in two only, Inverinate and Bawtry, were losses below 10 per cent. in the experimental areas, while in seven they were over 25 per cent. At Bawtry exceptionally large seedlings (3 to 5 in.) were used. As a whole the seedlings appear to have averaged little over 1 in. in height growth.

European Larch.

Both 1-year and 2-year seedlings were planted in a considerable number of forests in both countries. The 1-year seedlings did badly on the whole being unable to survive the June drought. Two -year seedlings did much better in Scotland where they were planted for the most part in the month of February. In the south very variable results were obtained, but on the whole losses were much fewer in areas planted in January and February than in those planted in March and April. The heaviest losses occurred at Allerston (36 per cent., March), Bruton (56 per cent., February), Brechfa (80 per cent., April) and Myherin (42 per cent., March). The Brechfa seedlings were described as very poor but in the other forests the quality appears to have been satisfactory.

Douglas Fir.

There was only one experiment in Scotland, at Inverinan in S.W. Division, where 30,000 2-year seedlings were turf-planted in the month of April with a loss of barely 5 per cent. In England and Wales 13,000 were planted at Gwydyr and a similar number at Dovey (both in Division 2) and in both cases planting was direct, *i.e.*, not on turfs. The Gwydyr area included a series of small plots planted each month from January to May. The failures increase consistently from the early to the late planting, the figures being : January 14 per cent., February 33 per cent., March 43 per cent., April 82 per cent., May 98 per cent. Transplants put in in February suffered 15 per cent. losses. Losses in the main area at Gwydyr and also at Dovey averaged 21 per cent.—both January planting. The latter area provided one of the instances where transplants did less well than seedlings, 2 yr. + 2 yr. transplants at Dovey having 41 per cent. of casualties.

THE P. 31 TURF SEEDLING EXPERIMENTS.

Further reports on some of the P. 31 experiments have been received and the following points may be of interest :—

Division N.E.

A detailed report on the P. 31 work in the Division discloses a very satisfactory position. Losses at the end of the second year are mostly below 10 per cent. At Midmar 2-year seedlings of both Norway and Sitka spruce are described as out of check and stocking is complete.

Elsewhere spruce seedlings are good except where patches of poor (*Scirpus*) ground occur; here they are yellow and checked and there has been some loss from frost throw. On the whole the seedlings compare well with the transplants.

Division N.

Sitka spruce seedlings grew very well at South Strome during P. 32 and stocking is virtually complete. At Glenloy the growth of the Sitka seedlings has been as good as that of transplants in similar conditions. In other forests the colour is described as good but growth is usually slower than that of the adjoining transplants. Norway spruce seedlings have done relatively less well.

Division 1.

The following are extracts from the Divisional Officer's report:—

Sitka Spruce.

North Tyne, Whickope.—These plants have improved and are now more promising. Growth 1 to 2 in. Colour good with lengthening needles. Practically no further deaths. Plot top dressed with slag April, 1932.

Thornthwaite.—Of the seedlings 85 per cent. are alive and 75 per cent. of good colour. Average growth 1 in.

Rosedale.—The 3-year seedlings have done considerably better than the 2-year. The latter are very disappointing, 40 per cent. having died and the remainder showing very little growth. Losses in the 3-year seedlings are below 10 per cent.

Kershope.—Development appears to have been greatly influenced by soil and exposure. At high elevations and on poor types of peat results have been unsatisfactory; there has been a further loss of about 25 per cent. and the plants are in check. On the better situations the plants have got a good colour and grew about 3 in. during P. 32.

European Larch.

Ampleforth.—Comparatively few deaths have been reported but plants put on only an inch in the second season. Weeds are troublesome as where bracken is cut other weeds such as couch and foxglove tend to come in and choke the plants.

Hamsterley.—Results remain good. Growth 9 in. on south slope and 4 in. on north slope.

In his general observations the Divisional Officer stressed the superiority of 3-year spruce seedlings for turf planting, the importance of excluding poor soils and exposed situations and of late planting.

Division 3.

Mention is made of a small increase in the number of failures in Sitka spruce at Brecon, Glasfynydd and Rheola but growth and appearance are generally described as good. At Rheola Norway spruce seedlings

have done badly on exposed ground, but where sheltered by surface vegetation they are sturdy and of good colour. Japanese larch seedlings in the same forest look strong and healthy and are much better than 2 yr. + 1 yr. planted direct in adjoining land.

Summary.

1. The P. 32 seedling experiments differed from those of the previous year in being much more extensive, in that selected seedlings were used and that the poorer sites were for the most part avoided.

2. The weather conditions were moderately favourable for planting, as evidenced by the success of the transplants of all the species concerned.

3. The result of the spruce seedling planting in P. 32 was in the main very successful. An average loss of less than 10 per cent. in both countries (apart from the small-scale trials in Division 2) cannot be regarded as anything but a satisfactory take. Special weather conditions seem to have accounted for the outstanding failure of Sitka seedlings at Salen. It is probably significant that practically all the heavy losses in Norway spruce occurred on ploughed mineral soil areas.

The relative ill-success of several of the small-scale trials in Division 2 is difficult to explain.

The method and depths of planting the spruce seedlings varied from plot to plot considerably in the different Divisions and forests, but where comparative trials were made these were not particularly illuminating. On the whole the evidence is in favour of planting the seedlings deeper than normal so that the roots can spread out on the natural surface below the turf.

4. The planting of 1-year seedlings of European and Japanese larch was not very successful, more especially in comparison with the transplants. Two-year seedlings did moderately well in Scotland. Early planting is indicated.

5. Douglas fir seedlings were successfully turf planted at Inverinate in Scotland. The only other trials were at Gwydyr and Dovey in Wales where the seedlings were planted direct and results were not as good as at Inverinate.

6. Reports on some of the P. 31 experiments at the end of their second growing season indicate that on moderately favourable ground growth has been quite satisfactory. Further death rate has only been appreciable where conditions were distinctly difficult owing to bad soil, exposure, or both.

Conclusions.

1. The work done so far suggests that seedlings of both Sitka and Norway spruce can be successfully used and economically substituted for transplants provided sufficient attention is paid to the following points :—

(*a*) The quality of the seedlings: sturdy, well rooted plants are essential. Three-year seedlings, especially if wrenched in the nursery, may be preferable to 2-year seedlings in the north.

(*b*) The type of ground: only reasonably good sites should be considered for seedlings. The P. 32 trials suggest that peat turfs are safer for Norway spruce than turfs or plough ridges composed mainly of mineral soil. On soils of the latter type direct planting may be preferable to any form of turfing.

(*c*) Shelter: exposed ground should be avoided.

(*d*) Weeding: seedlings have not the stiffness of transplants and are more liable to suffer from smothering.

(*e*) On high-lying ground in the north of England and south of Scotland late planting is advisable. Near the west coast of Scotland early planting may be safer owing to the risk of spring drought.

2. More experience is required as to the suitability of larch seedlings for planting on turfs. In experimental work larch seedlings have been used successfully on ploughed ground especially when basic slag has been applied. The seedlings should not be planted later than the middle of February—preferably earlier.

PROGRESS REPORT ON RESEARCH: JANUARY, 1933.

By W. H. Guillebaud.

1. Nursery Experimental Work.

The trial of various methods of covering small seeds was continued in both England and Scotland, European larch, Sitka spruce, birch and alder being the species investigated. In European larch the use of sand resulted in an improvement of 30 per cent. in germination as compared with nursery soil. In Sitka spruce the benefit of using sand was considerably greater, the germination was increased by 60 per cent. in one experiment and more than doubled in another. The maximum yield from Sitka spruce with sand covering, based on a count made towards the end of June, was 107,000 seedlings per pound. Well-decayed Douglas fir humus gave slightly better results than nursery soil but not nearly so good as with sand. In Kennington Nursery, where these experiments with Sitka spruce were carried out, the weather after sowing was cold and wet and attempts to reduce caking by covering the soil in some of the plots with (A) sphagnum and (B) Douglas fir twigs, were not successful. The secondary covering impaired germination in all cases. Previous work on the same lines had shown that in dry weather the sphagnum covering may be beneficial, but in normal or wet springs the method cannot be recommended.

The great sensitiveness of seed of birch and alder to type of covering was well brought out by experiments at Altonside. In earlier trials it was found that with a cover of well-washed sand a much higher germination resulted than with nursery soil. In the new experiments sand was used as a control and parallel plots covered with coarse grit, a material approaching to fine gravel; in both species the germination in the grit-covered beds was double that of the controls.

The beneficial effect of watering seed of birch and alder was again clearly demonstrated in Kennington nursery; water was applied until germination was general. The yield was increased over ten-fold in birch and five-fold in alder in the plots which received water. The weather conditions were fairly dry.

Some preliminary tests on the stratification of seed had given promising results in 1931 at Kennington and the method was followed up last year by tests with Norway spruce, Douglas fir, birch and alder. Peat and sand respectively were used for stratification and part of the seed was kept stratified throughout the winter and part stored in air-tight jars until January when it was stratified; there were also controls of seed sown dry in autumn as well as in the spring. The results are curious, stratification in peat was fatal to Douglas fir and not beneficial to Norway spruce but gave the best results with both birch and alder. On the other hand Douglas fir seed stored in jars until January and then stratified in sand until the spring gave a germination of 74 per cent. as compared with 39 per cent. obtained by the normal sowing of unstratified seed stored in jars and sown in the spring.

Improvement in yield of Sitka spruce was obtained in Inchnacardoch Nursery by pregermination, a considerable bulk of seed being used. The seed was kept moist for 20 days and turned at frequent intervals while control seed was soaked in running water for 6 days. Both lots were sown on 18th May; the pregerminated seed gave 30 per cent. more plants than the control.

Experiments on weed control were carried out in four nurseries using sulphuric acid 1 in 80 and 1 in 160 watered on immediately after sowing, 1 per cent. copper sulphate applied 7 days after sowing, and a blow lamp. (All the above treatments were not given in all the four nurseries.) The species used were Sitka spruce and, in one nursery only, also Scots pine.

The acid and copper sulphate treatments had little apparent effect on the germination except at Kennington where the acid treated plots had more than twice as many seedlings as the control. The blow lamp treatment gave quite normal germination figures in three of the nurseries, but in the fourth, where it was applied to Scots pine as well as Sitka spruce, it proved disastrous, destroying all the pine and the majority of the Sitka seedlings. Apparently late sowing at a time when conditions were favourable for rapid germination was responsible for this result. As regards effect on the weed growth the acid and copper sulphate solutions halved the amount of the first weeding and substantially reduced the second weeding; the blow lamp was not on the whole so effective, except in the one nursery where the tree seedlings also were killed.

Attempts to improve the growth of 1-year seedlings of larch, Sitka spruce and other species by the use of manures and raised boxed-in seedbeds have not led to any positive result. At the end of the growing season larch was the only species to benefit from heavy applications of broad leaf humus. Artificial manures increased weed growth to an alarming extent and heavy losses from weeding resulted.

The large-scale grading experiment has been continued in the costed nurseries; and the results of the P. 31 lining-out are now available. Losses in all species and nurseries were high, the second and third grade seedlings especially showing up badly.

2. Plantation Work.

Peat Project.

England and Wales.

A number of the experiments at Beddgelert have now been running for over 4 years and it is satisfactory to find the beneficial effects of phosphatic manures still persisting on the worst type of peat, while the unmanured plants have made no progress but if anything have gone back. In the first (P. 27) experiment at North Tyne Sitka spruce were planted on Belgian turfs in a very exposed situation at 1,000 ft. elevation. At the end of five growing seasons the plants were 26 in. in height with leading shoots averaging 5 in. The ground was molinia peat and the plants were not manured.

Scotland.

A. *Basin Peats.*—Experiments on the basin peat areas at Lon Mor give further evidence of checking after one or after two dressings with basic slag, but the retention of needles and the fairly green appearance of Sitka spruce even where growth is very slow, has made the general outlook this year more favourable. Even without slag Scots pine looks remarkably well. It is hoped that root investigations shortly to be carried out will throw light on the question of mergence from check. If roots are being extended in this period of very slow shoot development, then the probability is that, given sufficient drainage, a crop is ultimately going to be obtained.

As regards miscellaneous species on this class of peat, the growth of the hybrid and Japanese larches, *Pinus contorta* and grey alder is outstanding. Douglas fir and *Tsuga heterophylla* have done well on Belgian turfs but all species give poor results where no slag has been employed. Generally, the indications are that pine or another preliminary crop is going to be a surer means of afforesting this type than by the direct planting of pure spruce.

Methods of turf-planting experiments show up some results in a very distinct manner: Preparation in advance of Belgian turfing areas is apparently injurious but shallow turfed plots prepared 3 years in advance of the control plots now support Sitka spruce of equally good growth. The very marked superiority of planting on a group of four shallow turfs (with the amount of drainage that this entails) is maintained compared with either the single-shallow-turf or the Belgian turf methods. It is rather remarkable to find that whereas originally turfs from the surface layer (in Inchnacardoch 73, P. 28) supported distinctly poorer growth of Sitka spruce than did turfs from below 2 ft. the position is now reversed.

In the large intensity of draining experiment at Lon Mor, very vigorous growth continues to be made by *Pinus contorta* on the large Belgian turfs employed there, but both with this species and with Sitka spruce, better growth is quite clearly being made on the more intensively drained units.

Under average conditions slag alone produces a slightly increased vigour, and shelter alone has very little effect; the combined influence of these two ameliorating factors however is very marked on the poorer *Scirpus* types. Among the manurial dressing experiments, the superiority of "Semsol" and to a less extent, of potassium mineral phosphate, over basic slag is most striking.

B. *Shallower Peat Types on Sloping Ground.*—The most marked feature of the experiments on the poorest of these sites is the phenomenal growth of Japanese larch where slag has been applied. In 7 and 9 P. 28 Achnashellach, growth in certain parts of the slagged, turf-planted areas has reached 8 ft., and the appearance of almost complete establishment is given. Unslagged, growth is not at all encouraging. Under similar conditions, *Pinus contorta,* mountain and Scots pines grow vigorously, and where these species occur un-manured they appear to be rather more promising than does untreated Japanese larch.

There is evidence (Glenrigh 1 P. 24 and Achnashellach 2 P. 27 and 11 P. 28) to show that Japanese larch benefits in a marked degree through turf-planting alone (without slag) for notched control plants check severely. That various pines do better on turfs than when direct planted is demonstrated also (Inchnacardoch 18 P. 26).

Judging from the few available trials in which it occurs, hybrid larch would appear to be a species of decided promise for these peat-clad slopes (Glenrigh 12 P. 28 and Achnashellach 10 P. 28). Spruces have checked very severely where not slagged and even where treated with this manure check has often followed quickly. It appears probable therefore, that on this type of ground also, a preliminary or nurse crop of pines or some other species is going to be required if spruce is to be raised without a very long period of stagnation. Corsican pine promises well at Glenrigh when turf-planted and without slag (12 P. 28). Nootka cypress and Engleman's spruce continue to do well on drained and slagged ground.

Experiment 11 P. 24 at Inchree situated on rather a good flush peat is remarkable in so far as it shows no distinct improvement as a result of Belgian turf-planting. No slag was used and the control units were notched into the ground surface. Species: Sitka spruce. Alongside on similar peat a draining-spacing experiment demonstrates the beneficial effect of close draining (10 P. 28) on the growth of Sitka.

The plough-trial, also at Inchree (14 P. 28), and on a moderately poor *Scirpus* type shows very promising growth of Scots pine and quite favourable results with Contorta pine and Sitka spruce. Growth of the group-planted and slagged species at Corrychurrachan continues almost unchecked on the better types but a distinct falling off in colour of Sitka Spruce and *P. contorta* is noticeable on the poorer (*Scirpus*) areas (Glenrigh 21-27 P. 30).

Alnus oregona continues to do well on the slag-dressed groups in P. 22 Inchnacardoch (86 P. 30).

Plants in the experiments at Borgie are on the whole in a good condition and except among Scots pine (30 per cent.) losses have been few. In all experiments, however, the effect of basic slag dressing is at its height and less rapid shoot growth will probably be obtained in future. Remarkably vigorous growth has been made by the Sitka spruce (3 to 8 in. shoots) and *Pinus contorta* transplants (also 3 to 8 in. shoots) in the imitation ploughing section 2A and B P. 31, and it would appear that there is certainly a future for ploughing on this type of ground. Application of basic slag to plants at Borgie—either as top-dressing or in the turf—results in the strong local development of *Agrostis*, *Molinia* or *Juncus communis*. Apparently these plants appear on distinct types of ground, but so far these types have not been thoroughly recognized in the untreated state.

In addition to the species tried out in these experiments to date, it is proposed this year to introduce some Japanese and hybrid larch and Oregon alder. It has also been arranged to test the phosphatic manure "Semsol" at Borgie this year.

Calluna Soils.

England and Wales.

Experiments with 1-year and 2-year seedlings of different species on ploughed ground at Allerston and Wareham have been generally successful. Remarkable growth has been made by 1-year Japanese larch seedlings at Wareham on ground which had been dressed with basic slag; many of the plants put on over 9 in. of shoot and appear thoroughly well established. Such a response to basic slag in the first year of application is very unusual. One-year Japanese larch also did very well at Allerston and here puddling the roots before planting has a very definite effect upon the survival. Sitka spruce and Scots pine seedlings also benefited slightly from puddling. It is suggested that where seedlings are to be used on a large scale the effect of puddling the roots with a clay mixture to which a small quantity of basic slag has been added is worth trial.

Scotland.

In the experimental areas at Inchnacardoch, Teindland and Clashindarroch, good growth has again been made by pines and spruces on the ploughed and slagged ground. The prolonged drought of early summer does not appear to have caused a heavy death rate. Experiment 36 P. 29 at Teindland in which group-planting was carried out on hand-dug patches, shows up particularly well, there being little evidence of check, but in the large ploughing experiments, 16 P. 27 and 23 P. 28, growth has not been maintained at quite the 1931 rate. Slagged *Tsuga* still look well but losses among the *Thuya* have been very heavy.

Growth of Douglas fir on the moor at Inchnacardoch is poor and colour rather yellow, spruces also are checked but Japanese larch and the pines are coming on well on the ploughed ground.

At Clashindarroch (Drumfergue area) on the ploughed section Sitka spruce, Japanese larch, Scots pine and *Pinus contorta* have started promisingly without slag dressings, but the soil appears quite a good one and it is intended to introduce for comparison a directly planted control section in 1933.

It was interesting to find Sitka spruce planted in a mattock-trenched strip on a *Calluna/Erica cinerea* slope at Inchree (13 P. 28) evidently emerging from check. No slag had been applied, yet the majority of the spruce were of very good colour although active shoot development had not begun.

Drainage is shown to have a very marked effect on wet level ground of the poorer hard type judging from the much better growth made at Teindland by Scots pine at the drain-side compared with the plants intermediately between drains.

Breckland Soils (Thetford).

The birch and grey alder planted in P. 30 as nurses continue to grow satisfactorily.

In the Scots pine race experiments pines from Finland, from the lowlands of Hungary and from the Trentino have virtually failed. Most of the other lots are doing well.

Deer have severely damaged the underplantings of beech seedlings and transplants in Scots pine of different heights. The plots are to be fenced to prevent further damage.

Chalk Soils.

The experiments begun in P. 30 at Buriton with the object of finding a suitable nurse species for advance planting on shallow chalk soils (beech to be the main) are already yielding results of value. Grey alder, Oregon alder and common alder have grown remarkably well in the P. 30 and P. 31 plots. Many of the plants are from 4 to 6 ft. in height and in places the crowns have begun to touch. It is proposed to introduce beech this year (P. 33) into the most advanced of the plots. Of other species *Cupressus macrocarpa* and *Cedrus atlantica* have failed and birch and European larch have not done well. Next to the alder Austrian pine has made the best growth. Of miscellaneous species planted in small groups *Ailanthus glandulosa, Alnus cordata, Pyrus aria, Pyrus intermedia, Tilia parvifolia, Laburnum alpinum* and *Alnus rugosa* are all doing well, *Pyrus intermedia* and the laburnum being outstanding.

In P. 32 a trial was made of various methods of treating transplants of *Cupressus macrocarpa* prior to planting. Plants were lifted in the Kennington Nursery in October 1931, December 1931, and February 1932, and carefully heeled-in in trenches. Further plants were lifted in April and the four batches sent to Buriton for planting out. The result was as follows :—

Date of lifting in nursery.	*Percentage failures at Buriton.*
October	12
December	37
February	53
April	78

These figures show the advantage of lifting the plants in the autumn and heeling them in prior to planting.

The Loams and Clay Soils (Hardwoods).

Further series of plots were laid down in the Forest of Dean and at Dymock to determine the optimum date and density of sowing acorns in the field. For the first time since the series began, a fairly severe attack of mice occurred in the density experiment ; the monthly sowing plots suffered from birds, chiefly pheasants. In both experiments germination was much lower than in previous years. There was little to choose between any of the months (January to May inclusive) as regards germination ; the mean number of seedlings per yard run was 3·1, representing approximately 20 per cent. of the number of acorns sown. The experiment on density of sowing, carried out at Dymock, gave the following results :—

Density of sowing per yard run.	*Number of seedlings per yard run.*	*Number of 6-ft. units without a seedling.*
10	1·4	41
15	2·1	36
20	2·7	27
30	1·9	70

The relative failure of the heaviest sowing, 30 acorns per yard run, is difficult to explain, except on the hypothesis that once the mice had started on a row they would have no difficulty in following it down, as the acorns were virtually touching each other in the row.

The evidence of the sowing experiments extending over four seasons suggests that a sowing density of 15 to 20 acorns per yard (line sowing) will usually be successful. The evidence as regards date of sowing is somewhat inconclusive; out of the full range from November to May the three months January to March appear the most favourable.

A number of experiments in the Forest of Dean testing the relative merits of transplants and 1-year seedlings of oak have been assessed; the results, which are of some interest, are tabulated below :—

Experiment.	Mean Height (inches).		Percentage of plants with good habit and a definite leading shoot.	
	Seedlings.	Transplants.	Seedlings.	Transplants.
Brandhill—1 P. 27 ...	39	47	17	22
Pritchard's Hill—11 P. 27	35	43	15	19
Soudley—9 P. 28 ...	33	38	—	—
Lea Bailey—30 P. 30 ...	14	22	43	35

In each case the transplants have grown somewhat faster than the seedlings, while the proportion of erect growing plants is very similar. Except, perhaps, in the Lea Bailey area, the seedlings have held their own sufficiently well with the transplants to justify the use of the younger stock on the score of cost.

Experimental plots of oak and ash in Northamptonshire are still too young to give results of much value. One-year oak seedlings planted in groups at Apethorpe in P. 29 are making good progress, some of the plants being as much as 30 in. in height. Ash do not appear to have benefited from manuring at Oundle. A variety of species was planted at Drayton in P. 32 on old agricultural ground with the object partly of finding a suitable nurse for oak and partly of securing a faster-growing species which might be substituted for oak as a main crop. Three methods of planting, pitting, notching and planting on mounds, were adopted. There was a fair take, except in certain cases, where the

planting material was unsuitable. Further blocks will be planted this year.

Attempts to establish poplar have been made in many of the Commission's forests in England, but there has been a remarkably general lack of success. In P. 32, experiments were started in four nurseries—Selby, Salcey, Stockley in the New Forest, and Santon Downham at Thetford, in the hope of throwing some light on the problem. Cuttings taken from branches and from stools have been lined-out on unmanured nursery ground and also on ground which was deeply cultivated and heavily manured. The following table shows the position at the end of the first growing season :—

Nursery.	Stool shoot cuttings.				Side branch cuttings.			
	Unmanured.		Manured.		Unmanured.		Manured.	
	Height.	Losses.	Height.	Losses.	Height.	Losses.	Height.	Losses.
	Ins.	Per cent.	Ins.	Per cent.	Ins.	Per cent.	Ins.	Per cent.
Salcey ...	20	3	32	1	26	1	25	1
Santon Downham ...	34	1	40	1	29	14	34	13
Stockley ...	3	69	28	1	1	84	18	5
Selby	26	3	29	6	19	8	28	8

Some of these results are curious, notably the heavy failures and negligible growth of the unmanured cuttings at Stockley. As a rule, stool shoot cuttings have produced stronger shoots than branch cuttings and manured plants are better than unmanured.

One-year and two-year old rooted cuttings, cut back and not cut back, were lined-out in the nurseries and also (without cutting back) planted by different methods in the forest. In general, cutting back in the nursery has resulted in the formation of good new shoots, while those that were not cut back made little growth in spite of manuring.

Established poplar which were in check have been treated in various ways, *e.g.*, by throwing up mounds round the base of the stems, by hoeing to keep down weed growth, and by lifting. Lifting proved disastrous at Thetford, and neither of the other treatments has had much effect as yet. The nursery part of the experiment is being repeated this year.

Race Studies.

The main European larch experiment was carried a stage further last spring, when the transplants from the six nurseries were planted out. Losses have not been high, and it is significant that the Drumtochty lots have this year no more failures than the others. At Braemore, lowest losses occurred among the transplants raised at Auchterawe, and highest

losses in those raised at Ratagan and Altonside. There is no significant difference between the plants of the four distinct origins, either as regards failures or rate of growth.

There is nothing to report regarding other larch race experiments, except that a large number of new lots were planted out in the spring at Braemore, Clashindarroch and Drummond Hill.

Regarding Scots pine, the experiment (1 P. 29) on good heath at Findon shows up obvious differences. " England East " are best as far as height and vigour are concerned, " Darnaway " and " Beaufort " coming next. Many of the southern and eastern European lots have done very badly.

At Inchnacardoch (58 P. 28) and at Teindland (32 P. 28), both on good *Calluna* ground, distinct characteristics are becoming apparent in the different lots, and it is evident that these plots are going to become of increasing interest in future. On the poorer type of ground there is as yet little to report.

Pinus ponderosa at Findon (2 P. 29) are becoming established, and an improvement in colour is general. No difference between the lots of different origin is yet apparent.

Different *P. contorta* lots at Clashindarroch and Teindland show little difference to date except that the Mount Ida race appears to grow more vigorously although it suffered heavier losses in the early stages.

3. Sample Plot Work.

During the period October, 1931 to December, 1932, 59 plots were thinned and remeasured. Of these, 27 were in England and Wales and 32 in Scotland; 11 new sample plots were established in Scotland. Pruning work is now being carried out in certain of the sample plots but only trees in the surrounds outside the actual plot area are pruned. It is hoped that this work will eventually yield valuable information on such points as rate of occlusion and effect of the pruning on the quality of the timber of some of the less extensively grown species, such as *Abies grandis, Cupressus Lawsoniana*, etc.

Perhaps the most interesting of the plots dealt with during the period were two new plots of *Tsuga heterophylla* at Murthly and the Sitka spruce at Dunach which received its third thinning and measurement. The *Tsuga* plots carry a remarkably heavy stocking and volume for the height. The following are the particulars of two of the sample plots :—

Species.	Age.	Mean Height.	Mean Girth.	Number stems per acre.	Volume per acre (true measure).	Current Mean Annual Increment.
		ft.	in.		cu. ft.	cu. ft.
Tsuga	26	48	19	1,075	4,250	—
Sitka spruce ...	30	73	32	361	6,390	565

The increment of the Dunach Sitka spruce exceeds even that of the plot of the same species at Dunster, reference to which was made in the previous issue of this Journal.

A new sample plot was established at Largie in Argyllshire of *Cupressus macrocarpa*; this is the first plot of that species to be measured. The trees were planted pure but were beaten up with Sitka spruce, many of which have overtaken the cypress. The age of the cypress is 32 years; number of stems per acre 653 (plus 250 Sitka); girth 23 in.; height 42 ft.; true volume 3,200 cu. ft. per acre.

4. Research Work at Aberdeen.

The main work by Dr. G. K. Fraser, on the correlation of soil and tree growth, working on sample plots in the east of Scotland was continued. During part of the summer Dr. Fraser, assisted by Mr. R. E. Fossey, carried out a soil and vegetation survey of part of Achray Forest in Perthshire. The drift conditions were found to be exceptionally uniform and the general conclusion was that variations in soil and vegetation were more definitely associated with topographical features—elevation, aspect, slope, drainage, etc.—than with variations in the origin or composition of the parent rock.

An inspection was made of the deep-ditching experiments established five years ago in peat bogs in different parts of Scotland. Small areas of about one square chain were selected in a number of deep peat bogs and isolated as completely as possible by ditches cut down to the solid; the depth of the peat was measured and the vegetation charted. It is somewhat remarkable that at the end of five years virtually no changes would be observed either in vegetation or in depth of peat, *i.e.*, no shrinkage had taken place.

Dr. E. V. Laing, continuing his studies on mycorrhiza, has been investigating the distribution and ecology of *Elaphomyces*, one of the most common of all the fungi which are known to form mycorrhiza. It has been found associated with the roots of Scots pine, Norway spruce and European larch. A curious fact about its distribution is that it seems to be closely related to the abundance of red squirrel. Inoculation experiments have been carried out with the spores of this and other fungi.

Wild white clover, sown on peat turfs in which spruce seed was also sown, developed well and appear to be helping the spruce seedlings as these are a good colour and making vigorous growth. The seedlings in the control turfs without white clover remain yellow and checked. Phosphatic manures are necessary to get the clover to come away.

5. Pruning.

Experimental work on pruning was continued in the Forest of Dean. A considerable number of plots of Douglas fir, Scots pine, Corsican pine and Norway spruce of various ages were pruned using different tools and methods, the work being costed in every case. The Research forester in the Dean, Mr. J. E. Maund, was in charge of the investigation,

A report has been drawn up and circulated to technical officers. The following points, taken from the report may be of general interest :—

(1) In the course of the investigation satisfactory types of safety belts and climbing irons were devised by Mr. Maund and manufactured locally at very reasonable prices.

(2) A stiff bladed curved saw with the teeth set to cut on the pull stroke is the best tool for pole work from the ground for certain species (notably Douglas fir). A short knife blade set almost at right angles to the pole to which it is fixed makes a very good job of Scots pine and Norway spruce, provided the branches have been dead long enough to be brittle, and is quicker to use than the pole saw.

(3) In general, it is not satisfactory to prune from the ground higher than about 16 ft. with the pole saw and 20 ft. with the knife. Above these heights it is cheaper to use ladders and hand saws ; the ladders are used to get up into the tree crowns and the men work downwards standing on the branches and secured to the trees with safety belts.

(4) Douglas fir was found to be much the most expensive species to prune—owing to the size and toughness of the branches. Individual trees of Douglas vary remarkably in coarseness of branching. In the course of a detailed test coarsely-branched trees took more than three times as long to prune as fine-branched trees of the same height and diameter in the same stand. This is a point worth watching when marking trees of Douglas fir for pruning.

(5) Pruning up to a height of 18 ft. in plantations of 25 to 35 years of age was found to cost by day work per tree approximately as follows :— Douglas fir 2*d.*, Scots pine 1·1*d.*, Corsican pine 1·2*d.* and Norway spruce 1·7*d.*

(6) In some of the plots the workmen were allowed to select their own trees for pruning, the instruction being that only good straight dominant trees were to be chosen at a space of 12 to 14 ft. apart. In most cases it was found to be better to have the trees marked in advance by the forester.

6. Meteorology.

The meteorological stations at Nagshead Nursery (Forest of Dean), Lynford Nursery (Thetford) and Benmore Nursery are now established. Small plots of various species of conifers and broadleaved trees have been planted near each station and observations on shoot development during the growing season, time of flushing, incidence of frost, etc., are being carried out. The observations at Nagshead and Benmore are made by the school students under the supervision of the Instructors and at Thetford by a Research foreman.

7. Breckland Research Committee.

This Committee of science workers at Cambridge was set up two years ago with the object of studying biological conditions on the heaths of central East Anglia. There are no developments to report.

8. Mycology.

Research into Frost Damage.

Some further tests were made on the critical temperatures at which frost damage occurs. These were to complete the data already obtained and which are being prepared for publication as an Oxford Forestry Memoir. It may be of interest to note that tests carried out on larch plants raised from seed of Scottish, Silesian and Tyrolese origin showed that there was no appreciable difference in relative sensitiveness to frost.

This year research has been started by Mr. Day and Mr. Peace to determine some of the factors, other than the sinking of the air temperature below the critical point, which favour or help to prevent the occurrence of frost damage. The lines of work include:

(*a*) Variation in rate of flow of air and in humidity of air during freezing.

(*b*) Pre-treatment, *i.e.*, the exposure of the plant to high and low temperatures respectively before lowering the temperature to the critical point, also the effect of spraying with water immediately before freezing. In the case of European larch definite evidence was obtained that the severity of frost damage was considerably increased by watering. This may be of importance in connection with winter or early spring spraying against *Meria laricis*.

(*c*) After treatment. It has always been considered that the conditions prevailing during the thawing of frozen tissues are of importance in relation to the amount of damage caused. Attempts are being made to determine the effect of different rates of thawing in conjunction with slow or rapidly circulating humid or dry air.

Oak-rot Investigation in the Forest of Dean.

The first part of the investigation has been completed and the data analysed. Nearly 2,000 trees from 20 areas were analysed and the distribution and volume of the rot determined. In the best stands there were 64 per cent. of perfectly sound trees, but in the worst areas the proportion fell to 32 per cent.; the average was 47 per cent. of sound trees. The rot was chiefly confined to the higher part of the stem of the taller trees, but in the poorer stands there was a considerable proportion with rot extending nearly or quite to the base of the stems. A specially disturbing feature was the discovery that the younger (65–85 years) oak stands in the Forest were also affected by the rot to an appreciable degree. After examining all the factors which might have a bearing on the local intensity of rot in the oak stands, it was concluded that while the poorest stands and also some of those on the rim of the basin were the most severely affected, the most important single cause of the decay was undoubtedly the past silvicultural treatment to which the stands had been subjected. Excessive thinning in

early youth resulting in the development of large low-set branches which became gradually suppressed as the crop closed up again, has been primarily responsible for the trouble. It is proposed to examine a further set of trees in about four years' time in order to ascertain how fast the rot is spreading.

Elm Disease.

The past year has seen a welcome check to the continued spread of elm disease in England. In nearly every large area visited by Mr. Peace in the course of a survey carried out in September the disease had become less severe than in the preceding year. The number of apparent recoveries observed was quite large and many of the trees showed scarcely any signs of the previous attack. Cultures made from a number of these "recoveries" showed, however, that in nearly every case the fungus was still alive. This was found to be the case even in two trees which had shown no external signs of the disease since 1928. While this condition continues there must be considerable risk of the fungus becoming once more active.

Meria laricis.

Spraying experiments were carried out in four nurseries in England, testing different forms and strengths of spray and times of application. The use of strong winter sprays gave less definite results than in the previous year. Sulsol, Amberene and liver of sulphur appeared to be the best materials for summer spraying. A number of cases of scorching occurred in the different experiments, the result for the most part of spraying during hot sunny weather, and a good deal of useful experience was gained as to the conditions under which it is unsafe to apply the sprays.

Control by means of spraying was employed in most of the Commission's nurseries in which there were seedbeds of larch, with generally successful results. The dry weather in the latter part of the year also contributed to check the spread of Meria.

Ink Disease of Spanish Chestnut.

The fungus concerned in the die back of chestnut in the New Forest has been definitely identified as *Phytophthora cambivora.* A strain of the same fungus has also been isolated from a diseased beech in Somersetshire, while a further and virulent outbreak of ink disease on Spanish chestnut has been confirmed at Garnons, near Hereford. These are believed to be the first records of the disease in this country.

Damping-off of Seedlings.

A certain amount of preliminary work with various fungicides was carried out in the spring. An interesting outcome of the work was that when seedlings of Scots pine and Norway spruce were raised under conditions intended to favour the development of damping-off, the pine were quickly affected, while the spruce remained healthy in spite of the abnormal growing conditions.

9. Entomology.

Pine Shoot Moth.

The disbudding experiments carried out in P. 30 and P. 31 have now been carefully assessed. The conclusion is reached that the method is not effective as at present carried out. The cost is not too heavy—about 3*s.* per acre for a badly infested stand—but the worse the degree of infestation the less efficient does the disbudding method become, owing chiefly to migration from larvae which have wintered in buds on the lower branches and proceed to attack the leading bud in the spring. Calculations based on two of the plots showed that out of every 100 trees distorted in the control only eight or five trees respectively would have been artificially protected by disbudding. A modified form of disbudding is now to be tried. It is also proposed to make a survey to show the extent of severe damage at Thetford and Swaffham.

Defoliation of Oak in the Forest of Dean.

There was a fairly severe attack of oak-roller moth caterpillar in 1932. In spite of an exceptionally wet and cold May, which served merely to retard their feeding, the young larvae developed rapidly during the warm weather of June, and before the middle of the month large areas of the forest appeared quite brown. The areas principally affected were the valleys and lower slopes of the ridges. Within a badly attacked stand it was noticed that the earlier flushing trees were less severely defoliated than the late flushing forms. On investigation the earlier flushing forms proved to be predominantly of a sessile type. It has been established that *Tortrix viridana* is virtually absent from the Highmeadow Woods; any defoliation which has occurred in those woods in the past has been due to the caterpillars of the winter moth and other geometer moths, and not to those of the oak-roller.

10. Timber Investigations.

In connection with the test of the preservative treatment of fence posts, three lots of posts have been treated at the Princes Risborough Laboratory; one set has been erected at Clocaenog and a second at Thetford. The third set has been retained at Princes Risborough for comparison with the other areas.

One hundred and fifty poles of Corsican pine and a similar number of Norway spruce and Sitka spruce have been sent to Princes Risborough for testing the suitability of these species for telegraph poles. Strength and creosoting tests are being carried out on a proportion of the poles. If these are satisfactory, arrangements have been made with the Post Office to put 50 poles of each species into the line for service tests.

PLANTATIONS ON THE CARMARTHEN SHALES.

By G. B. RYLE.

The Forests of Brechfa, Caio and Crychan are situated at the southern point of that vast mass of Silurian rocks which cover a large part of Carmarthen, Cardigan, Montgomery and Radnor. In the former county shales predominate on the uplands, and these produce typically a somewhat solid but moderately porous clayey loam, generally of no great depth, underlaid by a fair depth of partially weathered shale which successfully absorbs surplus moisture. For the most part, therefore, peat is not an important factor even on the highest hills. There are exceptions, but generally the mountains are of the grass-heath type, commonly with bracken. The lower slopes are mainly bracken-clad. Of the land hitherto taken in hand, few of the hills much exceed 1,000 feet in height.

Direct evidence of the productive capacity of the higher land is not too abundant, and the following rough measurements are interesting.

Banc Disgwylfa.—A triangular plantation of hardly one acre in extent forms a conspicuous landmark at an elevation of 1,030 ft. and is fully exposed from all directions. Situated on the highest part of a gentle "saddle," the gradual falling off in height to all its margins is noticeable, and it is certain that even in the centre of the plantation the stunting effect of blast is felt. The soil is a typical hard loam on weathered shale and little more than 10 in. deep. The crop is a random mixture of European larch, Scots pine and Norway spruce, with a marginal belt of beech. The growth of this last is interesting in that it has formed a strong screen to full crop height. In the centre of the plantation the maximum height of all species at an age of 30 years is about 35 ft. (*i.e.*, 50-ft. Quality Class for larch and Scots pine and 60-ft. Q.C. for spruce). Taking the mixture as a whole, it is obvious that the spruce is the dominant tree both in actual growth and in form; Scots pine comes second, though it is considerably rougher. The larch is extremely rough, and a large percentage of the originally planted trees have become suppressed and killed.

At any rate, as a pioneer crop the larch can be ignored, but the Scots pine–Norway spruce mixture is possibly useful. We know from experience what a slow starter the spruce is on these uplands, and that Scots pine starts fairly quickly despite annual blast effects each March. As a nurse crop it may be of use. The strong growth of the beech, however, suggests an even sounder policy for these uplands: a spruce-beech mixture.

Lletty Llwyd.—A plantation of larch 22 years old on a N.W. aspect and varying in elevation from 900 to 970 ft.; moderately exposed at lower side and severely exposed higher up. Soil about 10 in. deep of rather heavy yellowish loam on weathered shale. An unthinned plantation on grassland. The height growth is up to 40 ft. on the lower side

and tailing off to slightly over 30 ft. near the upper boundary. This is equivalent to the 80-ft. and 60-ft. Q.C.'s respectively. Lower down the same valley, however, in a locality far more sheltered and on an old woodland (oak coppice) soil, another plantation aged 46 years only averages some 56 ft. in height (60-ft. Q.C.), so that it is possible that early expectations from this species on the comparatively shallow soil prevalent here may not be fully realised. Oak coppice is mainly suppressed by a full crop of larch, but where the latter is gappy very clean poles are developed.

Crychan.—Several plantations lying at a high elevation to the north-east of Crychan Forest are yet too young to serve as useful indicators. It is interesting to see that at an age of about 12 years a Scots pine–Norway spruce mixture in severe exposure still shows the former to be dominant. The appearance of the two trees, however, indicates that the spruce will soon take the lead.

A small block of *Alnus incana* at about 1,000 ft. elevation and fairly exposed except from the west, where it obtains some shelter from adjacent (smaller) conifers, gives a useful indication of the use to which this tree might be put for group- or strip-nurses. The plantation was formed in a small undrained seepage bog on a deep malodorous peat with molinia. At an age of about 15 years the height averages almost 30 ft. with several individuals considerably taller. Growth is clean and there is a copious sucker regeneration in open gaps. One sees too little of this alder planted in wet situations; for fire line or nursing purposes on molinia peats it might be useful.

ESTABLISHMENT OF OAK PLANTATIONS IN NORTHAMPTONSHIRE.

By D. F. Stileman.

Areas to be regenerated with oak in this district can be divided roughly into three main types :—

(1) Old High Forest areas situated on Upper Lias or Great Oolite formations, usually flat and badly drained, which after being felled produce a very dense growth of grasses such as *Aira caespitosa*, *Calamagrostis* spp., *Juncus*, and scattered growth of coppice shoots and thorn. Typical areas of this kind are to be found at Salcey, Hazelborough, Yardley Chase, Fermyn and West Hay.

(2) Pure coppice or coppice-with-standards, as found at Wakerley, Drayton, Brackley, Bucknell and Whistley Woods.

(3) Old agricultural land consisting of very stiff clay soils typical in all beats in the district except Yardley Chase.

These three types are dealt with separately below.

(1) In the old High Forest areas the usual practice at present in vogue is to plant oak 1-yr., 1 + 1, 1 + 2 or 2 + 2, according to stocks available in the nurseries, at an espacement of 4 ft. × 2 ft. or 4 ft. × 3 ft. The size of the plants varies from 4 in. to 12 in. Long tap roots are carefully pruned before planting. The plants are notched in by spade or Schlich spade with or without previous working of the soil according to circumstances.

At Salcey the method of planting adopted is as follows :—As early as possible in the autumn, a spit is taken out and inverted in the same hole from whence it came and after this has weathered, the oak is notched in.

At Fermyn in P. 30 and P. 31, the soil was dug up in lines by Ministry of Labour trainees (in P. 31 the lines were double dug) and 1-yr. oak seedlings were notched in. Unfortunately very severe frosts were experienced in the spring, with the result that a large proportion of the small plants were frost lifted and casualties were very heavy. Oak sowings in P. 30, on worked lines, have proved very successful, the average height at the end of 1932 being 12 in., maximum 36 in.

In the old Crown woods of Salcey and Hazelborough the practice is to fell the mature oak in strips of 1½ chains and plant up the strips with oak leaving belts 1 chain in width running in an east to west direction with the object of affording shelter from sun and wind to the young crop. Belts are also left round the boundaries of each compartment under regeneration. When the regenerated crop has found its canopy the surrounding belts are felled and regenerated. In other areas which are planted up after being clear felled, it is customary to plant two rows of oak and a third row with a nurse such as S.P., N.S. or E.L. As regards weeding, the growth of *Aira* and *Calamagrostis* grasses in these

areas is exceedingly dense, growing to a height of 4 ft.—5 ft. in some cases. It is usual to carry out at least one weeding per annum and in some years when there has been exceptionally heavy weed growth and the plants have been small, two weedings have been found necessary. In the case of recently-formed plantations it has been the practice to weed the oak for three and sometimes four years.

Judging from actual results in the plantations, it is not at all an easy matter to arrive at a definite conclusion as to how a crop of oak on these very stiff, impermiable, badly drained soils can be established within a reasonable period. It is almost certain that some method of working the soil preparatory to planting is advisable in order to give the plant a chance of establishing itself and of "getting away." The ordinary method of pitting appears to be inadvisable on these stiff clay areas in as much as the pit becomes full of water by the time that planting is due to be done. To obviate this difficulty, a better method is to get out a pit in the ordinary way, break up the soil and throw it back into the pit, the top soil being put at the bottom, after weathering the soil is in ideal condition for planting.

A considerably cheaper method, though perhaps not quite so effective, is to work the soil with a pick mattock, heaving up the ground with one or two strokes of the mattock end and then using the pick end to loosen the soil as deeply as possible.

Turf planting should also prove effective where small plants are used, and where the ground tends to be waterlogged. By this method the small plant has a better chance of competing with the dense grasses. In planting, care should be taken to insert the tap root well into the surface soil, otherwise there is a danger of the plant drying out. An experiment on these lines was carried out by the Research Branch in P. 32 at Yardley Chase, and at the end of the first year the plants have practically all survived, though it is too early yet to judge. The type and age of plant are undoubtedly the most important points to be considered. In this type of area, a 1-year seedling, planted in the ordinary way, is not an ideal plant to use, owing to the dense smothering nature of the weed growth. The object to be aimed at is to obtain a good sturdy plant which has some chance of competing with the weed growth from the very first.

Judging by results in Salcey and Wakerley Wood, a good 2-yr. seedling will get away far more rapidly than any transplant. In P. 30 Salcey, the area was planted with heavily-culled first grade 2-yr. seedlings with slight pruning of the tap roots. At the end of 1932 the average growth was 18 in., equal to the average growth in P. 28 and P. 29 Salcey where transplants were used. This seems to point to the fact that we should aim at producing really good 2-yr. seedlings in our nurseries. To effect this the seedbeds should be more heavily manured and the plants heavily culled. Another alternative is to produce transplants 2 ft.—3 ft. which when planted will require no weeding. The cost of producing and planting such plants is bound to be high, but the resultant saving on weedings may well justify the enhanced cost.

It is not yet possible to say what amount of weeding is absolutely essential. The Research Branch have laid down experimental plots in P. 30 Fermyn in direct sown areas and in plantings of 1-yr. seedlings to ascertain the amount of weeding which is necessary, if any. Other plots in the regular plantations, where transplants, 1-yr. and 2-yr. seedlings have been planted, have been left unweeded at Salcey, Hazelborough and Yardley Chase to watch results. Judging from results up to date, the probability is that if a good-sized plant is used, weeding may only be necessary for one year, or at the most two years, or it may be that experiments will prove that no weeding at all is necessary. Draining is required in the establishment of oak plantations, and in so far as funds permit, this is being carried out in all the oak areas.

(2) In the old pure coppice and coppice-with-standards, the usual practice is to plant small oak, 4 in.—12 in., by notching in lines, without working the soil, at an espacement of 4 ft. × 2 ft., or 4 ft. × 3 ft. The coppice is usually cut back annually to within 3 ft. of the ground to prevent the smothering of the plants.

It has been found that where the coppice has been left uncut for three years, the shade is too dense, and the plants have made no appreciable growth and have a stunted appearance. The probability is that when once the oak begin to get away, the coppice can be left to grow for at least one or two years without cleaning, and the competition will help to draw up the oak. Present experience goes to show that it takes at least three or four years before oak starts to move in these coppice areas.

It seems questionable whether it is necessary to plant oak at such a close espacement as 4 ft. × 2 ft. or 4 ft. × 3 ft. in such areas. Crown and stem competition is ensured by the coppice, and at least 15—20 years will elapse before the oak dominates the coppice. By that time the crowns of the oak, if planted at a wider spacing, say 6 ft. × 6 ft., even allowing for casualties, would meet and form a canopy.

(3) On old agricultural land, the practice has been to prepare the soil by skim ploughing in lines at an espacement of 4 ft. × 1 ft., 2 ft., or 3 ft., and sow or plant oak in the furrows. It has now been realized that it is a mistake to sow or plant in the furrow, as the plant starts at a disadvantage with regard to weed growth, and the roots come into immediate contact with unweathered soil and are more likely to remain in a state of check. In certain areas, where steam cultivation had previously been employed, a plough pan has been formed, and in such cases the oak have been in check for years. This is well exemplified at Apethorpe P. 21, P. 23, P. 24, P. 25 and P. 28 sown areas, where the growth of oak has been terribly slow. The oak in P. 21—24 acres—are now getting away fast, and average 3 ft.—5 ft. in height, maximum 12 ft.—15 ft., but one still comes across tiny plants which are only 3 in.—4 in. in height with tiny stunted leaves. In P. 25 and P. 28, the plants are generally still minute, but here and there they have become sufficiently strong to break through the pan, and are starting to move. Another disadvantage of sowing and planting in the furrows is that on flat badly-drained ground the furrows become waterlogged.

The practice now adopted is to plough at an espacement of 4 ft. and plant or sow on the upturned weathered ridge or alternatively to plough up the whole field as deeply as possible, thereby ensuring good aeration of the soil and checking weed growth. In such areas it is usual to notch in small oak from 4 in.—12 in. in height and of varying ages. Generally speaking the areas are weeded once annually for one or two years, or not at all, according to the density of the weed growth. It is customary to plant two rows of oak and the third row with a nurse, such as S.P., E.L., or N.S.

From the above it will be seen that we are still in an experimental stage in dealing with the establishment of oak plantations on the heavy clay soils formed throughout this district, but it is hoped that in the course of the next few years, by patient and continual experiments, some of our problems may be solved.

FRISTON FOREST.

By T. Aston.

Friston Forest in Sussex offers some interesting and perplexing problems in the planting of exposed chalky sites with the complications of maritime conditions. It is situated on the south coast about ¾-mile from the sea, the southern boundary being on the Brighton-Eastbourne road approximately 2½ miles east of Seaford and 4½ miles west of Eastbourne.

The area is about 2,100 acres in one block of irregular shape, and is looked upon as the catchment area of the Eastbourne Water Works. It was acquired by the Forestry Commission in 1926, previously poor farm land and sheep range, it is considered that afforestation will improve the area for water supply purposes. The soil is very poor in quality and extremely flinty and shallow, the depth varying from practically nil up to about 10 in. and averaging 5 in. over a few inches of broken chalk below which borings have shown 120 ft. of solid chalk. Drainage is therefore natural and rapid. The soil cover is mainly composed of rough grasses with, especially in the north, large areas of gorse and blackthorn scrub ; there is dwarfed bell heather in one place.

The area is quite unprotected on all sides except for depressions due to unevenness of the land, equally open to all winds, the prevailing wind being from the S.W., and in spring, planting and nursery work suffer from biting E. and N.E. winds.

Between 1927 and 1931 the areas were mainly planted with various mixtures of beech and European larch, beech is the normal tree with larch as a nurse ; at first both appeared very unhappy, but the beech has recovered and is now getting away and leaving the larch standing except in a few places of comparatively small extent where the position is reversed. Sycamore planted in 1927 proved disappointing on a northern aspect, living but not growing till last season, the causes being perhaps equally the small grade weakly trees and inexperienced labour. Grey alder planted on a small area as a nurse in 1927 has done very well, some of it being now 9–10 ft. high.

This plot gave us reason for a more extended trial in 1931 both to nurse existing poor areas and in wide spacing, to establish nurse crops on land to be planted in years to come. Criticism at this stage is premature, but apparently large plants on poor soil result in heavy failure, particularly in Douglas fir, which on good clayey loam was never checked but simply romped away. More details of this experiment will be available in 1934.

The tendency has been gradually to improve the methods of soil working. From 1927 to 1930 the general method was to screef and add one blow of the pick end of the mattock to loosen the soil, planting being done with the Schlich spade. It was readily noted that plants inserted in beating up easily passed those first planted—this pointed to the benefit accruing from the second working of the soil.

So in 1931 we screefed as usual using mattocks with 18 in. pick ends and thoroughly breaking up the soil, the following September count revealed a 93 per cent. take, much of the 7 per cent. failure being due to hares hunted in and left by a local beagle pack.

In March, 1931, towards the end of the planting season, we planted a number of trees in ground which had been screefed and false pitted with the garden fork, the results led us to standardise this method for 1932 and the results of this are remarkable in comparison with early plantations. Experience leads me to state that much the best method at Friston, is that adopted in 1932 and using 12 in.—18 in. well-rooted transplants aged 1 + 2 or 2 + 2.

Cupressus macrocarpa has been given a fair trial as a shelter or nurse species, but it is too tender and after a salt wind or a really bad north-easter it appears as though scalded.

Extensive sowings of Spanish and common brooms have been made for shelter both in planted areas and on ground due for planting during the next few years; the crop is hard to establish for several reasons particularly because the rainfall is low and omniverous omnipresent slugs and snails devour the seedlings from the cotyledon stage onward. Common broom now 3-year old, sown in compartments 18 and 19, are up to 7 ft. in height. These shelter experiments are yet in their early stages, but we hope by them to check the alarming die-back of leading shoots on newly-planted stock. During the next year or two we expect to learn much regarding the time and method of preparing the soil, the effects of root and shoot pruning and puddling.

CORSICAN PINE PLANTING.

By A. Simpson.

The Corsican pine in its native habitat reaches a height of 150 ft., with an umbrageous head, and not unusually with a 12-ft. diameter butt. This is mangificent and worthy of admiration, but there is no such prospect in Britain nor of anything approaching a shadow of it—unless my vision is restricted, but even were it possible, what is the commercial prospect, for instance, within the next quarter or half century ?

Plantations of say 15 years of age, following a first cleaning will produce poles during the next few years, but even as firewood these do not appeal to prospective buyers. Should the species reach the timber stage, the prospect of disposing of it commercially appears to be just none at all. If this be conceded, and I think I have the support of many, it is difficult to understand why so much of this comparatively useless species is planted as a pure crop. In this area (Alice Holt Forest) during the past ten years many areas have been "planted." Plants have been "put out" or planted, whereas nursing for a further 2 and sometimes 3 years, would have justified the term planting. When a man puts in a plant and, in completing the operation by treading, carries the plant away on the soil adhering to his heel (which has actually happened) it partakes of the burlesque and illustrates the class of plant that has been used. As for the date of planting, no Corsican pine plant of any size should be lifted or transplanted after the shortest day in the year. If so, there will be disastrous results as proved by experience. About the second or third week in December, the rootlets are active and these will be stripped off in lifting and the plant will receive a check from which it will not easily recover if it ever does. I have known such plants hang—just alive—for two or three years before they moved in growth. I have received plants with the rootlets stripped white for as much as 2 in. In such cases the percentage of failures is enormous. Up to the age of ten years and more, large patches have gradually died out.

The planting of such small plants—by age and constitution, weak and in need of nursing—bracken, briars, etc., to a depth of 3 to 7 ft. (bracken 8 ft. high has been measured) even if they do survive necessitates weeding annually for from 4 to 6 years thereafter. The cost is high and unnecessary and there is still replanting ahead.

There is also the operation of "screefing" for which I have no great love, it consists in forming a saucer-like formation by removal of the surface vegetation of varying species exposing the soil. Into this is placed a small plant, the terminal bud of which in many cases is just on a level with the adjoining ground, and theoretically encircled with the halo of a bright future. So far so well, but planted late in the season, suffering from check, succeeded by a dry spring, opened up by the first weeding and probably a second or even a third and fourth, the result is disastrous and a painful squandering of plants, time and money ; and the old adage of "the more hurry the less speed" holds good. By comparison with

former methods of preparation of ground in its stages, the selection of plants, suitable, as to size and age, and the method of planting then adopted the plantations would have been established in three years at the outside. The former decade provides examples for comparison.

There has also been a disposition to preserve shoot-growths, presumably to " take the frost " and provide shelter. This fallacy should be rigidly suppressed, together with the stool-growths, until the plantation is established. Much harm has been done by allowing these growths to predominate.

Let it be clearly understood that the foregoing remarks are applied only to the area under review and not beyond it and if a lesson may be learned resulting in greater success in the future, something will have been gained from this statement, which is made not as a criticism, but as a fact and the subject is not exhausted.

(Opinion on the use of large plants is varied, but owing to the difficulties of transporting Corsican pine I am of opinion that a small plant gives the best result, but naturally this entails a longer weeding period.—A. L. F.)

OBJECTS OF MANAGEMENT.

By D. W. Young.

This is a regular title to a chapter in any comprehensive book on forestry. It has an academic flavour and calls to mind phrases such as "the greatest financial yield," "special desires of the owner," and "amenity considerations." It had lost nothing of that academic flavour when it came up for discussion at a recent technical meeting, except for the merest dash of practical meaning imparted to it from the fact that it is one of the headings which under the code have to be dealt with in the working plan.

In the course of the discussion approximately two more views were expressed than there were officers at the table. The discussion had its useful side beyond the amusement it afforded. It was well to know where we stood. After all an objective is important and a forester needs a long view. Admittedly these long views have their defects as springs of action and it is not altogether a bad fault that a young department called into being to get a specific job done should have kept its eyes at first on a more immediate objective—but that will not work for long in forestry. Necessarily planting programmes held sway to start with, but casting our eyes back on what we have done we might have planned more carefully with an eye to the kind of plantations we were producing. Financial stringency has called a halt in the expanding programme and given us time to concentrate on this and to consolidate what has been done already, taking care at the same time as far as possible to avoid the early mistakes. In our new plantations our mind's eye is travelling restlessly further; however, it lingers now on the pole stage. What shall we do about thinnings? To what end shall we thin? Even that will not hold us long: we need a clearer view of the country beyond. Do the roads we are taking lead anywhere? To leave the metaphor, have these plantations we are forming a future? Are they to be fine stands of good quality timber or is their end to be stretches of unsaleable scrub like so much of the old Crown woods? Even if not scrub are they to be vast stands of timber for which there are no markets because of a quality with which the market is glutted. These are questions which we ought to face. Short views soon lose their driving force if they have no purposive background. Where there is a lack of confidence of the ultimate usefulness of the work we are doing the quality of the work must suffer, but there is more in it than that. Short views are a positive danger because they lead us ultimately along the line of least resistance. At their behest "greatest financial yield" gives way to "the cheapest thriving plantation in the shortest possible time" and that is the negation of forestry. It leads us to plant Corsican pine for instance on chalk or limestone soils when we ought to strive to establish slower and more difficult hardwoods; to planting pines in wet frosty hollows where spruce alone can reach maturity, to using all sorts of exotics without a clear knowledge of their soil and climatic requirements and to planting the very accommodating larch here, there and everywhere.

It is not suggested that all our work is stamped with these crude mistakes, or even a great part of it, but there are other mistakes less obvious which no doubt we will continue to make so long as we remain content with these shorter views. Foregrounds and distance are integral parts of the same picture, just as tactics and strategy are complementary in the science of warfare. Similarly the forester's yearly programme is or should be but a part of and definitely related to his working plan proper, which is no working plan unless it has some definite objective.

These, at any rate, are the thoughts prompted by that discussion, and they seem worth following further. It would be incorrect to say we are moving forward entirely without an objective, but an honest self examination would bring most of us to realise that that objective was thrifty plantations with a vague idea that some day they will grow into woods. First and foremost, our objective is timber, but the question is, what timber ? We hear much of a timber shortage before us and are perhaps tempted to think in such a position we cannot go far wrong—any timber will be of value. In other words, that the law of supply and demand will put the price curves of all classes of timber at a uniformly steeper slope. This appears to be an entirely falacious line of reasoning. It ignores for one thing some of the most elementary laws of price determination. Secondly, it takes no account of the trend of industrial development and lastly, it ignores the fact that the appreciation of the risk of this timber famine is world wide. It would be out of place to attempt to go into this matter deeply here. The briefest discussion of these three points must suffice.

Take the question of price determination first. Timber is used for a variety of purposes. In its highest form it is used for cabinet making, interior decoration and the like, where all its properties are utilised, strength, resilience, durability, weight and figure. For these purposes it can be replaced but never satisfactorily substituted. Synthetic materials may be invented to look like timber, but their value is determined largely by their quality as counterfeits. Timber in all its qualities is the standard by which they are judged and its value will always be determined by the laws of supply and demand and very little affected by the cost of these counterfeits.

The next category of utilisation—and by far the largest—would be for structural and manufacturing purposes. Here some of the qualities of timber are of prime importance but seldom all. Figure for instance is rarely taken into account. Strength and elasticity generally are of first consideration, durability may or may not be of equal importance. Weight often is a secondary consideration. In the whole gamut of structural uses you may at the one end have cases where timber—generally a particular kind—cannot be substituted. Here price conditions merge into those of the first category. At the other end you have cases where timber is only used as a cheap substitute for other materials. Here there is obviously a limit beyond which prices cannot go. Timber shortage will have little effect on these. As to the trend of industrial development, timber, to its detriment, has lagged behind other materials

in the matter of standardisation. A beginning is only now being made in the crudest form, the increasingly scientific background of industry cannot be ignored.

The spheres of usefulness of timber are contracting yearly. Until quite recently, it was considered sufficient to specify the port of origin. Grading on very crude lines has now started and will have to be carried much further. Freedom from knots, faults and shakes and all those mysterious qualities defined as cleanness and brightness, go without saying, but width of ring and even proportion of spring and summer wood will have to be taken into account before long. We already know that they have a definite relation to the technical properties of timber.

This is not idle prophecy but an attempt at intelligent anticipation. The cement makers of to-day make cement for the users of to-day. We are producing timber for a scientific age as far advanced from our own as ours is advanced from that of Queen Elizabeth. We ought to be before our times and we are behind them. It is a case now of bringing the practical administrative officer, the experimentalist, and the fundamental researcher together in wholehearted co-operation. That is true of our work at every stage, of course, and some advance has been made towards it, but we are still pitifully far from its full attainment considering that it is the very condition of advance. We must have sound accounting of course, but to hold up work while we debate the vital question whether it should be charged to H. 1 (*d*) or E. 17 seems wrong.

The third broad category of timber utilisation to be considered is the variety of processes in which timber is broken down to its elementary constituents, wood fibre, pulp, cellulose and charcoal and other distillation products. For these uses the quality of timber, as such, is not of much account—low-grade timber within certain limits serves the purpose equally with that of high quality. What is needed is not timber, but the stuff of which timber is made. This form of utilisation may provide useful outlets for the by-products of our main operations, but the return will always be small. It may be possible, in special circumstances, and on special areas, to work forests on a short rotation for pulp wood quite profitably. Probably that will be the destiny of some of our larger stretches of spruce in remote areas, but our main operations are not likely to be affected. In the majority of cases it is quite vain to look to the foreign shortage making this useful side line a profitable main outlet.

Generally speaking British woods are famous for the low quality of their produce, even Britons look down their noses at home-grown timber. Often they are justified. Quite frequently, however, first-class parcels are put on the market, but they suffer from the general depression caused by all the bad stuff. We have to get rid of our rubbish and replace a bad name with a good one. It will be a long and arduous business and will only be achieved if we can bring about a condition of affairs in which generally our timber is of high quality in accordance with standards likely to prevail some 70 to 100 years hence.

It is not a question of producing a lot of mediocre forests with a few high-class areas, but of producing a mass of forests where a high standard

of timber production is the rule rather than the exception. So much for our ultimate objective. We are, or should be, manufacturers of first-class timber, our woods are our factories. Their management, from start to finish, must be directed towards this objective. No amount of good management will produce the goods from factories not properly equipped for the purpose. We are at present making the factories, and all our immediate activities should be bent towards designing them on the right lines. That for the moment, and for some time to come, must be our main, if not our only object of management.

The limitations of forestry are very great. There may be many species we would like to grow because they promise a high return. We may say, for instance, ash sells well—let us plant it on as large a scale as possible. That way failure lies. Our commission is to produce timber—species unspecified ; for the moment all accidental considerations of price must be forgotten, we have to consider only what species is most likely to grow to full and first-class maturity.

This may sound strange, but it is fundamental. In the long run it is true to say that we can only produce sound timber in sound woods, and to appreciate this fact properly we have to divest our minds of many preconceptions. Many woods which in a variety of ways fall short of our ideal of good management, are essentially sound, and individual trees in them proclaim the fact. Such trees are the very thing we are wanting, and if they will not grow in serried ranks, making full use of every available square inch of ground, as we should like them to do, it is folly to try to make them. We attribute the pitiful condition of the Crown woods variously to improper thinning, bad planting methods, or neglect of drains. All these are contributory factors no doubt, but there are strong grounds for the suspicion that in the insistence on pure oak woods the seat of more than half the troubles is to be found. Pure oak woods are not natural. It is doubtful whether with one or two possible reservations pure woods of any species are sound, at any rate in the greater part of England and Wales.

In the main we are engaged on planting pure woods. It is difficult to know what else we could do. The correct choice of one species for any particular area is a difficult enough problem. It would be complicated almost infinitely if we set ourselves the problem of selecting suitable mixtures before we had a very close knowledge of locality factors. We have to use imagination in this respect. Some misguided person once called the beech tree the mother of the forest. It may be, but it is quite certain that we are going to add heavily to the problems of the future by too slavishly using it as a nurse with all species. Beech is prominent amongst the raw humus formers on certain soils and in certain conditions. None the less, it is essential that we should mix species in our woods. The trouble is that we have so little data on which to go. It is amazing, after all the years forestry has been studied that this should be so, but it remains a fact. The new ecological approach promises in time to get us this information but meanwhile we have to feel our way with such flashes of intuition as our association with woods brings

us. At root the problem is ecological—a question of plant communities in which bacteria, fungi, herbage and trees all play their part. A wood is not just a plot of ground with trees stuck in it.

We foresters as a rule are none too ready to be guided by nature, we are obsessed with the idea of forest management with a big M. We seek to dragoon our trees and do the sergeant major over them, and though we have our way for a time, the end product is likely to be far more interesting to the mycologist than the sawmiller. We, perhaps, rightly avoid gardening methods, but there are many essential experiences that we share with the gardener, and the fact that we cannot adopt the gardener's methods makes it more necessary to exercise adaptability. We must remember it is firstly a process of naturalisation we are engaged upon, and only secondly one of silviculture proper.

Too often first thinnings are seized as an opportunity to bring a plantation back to its pure condition to its ruin. It seems the obvious thing to remove a birch, sycamore or oak, which may be sitting on a good conifer, but that operation may be the plantation's ultimate undoing. It is a thing one may be too dogmatic about, but it is at this stage that it is above all important to remember that a healthy wood is our first objective, and all that we know of English plantations points to the avoidance of pure woods of most species. One need only point to the fact that on private estates, as a rule, it is the home coverts that produce the best timber. They generally are mixtures of hair-raising complexity. The one useful thing that came out of the Dauer Wald controversy in Germany a few years back was the important part which a sprinkling of intrusive hardwoods, notably pedunculate oak in pine, had on the general health of the forest.

We cannot, of course, let nature have things all her own way. So far as trees are concerned, nature's aims are not the same as our's. She is interested solely in a fruitful tree and in timber only in so far as it will support the fruit-bearing crown. It is by control of the crown that we can control the development of the timber—a matter of thinning mainly, but not entirely. Control of factors of growth such as soil aeration and water supply, which in turn affect soil temperature, is of prime importance. As a rule, a tree badly planted, with its roots all cramped, or planted in soil of poor drainage or aeration, will be a far more branchy subject than its neighbours not growing under the same disability. It is not only a question of the number of branches, but the tree's retentiveness of them. A self-cleaned tree is better than a pruned one. Pruning we shall have to resort to, but we must always consider it a poor substitute for self cleaning. We have in this connection appreciated the importance of race, and been too apt to overlook the effect of health.

Some apology is needed for this somewhat discursive silvicultural discussion of a matter of forest management. Discursive it had to be in so brief a treatment of a big subject. If the premises are correct, the approach could only be silvicultural. Though little has been said that is new, the line of approach to the subject is fresh and brings out

how very inadequate our knowledge of the subject is for the task which lies before us. We are brought into almost unexplored country all along the line. Real pioneer work lies before us which calls for the closest co-operation between all concerned. The task is daunting in its magnitude and complexity, but to turn from it on that account means failure. With a common appreciation of what it means and real team work the advance can be rapid. A new forestry will result. The old science is fettered with tags and phrases imperfectly understood which are too often masks for our own ignorance.

THE ROYAL SHOW, 1932.

By L. E. MacIver.

To those who were not fortunate in being able to attend the Royal Show held at Southampton in July, 1932, a brief account of the Commission's exhibit in the Forestry Section may be of interest, and possibly of some use to those who have not yet taken a part in the staging of such an exhibit.

The show was open for five days, and the two previous days were occupied in setting up the stand. The scheme had, of course, to be thought out weeks before and preparation of certain of the items put in hand, *e.g.*, the model nursery which was part stocked with seedlings grown *in situ* from seed.

It is doubtful if the Editor would find sufficient space for a complete list of the exhibits, but the main items are described hereunder :—

(1) Model Nursery, 3 ft. by 8 ft. 6 in., built up in six sections, all to scale of 1 in. to 1 yard, the area divided by a main path 4 in. wide running lengthwise and two 3-in. paths running transversely.

Section 1 contained seedbeds of beech, Norway spruce, Corsican pine, Japanese larch and European larch ; lath shelter over the Norway spruce.

Section 2 contained 18 lines of transplants, J.L., E.L., S.P., C.P., *A. grandis*, beech and ash.

Sections 3, 4, *and* 5 contained seedbeds of various species.

Section 6 contained one bed of lupin (growing) ; one bed of E.L. showing attack of *Meria laricis* in three sections : (*a*) slight, (*b*) severe and (*c*) plants recovering after spraying ; one bed of beech in three sections showing *Phytophthera omnivora :* (*a*) slight infection, (*b*) primary leaves destroyed but recovery taking place after spraying and (*c*) reduced vitality causing death ; one bed of beech, Corsican pine and *A. grandis* damaged by *Melolontha ;* one bed of oak showing attack by *Oidium*, and one bed of the same after spraying. A nursery shed and model seedbed roller and a wire netting fence round the whole completed a real nursery in miniature. Outside were seed boxes showing seeds, plain and red-leaded, ready for sowing, seedlings showing roots damaged by chafer, chafer grubs, a chafer imago and cutworms.

(2) Spruce specimens showing great difference in growth and healthiness in favour of mound planting ; one planted P 29 on mound, one planted P. 28 on mound and one laggard planted P. 26 on flat.

(3) Glass-fronted boxes, two showing correct and incorrect methods of notch planting, two showing correct and incorrect method of lining-out and two showing flat and deep planting of spruce.

(4) Growing pines planted on ploughed and unploughed ground in same P. year ex Dorset Heaths.

(5) Natural Regeneration Model showing by means of a cut-out enlarged photograph a long view of a typical pine wood with felled strips

on which natural regeneration is taking place. This was accompanied by patches of soil in good receptive condition from the felled strips containing growing S.P. seedlings, and patches of poor reception with few sickly looking seedlings, or none at all; also two boxes showing soil profiles of above.

(6) Healthy Sitka spruce planted on the flat, P. 24, showing decayed original root system and secondary roots being formed.

(7) Model of pine stand ready for thinning.

In order to indicate the proper silvicultural method as opposed to the rule of thumb method of taking out a certain percentage of trees to the acre, rows of standing trees were formed of plywood covered with actual photographs of trees and cut out with a fret saw. This made a very realistic pine wood in miniature. By releasing a spring catch, the trees which should be taken out in the first thinning disappeared into the well of a box frame, a second catch released the next thinning, and another one the third. It was a highly ingenious arrangement, but gave a certain amount of trouble.

Altogether, there were 63 exhibits which filled the 42 ft. of benching plus the small floor space allotted to us.

Although the general attendance at the Show was disappointing to the Society, the large number of people passing through the Forestry Tent was surprising, and more surprising still was the number of people who showed keen interest in, and a distinct knowledge of, forestry matters. One exhibit, a sod such as is used for turf planting, with a physical demonstration of the actual method of putting in the plant, aroused the greatest interest, and after the first day of showing a fairly regular stream of people of all classes having been told about it by others came through asking to see the method demonstrated and to know the reasons for, etc. The impression given was that there will be many spruce trees planted on mounds this winter outside the operations of the Forestry Commission.

The work of setting up and acting as Steward for four or five days was tiring but interesting. The weather was hot and, in the tent, at times it was unbearable. On the second day, the Duke and Duchess of York visited the Forestry Pavilion. We had had considerable trouble in getting the home-made thinning model to work, and a plot was laid to lead the Royal visitors past it as quickly as possible, but the Duke's interest was aroused as soon as he saw it and he demanded a full explanation of the model. This was given but without any offer to show its working; His Royal Highness, however, was not satisfied and asked to be shown how it worked, so there was no escape. But we were lucky; the catches were released and the strips fell in proper order without the slightest hitch, the first time since the Show opened!

Altogether, there were indications that we had succeeded in putting up an interesting exhibit. It required a good deal of thought and time to make it instructive and educational and to avoid a mere collection of museum exhibits. One point which came out very clearly from the

questions asked was that we need not be afraid of staging too elementary matters. It would seem to be a mistake to try to make the exhibit too comprehensive. An excellent exhibit put up by the Surveyors' Institution on the cricket-bat willow attracted a lot of attention and gave to anyone seeing it a very clear idea of the lesson it was intended to convey.

PRUNING.

By D. W. YOUNG.

There was a time when it could be argued with some justification that pruning was not a forestry operation which could be justified by actuarial calculations. The assumption was that by proper silvicultural methods at least a final crop of knot-free timber could be obtained. For proof certain well managed woods were referred to and it was assumed, often quite erroneously, that these woods had reached their high standard of quality by the methods of silvicultural treatment then in vogue there. In a few cases this might be true, but in a large majority of cases the woods had been raised by natural regeneration—with a density which it would never pay to reproduce by planting methods. The woods, moreover, had been treated very conservatively with methods of thinning which according to modern ideas would be considered little more than cleaning operations.

Ever wider spacing has been adopted in planting in order to reduce the initial cost and thinnings have been made increasingly heavy in order to get early maturity. It may well be that there is a tendency to carry both these ideas too far. On the one hand, the spacings we adopt may not be sufficient to give us enough selection to get the requisite proportion of trees of the right type. Nature's prodigality in natural regeneration is not without its advantages in this respect. On the other hand, the heavy thinning with its consequent maximum girth increment may be producing timber of a low grade and of poor strength. It is quite clear that with the methods now in vogue, we seldom can get satisfactory self cleaning and unless our timber is to add knottiness to its other defects we shall have to adopt pruning.

In the present chaotic state of markets it is difficult to quote prices. In these times it may be a question of being able to sell at all. Coarse rough soft woods are a drug on the market just now. Under normal conditions it would not be putting it too high to say the difference in value between good clean Scots pine, for instance, and the knotty coarse material which makes up the bulk of the Scots pine woods in southern England would be at least 2*d.* per foot. At 80 years, on a second-class locality with a 75 per cent. production, this means a difference of £27 10*s.* in the value of the crop.

On the 4 per cent. table half the trees standing at 25 years could be pruned at a cost of a halfpenny per tree, at 35 years some 250 could be pruned for a further expenditure of a penny per tree, and at 45 years a like number could be pruned at 3*d.* per tree, and the total cost, inclusive of interest, would be less than the gain in value, and we should have, withall, a much more marketable product. These figures do not give the whole of the story. A number of the pruned stems would come out in the thinnings and make attractive poles commanding 8*d.* a foot or more, where in the ordinary course they would only be suitable for pitwood or pit props and fetch a doubtful 4*d.* or 5*d.* a foot, according to situation.

This is only a crude example. A more careful presentation of figures would make a far more convincing showing. It can be shown that with some of the exotics which we are introducing pruning is essential to make the timber marketable at all. All that is attempted here is to make out a prima facie case. No conclusive calculations will be possible until we have worked out the technique of the work and the extent to which it can be usefully carried.

A good deal of work has been done on the subject in the past three years in the Forest of Dean and during the last year in the New Forest. The work in the Dean has been largely confined to young plantations and is more important on that account. It is quite clear that for a policy of pruning to be effective it must be started early and carried on periodically until a useful length of stem has been cleared. The work in the New Forest has been practically confined to middle-aged woods, and has been useful in getting information as to the heights to which pruning can be carried and as to the probable cost. Also some experience has been gained as to the usefulness of the various types of tools available. The two types of experimental work that are being carried out, in young plantations and unpruned middle-aged woods, are not necessarily complementary. On the contrary the pruning of middle-aged woods of the same age as those which are being tackled in the New Forest, but which have been pruned once or twice in their younger stages, will present an entirely different problem. In this respect the experience with these middle-aged plantations will be useful in guarding against making unnecessary difficulties for ourselves.

The whole problem of pruning divides itself naturally into two parts. First, the question of the extent of pruning desirable and secondly, the practical difficulties of carrying that pruning out. The solution will inevitably be a compromise. As regards the first set of problems, it must be a matter of personal predilection until we begin to collect reliable data on the effects of pruning. The ideal from the point of view of timber would be to prune at frequent intervals and never let any branch grow thicker than half an inch, or to extend beyond a central cylinder of the tree of, say, 5 in. diameter. Probably 40 ft. would be a useful height up to which to carry it, though on selected trees it might be carried with advantage much higher. Such a method would yield the maximum quantity of knot-free timber, but there are serious practical difficulties in its attainment. The practical difficulties of pruning at frequent intervals will be discussed later—they are purely physical and in the end involve questions of cost. The thickness to which we let branches grow before pruning is a question which involves silvicultural considerations. Half an inch is a very small diameter. With the majority of species it will be an unattainable ideal unless we are to cut heavily into the green crown. Questions of thinning intensity are involved here. The heavier the thinning the greater the live crown per cent. and consequently the longer and thicker the branches grow before suppression. A more important question involved is what is the largest diameter of branch that will give us satisfactory occlusion. It may not only be a question

of thickness of the branch but also a question of the methods adopted. We prune close to the stem. Many old pruners advocated leaving snags and claimed in that way to avoid the pocket of resin which often appears in coniferous timber that has been pruned. The question of the thickness of the central cylinder of the stem to which knots are confined is also closely connected with the question of intensity of thinning. In a heavily thinned wood—especially of hardwood—that central cylinder must, of necessity, be much thicker, unless we are prepared to prune into the green crown. Pruning into the green crown is generally avoided but may have something to recommend it on other grounds. It affords a method of controlling diameter increment in coarse growing species and it is claimed in some quarters that a cut green branch occludes better than a dead one. The last point requires investigation. As regards the first point, the method of restraining the crown development by maintaining the density of the wood appears more natural.

The actual work in the New Forest has been directed towards discovering methods that are economical for large-scale operations. A variety of tools and methods were tried—some of them of the Heath Robinson variety—but all interesting.

One tool which proved of great use was the long armed saw. Twenty-two feet was about the utmost limit of height to which work could be carried with it. For comfortable work it could not be pressed much beyond 20 ft. The length of the handle sets the limit. This is, in turn, limited by considerations of weight and rigidity. The importance of lightness is obvious. Unless it is fairly rigid much time is wasted in setting the saw in position, as the weight of the saw makes it wobble. Some of the men in the New Forest found that the Grecian type of saw with its pointed end added to these difficulties. As it wobbled it was apt to get stuck in the tree and more intense wobbles set in when it was unstuck. A straight square-ended saw with teeth set in the same way proved generally more effective. These long-armed saws can only be used effectively from the ground. For heights above 20 ft. hand saws have to be used with some means provided for the man to climb.

A variety of methods have been tried, including climbing irons, short ladders and long ones. We had difficulty in finding a climbing iron that was satisfactory. One design by Mr. Maund, in the Dean, proved quite effective for climbing but tiring to work with. Light expanding ladders were tried but their lightness proved only relative, they required three men to operate and were very slow. In the end, the method which proved most effective in the middle-aged woods which were being dealt with was to prune with the long-armed saw to 15 ft. or so, then a man followed using a 12 to 15-rung ladder from the top of which he could reach a branch. He climbed thence to the height to which he was to prune with his saw slung on his back. Standing on a branch he sawed off the branches round him and descended pruning as he went. He used a safety strap at these heights which left his arms free. Working in this way and pruning to a height of 30 ft. and sometimes 40 ft., two men could prune a couple of dozen trees per day, the cost working out

at 6*d*. per tree. The first essential is that the ladder should be easily portable so that one can manipulate it with occasional assistance from one's mate, when two men are working together.

It is here that the difficulty of pruning at frequent intervals arises. Assume for a moment that at a second pruning the pruned height has been raised to 25–30 ft. For the next pruning the men will have to use a 25-rung ladder, which is a very different proposition. Unless a very light and safe form of ladder can be devised it seems probable at the moment that we shall have to content ourselves with pruning in two stages. The first would be undertaken in the pole stage, when we can prune to about 18 ft. or so and the second postponed until the trees are ready to be pruned to the full height to which we propose to take the pruning. This is not a very satisfactory conclusion because it is to be anticipated that a tree 55 to 60 ft. high would measure 7 in. or more in diameter at 18 ft. and that thickness of central cylinder would remain knotty. Apart from this the knots would by that time be of very considerable dimensions. It is possible that the solution may be found in a ladder, built on the girder principle from duraluminium, or in some form of mechanical saw worked on a very long arm from the ground.

Work is only at a very early stage and it is not safe to draw any conclusions from the results. It has at least proved that the cost need not be prohibitive. This note is intended to show some of the problems involved. Considerations of these may well have an influence on present day ideas of thinning. Trees may not clean themselves in dense woods, but the thickness of the branches can be kept in check and the main diameter increment postponed until after the complete pruning has been carried out.

THE AUTO CULTO.

By A. H. POPERT.

Of the large number of machines employed by the agriculturalist to reduce his labour bill very few are applicable to forest nursery conditions and we have to turn to those produced primarily for market gardeners. To this class belongs the Auto Culto, a small motor-driven machine made by Allen and Simmonds, of Reading.

The Auto Culto is a machine that has been tried out in Division 7 and has certainly proved efficient in many ways. The first one we had was bought under the auspices of the Research Branch for assisting oak regeneration by breaking up the surface, but proved to be not powerful enough for all that was asked of it, and was afterwards used in a nursery. The machine had an engine of one and a half horse power which was not strong enough for any deep ploughing or for ground with large roots and stones, but worked efficiently with a shallow plough or four cultivating lines. A special spring plough was made, with a view to allowing a certain amount of " give " if any obstruction was encountered, but it was ineffective. On transference to a nursery, the Auto Culto was tested on turning over turfed uncultivated ground and it was found that the addition of a single rotary coulter wheel with a sharp cutting edge facilitated this work, but even so the little engine had not enough power and tended to get overheated, in spite of a four-bladed fan. The machine was finally used for ploughing and cultivating nursery fallow areas, the cost being about 4½*d.* to 5*d.* per unit of 100 sq. yards.

Last summer one of the latest model Auto Cultos, with a 2½-h.p. engine, was obtained at a cost of about £50 with accessories. This has been used on all possible occasions in Fairoaks Nursery, and has eliminated practically all hand digging and cultivating. It is a great improvement on the first model, but costs rather more to run, viz., 9*d.*-10*d.* per unit for ploughing, and 7*d.* for cultivating. This machine is capable of pulling a deep furrow plough which can be regulated to a depth of 6 in. or more. It has one disadvantage, the shafts are too short when the plough is in use and the user tends to put his ankles against the end of the plough share. In heavy soil there is a danger of plough pan forming, but this can be obviated by fixing a single tine at the back of the plough itself. The plough is provided with a vertical coulter and costs about £6 complete. It was not as successful as a horse plough in turning in a green crop, but for any other purpose appeared to be as good and much cheaper. One advantage is that the turning headland is almost nil, whereas a two-horse plough needs a considerable area.

A brief description of the machine may be of interest. The engine is a single cylinder, air-cooled, 2-stroke, with petrol lubrication (the makers advocate 1 part oil to 16 of petrol but we found that 1 in 10 was better). It is built into a cast-iron chassis with a pair of double-flanged driving wheels keyed on to a solid cross shaft. The connection between the engine and driving wheels is by a dog-clutch with a single

gear, operated by a lever over the right-hand handle. The machine is held up and directed by one man who holds the two curved handles, like those of a lawn mower, attached to the sides of the chassis. The tools attached to the machine are carried by a perforated steel plate which, in turn, is bolted to adjustable L pieces bolted to the chassis. This tool plate may be up to 3 ft. in length, allowing for 6 cultivator teeth to be used at once. It is essential for the machine to be left in the charge of one man, who can use it properly and who can also look after it mechanically and not hand it over from one man to another.

Attention should be paid to lubrication of the wheel bearings, fan and other working parts every day; an Enots grease gun is provided in the latest models.

There is one drawback to the machine which may not be apparent in other nurseries, and that is the wheel tracks are not so spaced that it may be used in transplant lines, but it seems that in these days of reduced nursery programmes that increased spacing between lines, to allow of the use of an Auto Culto for ordinary weeding with small flat hoes, would be well worth while.

The use of this machine in Fairoaks has cut down the labour bill by the equivalent of four or five men, and has meant that all the fallow ground can be gone over about once in three weeks, to keep down weeds.

The actual accessories which are necessary in a nursery are given in the list below, with their approximate prices.

	£	*s.*	*d.*
1 Auto Culto, type E, 2½ h.p.	42	0	0
1 Trailing wheel	1	0	0
1 Deepcut plough	7	15	0
1 Tool place (No. 554) ..	0	16	6
2 Universal (No. 546) ..	0	13	0
1 Furrower (No. 547) ..	0	8	6
1 Pair light ploughs (No. 543)	0	9	0
1 Medium plough (No. 544)..	0	8	6
2 Tooth rakes (No. 540) ..	0	9	0
8 Cultivator teeth (No. 539)	0	16	0
Total ..	54	15	6

It is thought that economies can be effected in the Department's larger nurseries by the use of this machine.—W. L. T.

FOREST WORK OF STUDENTS AT DEAN.

By D. N. Williams.

I venture to think that a brief account of the Dean Forest School, and some of the results obtained, may possibly be of interest to a good many readers of the Journal. When I was appointed as Forester-Instructor in 1930, I was almost entirely ignorant of the system in vogue at the School and although I have been here only 2 years it has been a time of new and instructive experience.

The function of the School is, of course, to train young men as foresters mainly but not entirely for posts under the Commission. The course is of 2 years duration.

We have two distinct types of students, viz., those entering with experience gained on private estates and those with mostly Forestry Commission experience. Both these types have their various advantages, of course, but I am not discussing the pros and cons of State and estate forestry. There is one point, however, which my short experience has shown me, namely, that the man with previous Commission service has a distinct advantage on entering, inasmuch that he has a " costing " sense, and as this costing sense is ever rammed home and developed the whole time he is at the School, he realises better than the other, I think, the necessity of such procedure. This costing sense is, as I have said, insisted upon and yet it is not made a fetish of, as students sometimes are apt to think, and I know that they realise the benefit of it in their after-school experience.

The value of pay and allowances to each student is fairly similar to the wages of the ordinary forest worker. Under these circumstances, the students are costed for their work, for accounting purposes, at the normal forest day rates according to age. They work the normal forest hours, viz., 7 a.m. to 5 p.m., but usually have 1½ days per week for theoretical instruction. They also have evening classes in botany, mathematics, English and science, on two evenings per week during the winter. The chief work undertaken by students consists of the usual forest operations including prep. ground, fencing, draining, planting, weeding, cleaning and thinning, and felling with all its attendant produce, etc. Nursery work of course occupies a large proportion of the time in practical work and is almost a chapter on its own. We have 14 acres of nursery, an area which is almost entirely run by students, and there is no doubt whatever that students gain a first-class knowledge of nursery practice, whilst an official meteorological station and also an adjacent phenological garden add to the general forestry interest.

Other work practised by the students includes the measurement of standing woods and felled timber, pruning, fire-line cutting and burning, coppicing, hedging, cleft stake-making, wattle hurdling, grease-banding for the winter moth, etc., experimental work (under the Research Branch), working plans and budget estimates.

Fire-fighting is also undertaken largely by the School—the students are held mainly responsible for the suppression of most of the forest fires. There are several look-out stations, connected by telephone with each other and with the School as well as the various foresters' lodges. Each look-out station has a 3-in. to the mile scale map, which is marked in a series of concentric circles, and lines radiating from the centre. The map is oriented and the location of the fire is determined where lines from two stations intersect. This is 'phoned to the School, and the fire-picket immediately charters a lorry or car if the severity of the fire warrants and proceeds with shovels, and billhooks (and, if after 5 p.m., with hurricane lanterns—a very necessary precaution), and to the accompaniment of much noise, etc., go to the good work. It must not be supposed that the School is run at a dead loss—the forest work done by students is really their earnings. I have taken the trouble to find out what really are the average earnings per student on account of their forest work, and I find that each man earns approximately 17*s.* to 18*s.* per week for the forest. I should also like to point out that the standard of students' practical work is quite good, and compares very favourably with the average work done by forest labourers who of course are generally more experienced. This applies both as regards quantity and quality of work done.

The allocation of costs for the various operations is conducted as follows. Let us say, for example, that a number of students are sent on to a forester's beat for tree-felling. It is obvious, that being more or less novices, they are rather expensive to the forester concerned. Under the circumstances the forester is debited with the total value of work done, which is reckoned at normal forest rates. In this case, the normal forest rate would probably be about 7*s.* per 100 cu. ft. for felling, and 6*s.* per cord for cording. The students' costs on felling generally average about 12*s.* to 14*s.* per 100 cu. ft., and about 7*s.* per cord for cording, or say nearly double the piece-work rate. The difference between the total value at normal forest rates and the total value of students' work is allocated to instruction, *i.e.*, their training, so that the forester loses nothing in his estimates, the obvious extra cost being borne by the School.

Such is a general account of the system of the Dean Forest School in training its apprentices, apart from the class-room instruction, and the general conclusion I have drawn from my experience here is that the course is a very useful one for service under the Forestry Commission. We try, at any rate, to make it as comprehensive as conditions will allow. The students have very creditably started a School Magazine, and I think this is a suitable place and time to appeal to foresters and others connected with us to support this venture.

Finally the School must be viewed as a place to train and give the students a good ground-work and it must not be expected by a forester that when he receives a school man as a ganger that he is receiving the "compleat forester"; but by careful supervision and instruction he should carry on the training until the youth is able to stand up to actualities of dealing with forest labour and forest problems in his new surroundings.

OAK AREAS: EUROPEAN LARCH AS NURSES.

By F. WATSON.

The raising of oak plantations by the introduction of larch nurses is a method which has been fairly widely adopted in the Dean Forest until recent years. The formation of these plantations has been carried out in various ways; on some areas larch nurses have been planted at the same time as the oak whilst in others the larch have been introduced several years later and their proportion to oak and their distribution have been considerably varied.

A plantation here which had been formed by the above method in 1917, was recently treated for the removal of a number of larch nurses. This plantation was formed on a fairly steep slope, facing east, and at an altitude of from 500 to 600 ft., the situation being somewhat sheltered. Soil formation was as follows :—a layer of 2 to 3 in. humus, 5 in. dark loam, 9 in. of sandy loam and a sub-soil of 18 in. of sandy loam with broken sandstone, the area was on coal measures. Weed growth had been considerably checked by the previous mature crop of oak and beech, and consisted of patches of weak bracken and bramble. Natural seedlings from the 1914 seed were lifted from the forest and used for planting, these were good plants averaging 2 ft. The larch were 1 + 2 transplants of the same size. The area was planted in alternate lines of oak and larch giving an equal percentage of both species, the spacing being $4\frac{1}{2}$ ft. × $4\frac{1}{2}$ ft. A group of oak natural regeneration also from the 1914 seed crop and nearly an acre in extent formed the lower end of this area. This crop was thin in places, so 200 similar larch transplants were planted in small groups of from 1 to 4 plants where the regeneration had been poorest. The object in view at that time in introducing the larch nurses was to encourage the oaks to increase their rate of height growth and at the same time check the growth of big side branches. The nurses would be taken out gradually when they had reached a marketable size as pitwood or poles and give some financial return over a short period as well as benefiting the growing oak crop.

Weeding was necessary for the first three years in the case of the planted oak as many of these made very little growth during that period and bracken was growing vigorously again over the area. The larch made good growth right from the start and required but very little attention. One cleaning was carried out during the summer of 1924 for the removal of a small amount of birch and oak coppice.

A description of this area at the beginning of the present year may be of interest. Both oak and larch were growing fast and had a healthy appearance. There were, however, several patches of the planted oak which were suppressed while quite a big proportion of the oaks were getting over drawn. The larch averaged 22 ft. and the oak 14 ft. in height on both the planted and natural regenerated parts of the area. Almost a complete canopy has been formed by the larch which were rather heavily branched and at a distance the area had the appearance of a pure larch

plantation. It was very obvious that a big percentage of the larch nurses were having an adverse effect on the growth of the oak, so it was decided to remove about 40 per cent. of the nurses, these would be the most dominating trees and to brash the remaining larch where necessary and remove all or part of these in several years' time.

The removal of the nurses calls for the greatest care if damage to the oak crop is to be avoided, especially if the larch, as in this case, are good sized trees or if patches of natural regeneration are being dealt with. The trees which it was decided to remove were first brashed to a height of about 16 ft. and roped at that point, a ladder being used. Two men carried out this work, one would partly fell a tree until it had a certain amount of "lean" in the desired direction, whilst the other man would fix the rope to a piece of coppice or a badly-grown natural oak a convenient distance away and by winding the rope round the stick a couple of turns and not tying it, the fall of the tree could be easily controlled by the man holding the free end of the rope. A tree could be brought to a stop in this way during almost any degree of its fall whilst the other man held the oaks aside beneath it.

In the natural regeneration it was necessary to cross-cut the poles into 6½-ft. pitwood lengths before carrying to roadside owing to the difficulty in turning with the usual 13-ft. pitwood lengths. A saw was found to be the most suitable for this, as an axe could only be used with difficulty owing to the density of the oak crop.

I am unable to furnish the costs of the earlier operations, but the following costs per acre of the recent operations might be of interest:—

	£	*s.*	*d.*
Cost of felling, carrying to roadside (this includes brashing and cording the pitwood)	3	12	0
Value of produce prepared	6	5	3
Net return	2	13	3
Cost of brashing the remaining larch	0	7	3

In giving my views on larch as nurses for oak, I believe the success of this method depends largely on the percentage of larch introduced and the time they are planted in relation to the oak. In the plantation which I have described it would appear that the percentage of larch is much too high. It will be realised that if the remaining nurses are all removed during the next two or three years the planted oak will have a spacing of 9 ft. × 4½ ft., of about one quarter the desired number per acre at 20 years.

The high percentage of larch planted as they were at the same time as the oak, resulted in some oaks being suppressed right from the beginning. This risk can be greatly reduced by introducing the nurses some 2 or 3 years later, when the oak have made a start. This means planting over the area twice and if many failures occur it is likely to become a long drawn-out job, it will be obvious that failures in the oak could not be ignored in the same way as they might be in pure oak of close spacing. A more suitable percentage of larch is, I think, ¼ larch to ¾ oak, any deaths

in the oak wlll then have a less serious effect on the stocking of the plantation, also the height growth of the oaks should be more uniform.

Good oak woods can be raised by this method as is shown in a very fine 60-year old plantation situated at Bradley Hill in Dean Forest; I do not know what percentage of larch nurses were planted there. Of the younger oak plantations up to 20 or 30 years, I consider the most promising ones are where the planting was done with pure oak at close spacing.

YOUNG ASH IN HIGHMEADOW.

By F. SMITH.

In these notes I have given a short description of two compartments so that the reader may visualize the conditions under which the plantations were made.

Compartments 67 *and* 68.

Altitude: 550 ft. Soil deep loam overlying iron-ore measures, wet in parts, sheltered, but subject to late spring frosts; eastern aspect. The previous crop consisted of old oak standards with coppice of hazel, ash, alder and sallow, and was felled in 1909 and 1910. The ash were planted pure in 1910 and 1911, 4 ft. × 4 ft., only in the lower-lying part of the compartment, practically in a valley

As soon as the ground was cleared dense masses of *Aira cæspitosa* came in and the ash were very slow in getting away. In fact in one small plot it was decided to interplant with Norway spruce and this was done 4 ft. × 4 ft. between the ash plants, and in another small area the Norway spruce were just dotted about, no particular spacing being observed.

The present conditions are as follows :—

1. Where the Norway spruce were just dotted about there is a fine crop of ash some of the trees being 35-40 ft. high and measuring up to 15 in. girth at breast height. The bark is beautiful, the stems straight and clean and there is every prospect that the timber will be of first class sports quality.

2. Where the Norway spruce were planted 4 ft. × 4 ft., the ash crop is very irregular. In some parts sufficient ash have come through to form a crop, but in others the Norway spruce have killed the ash and will have to be accepted as part of the crop. The ash stems although as high as in No. 1 are much thinner and care will have to be exercised when taking out the Norway spruce. Here again, the timber will be of first-class quality.

3. In the pure ash the coppice was kept cut just below the heads of the ash for several years, and then allowed to grow on. There is a complete crop of ash rather irregular in growth varying from about 15-35 ft. high, and up to 14 in. girth at b.h. The quality is inferior to Nos. 1 and 2, the bark is not so good in colour and the small side branches still persist which give fine knots, thus spoiling the timber for sports purposes. I should classify this as Grade II. When one considers that Grade II poles of 6 in. to 8 in. fetch about 1*s.* to 1*s.* 2*d.* per cu. ft. in the wood and that poles of similar size in Grade I are worth 2*s.* 3*d.* per cu. ft. for the first 12 ft., it shows that every effort should be made to get as many poles in Grade I as possible.

To sum up, it appears at present as though the best results would have been obtained if the original plantation had consisted of 75 per cent. ash and 25 per cent. Norway spruce. This may appear to many as being

an unorthodox mixture but I have been informed by one who had an extensive practical experience in purchasing ash for aeroplanes during the war that the best ash he got was grown along with Norway spruce.

Compartment 55.

Altitude : 700 ft. Stiff loam, shallow in parts to fairly deep, overlying limestone. Sheltered by surrounding woods except on north end of compartment. Previous crop consisted of oak standards with coppice of ash, hazel, wych elm, birch, maple and sallow. Felled in 1915. Planted in late spring of 1916 with ash 75 per cent. and beech 25 per cent., $4\frac{1}{2}$ ft. × $4\frac{1}{2}$ ft., one row pure ash and one row alternate ash and beech. Judged from a planting point of view, this is a very successful plantation —not a blank anywhere. The beech plants, however, have now become a serious problem. They are in many cases 4 ft.–6 ft. higher than the ash and meeting in the rows with the result that many of the ash are being suppressed, and unless something is done very soon to relieve the ash the plantation will eventually be a pure beech one. The obvious remedy, of course, would be to take out the offending beech and if this were done now sufficient ash would be saved to form a plantation, but the operation would be a dead loss as the beech is not yet big enough for pit props and it would not pay to carry it to the rides for firewood. Also so far as can be seen at present no beneficial effect has been made on the plantation by planting the beech with the ash.

The forester in charge carried out an experiment last winter and took out the beech on 2 or 3 perches. The beech were cut level with the ground except in one instance where a forked one was pollarded at about 3 ft. 6 in. high. This has put out several strong shoots but of the former only three or four show signs of coppicing. The butts of the others, however, are still green and it is probable that a number of them will coppice next year.

Speaking generally, ash is not an attractive species to grow pure, although it is a successful one to transplant; yet except in favourable situations not much growth is made for several years. In this locality the best situations are in the valleys on the old red sandstone where the soil is deep and always more or less damp, and here within a year or two of planting annual growths of 3–4 ft. are not unusual. It is useless to plant ash on shallow soil as although the plants may keep alive the rate of growth is too slow to be remunerative. To anyone who intends to plant ash I would certainly advise a mixture of Norway spruce in preference to beech, as owing to the erect nature of the former as opposed to the spreading nature of the latter to my mind the spruce is the better companion. Also where it becomes necessary to thin the plantation a small spruce pole is more valuable than a small beech, to say nothing of the possibility of obtaining a Christmas tree from the top of the former. Again, owing to the fact that spruce retains its branches, the side branches of the ash are killed out young, thus ensuring clean butts which are essential if timber of sports quality is the objective.

ARTIFICIAL FARMYARD MANURE.

By J. M. MURRAY.

In certain districts the forester finds great difficulty in gathering together sufficient farmyard manure and leaf mould to supply what is needed in his nursery. Manure may be not only scarce but dear and in many places in which the Commission's work is carried out there may be no trees to produce leaf mould. Under these conditions recourse has to be made to soiling crops such as lupins, vetches, and the like. But crops of this kind are expensive and, to some extent, are themselves dependent on the soil being in fair condition. With an impoverished soil the growth of the soiling crop tends to be poor and the weed-growth may even overcome it. It is of some importance, therefore, if a substitute can be obtained by making use of material which otherwise is wasted.

The essentials in any good substitute are firstly that it should be able to replace the real article in its primary purposes and secondly that its cost should be reasonable. A substitute for farmyard manure has to provide organic matter for humus, and the essential minerals that are most readily lost from the soil.

Farmyard manure varies greatly in its composition. This variation arises from the nature of the litter used, the kind of stock kept, its feeding, and the method and period of storage. Chemical analyses have given the following results for good manure made where animals were cake-fed :—

	Per cent.
Moisture	72·6
Dry matter	27·4
Nitrogen	0·77
Phosphoric acid	0·39
Potash..	0·60

In addition, farmyard manure has physical properties which are of very great importance to nursery soils. These properties are due to the organic matter (humus) that is present. The effects of humus on soils are well known and may be stated briefly. Humus darkens the soil making it more easily warmed in spring; chalk soils, however, overcome this darkening tendency and remain white. Humus decreases the risk of the soil drying out owing to its capacity for retaining moisture. It binds loose soils and lightens heavy ones. Cultivation is made easier. The presence of 15 to 20 per cent. of organic matter in a soil masks the distinctions between sands, loams and clays. Caking of the surface tends to become less pronounced in the clayey loams as the amount of humus present rises. Humus can increase the activities of living organisms in the soil. In *Forstarchiv* (1929) and again in *Forstwissenschaftliches Centralblatt* (1931) Nêmec showed that there is a connection between humus, the nitrogen content of the soil, and the growth of plants.

The production of a humus and nitrogen-rich substance is what is attempted in making artificial farmyard manure. The first serious efforts to produce an artificial farmyard manure were made towards the end of the war when crop production was an urgent necessity and when large areas of corn were laid down without a corresponding increase in live stock to make manure of the straw.

It had been considered necessary previously to have an admixture of animal fæces to produce the decomposed product known as well-rotted farmyard manure. This was early proved to be false, however, and decay of straw could be brought about by the action of aerobic cellulose decomposing bacteria. The result was found to be due in great part to the mineral substances contained in the bacterial culture used in the experiments.

The final stage of the investigations showed that the essential factors in rotting straw are : moisture, suitable temperature, a supply of soluble nitrogen compounds and a supply of air.

Moisture is either present in suitable amount in the material being converted into manure or it can be supplied artificially. Nitrogen is essential to bacterial development and it is found that over 10 per cent. of the dry weight consists of that substance. In straw the amount is small and it must be augmented by addition of compounds rich in nitrogen. But this addition is insufficient to carry the operation beyond a certain point. As the action progresses acids are produced and these inhibit the decomposition processes and ultimately may bring them to a standstill. It is essential that an alkali should be added so that the decomposing mass is kept slightly alkaline rather than acid. What the nitrogen compound may be depends on circumstances such as cost. It is essential that it should be readily soluble and it is an advantage if it is not markedly acid.

The rise in temperature required for the process is obtained by the heating that occurs naturally if moist straw or other similar material is put into a compact heap and this is raised still further by the nitrogenous compound that must be added. It is necessary, if the proper type of decomposition is to be obtained, that the supply of air should be sufficient during the earlier period. It should be remembered, however, that reduction in the amount of air available in the heap causes a reduction in the demand for nitrogen as compared with conditions in which there is a greater air supply. The rate of decomposition is slowed down, however.

Investigations carried out by Hutchinson and Richards led them to the conclusion that 0·70 to 0·75 parts of nitrogen per 100 parts of dry straw are necessary for pronounced rotting. This amount is the same as that which straw is capable of fixing in the form of ammonia. It has been found also that where only low amounts of nitrogen are present the heap tends to accumulate more nitrogen while straw oversaturated with nitrogen loses it till a stabilised condition is reached. This condition appears to be identical for both states. The supersaturated straw in a fermented state holds a portion of its nitrogen as ammonia

so long as the material is moist but it loses this on drying. This loss also occurs in farmyard manure.

It has been found that addition of phosphate is a help in forming the rotted manure although the process can proceed without it. Hutchinson and Clayton found that fixation of nitrogen could be brought about by mixed cultures of the cellulose destroying *Spirochæta cytophaga* and the nitrogen fixing *Azotobacter* when grown in cultures containing pure cellulose. *Azotobacter* is so rich in phosphorus that the ash of the surface growth of cultures can yield 60 per cent. of phosphoric acid. It is essential, therefore, if this organism is to be encouraged, that a supply of phosphate should be available.

In making artificial farmyard manure urea and ammonium carbonate are the most suitable nitrogen compounds. But both are expensive and sulphate of ammonia and cyanamide have been recommended. Cyanamide contains free lime and can keep acid formation in check; sulphate of ammonia requires the addition of ground limestone, chalk or waste lime.

Experiments were carried out in an east coast nursery (Tulliallan) with artificial manure produced by three methods, namely, straw and waste vegetable matter treated with (1) calcium cyanamide; (2) Adco; (3) sulphate of ammonia and ground limestone. In all cases a considerable degree of rotting was obtained. This was most active in the heap treated with sulphate of ammonia, less in that to which Adco was applied and least in that with cyanamide. There was little difference between the Adco and cyanamide heaps which is quite understandable.

The manure produced was used satisfactorily to grow potatoes and, in addition, certain plots on overworked ground had equal applications of each manure applied prior to being sown with vetches. The resulting vetch crops were best where ammonia-limestone manure was used and least satisfactory where cyanamide manure was applied. Scots pine, European larch, Sitka spruce and Norway spruce seedlings were lined out on the plots. Each plot had an equal number of each kind of seedling. Plants on ground treated with cyanamide manure show poor growth and a heavy death-rate; those on sulphate of ammonia manured land are excellent with less than 1 per cent. death-rate, while the results with Adco manuring are less satisfactory but better than with cyanamide. On the west coast, Adco seemed to produce the best results.

The practice of making artificial farmyard manure has been continued as a means of supplementing the regular supply of manure and the sulphate of ammonia and ground limestone method has been adopted.

Any kind of refuse as free as possible from weed seeds is used. The material comprises grass cuttings, straw, rushes, etc., and where convenient these are used green. Straw, however, is only used after the grain has been threshed, and being dry thorough wetting presents some difficulty. This is overcome by wetting the straw in layers and leaving it for a few days to ferment. It is then thoroughly soaked. If a pit were available the straw could be heaped into it and then saturated.

In practice it has been found convenient to spread the ground limestone and sulphate of ammonia in alternate layers, the former at the rate of about 1 cwt. and the latter of $\frac{3}{4}$ cwt. per ton of dry material in the litter. It would be quite effective to spread the sulphate of ammonia on the top of the heap and allow it to soak in with heavy waterings. One or two cwts. per ten to fifteen tons of litter of phosphatic manure are also added. Where urine from cowsheds can be obtained, it may be used in place of sulphate of ammonia, but if loss is to be avoided it should be made very weak by adding water. It is intended to try the experiment of using poultry manure as the source of nitrogen and phosphate. Approximately 3 cwt. of dry manure should be equal to $\frac{3}{4}$ cwt. of sulphate of ammonia. The heaps are thoroughly wetted after they have been made up and they may be turned once afterwards. It is found that 1 ton of dry straw treated this way produces 12 to 15 tons of brownish-black manure in three to six months.

A manure made in this way will contain less phosphate or potash than manure made by feeding cattle or horses where the fæces introduce considerable amounts of these materials and it will be necessary to apply artificials of these kinds separately.

DAMAGE BY VOLES.

By A. H. Gosling.

In the winter of 1929–30, and again in the winter of 1931–32, considerable damage was done to young plantations by voles in the Forests of Benmore, Glenbranter, Glenfinart and Ardgartan in Argyllshire.

The field vole (*Microtus agrestis*) which caused the damage can readily be distinguished from the common house mouse by its short nose, short ears and short tail. It is considerably larger than the mouse.

Although normally the number of voles on an area is insignificant, the population is liable to great fluctuation and only when the number is large does the damage become serious in plantations. The prominence of the surface runs is one of the first indications to a forester that voles are on the increase. These runs are often quite open for some length, or can be seen easily if the surface vegetation is moved aside with the hand. Fresh runs can be distinguished from old ones by the presence of heaps of fresh droppings at intervals, and scattered small pieces of chewed green vegetation. When voles are really numerous the surface becomes one whole network of runs, voles are often seen darting about in these runs and on bright dry days many more may be seen than at other times. During the summer the presence of large numbers of voles on an area can often be detected from a distance. All the new grass may be eaten as it comes up so that the area may not change from its winter aspect. This was very noticeable in the summer of 1932. Extensive areas of Juncus, molinia, and grass land showed no sign of becoming green until August, and in many places never became green. Much interference is also caused to drainage by the underground runs and infested areas become wetter in appearance than normal.

The damage done to young plantations by voles may be regarded as of three types:—

(i) *Pruning of the Shoot.*—This varies greatly in intensity. A tree which is slightly attacked may have only a few of its lower branches pruned off. It is not uncommon, however, to find plants of the size of a large 2 + 2 Sitka spruce reduced until nothing is left but a mutilated stalk a few inches high. The cuts made by the voles are clean, but can be distinguished from damage by other animals or instruments by the marks of the incisor teeth. These marks are similar to those made by a rabbit but, of course, much smaller.

(ii) *Ringing.*—The tree may be either partially or completely girdled by the nibbling of the bark from around the stem. The damage is often confined to the base of the stem, but may extend much farther up.

(iii) *Root Damage.*—The roots are generally girdled and are often severed completely fairly near the collar. This may take place only on one side of the tree or all round. This type of damage may not be noticed, if it is not searched for, until the trees begin to blow over. It is less widespread than ringing and pruning, and is usually confined to spruces.

All types of damage frequently occur in the same plantation but seldom on the same tree. Speaking generally pruning is most common in plantations one year or two years' formed, ringing and root damage in older plantations. Trees up to 12 ft. in height have been ringed, but extensive damage has not occurred in plantations over 6 ft. in height.

Our experience as to species most liable to attack is confined to conifer plantations. All species may be severely attacked. *Thuya*, Lawson's cypress and *Abies nobilis* are most liable to damage; pines often suffer severely but Scots pine is much more subject to attack than mountain pine and *Pinus contorta;* all larches are badly damaged and Norway spruce is probably attacked more frequently than Sitka spruce and has much less recuperative power. Among broadleaved species found in the plantations it was noted that poplars, willow, beech and hazel are frequently eaten, birch appears to be one of the least attractive species.

Damage occurs on all types of land—dry heather knolls, bracken slopes, or Juncus, molinia and grass land. It is usually particularly severe on areas with a dense Juncus-molinia vegetation. Severe damage has been noted from November to May inclusive, but February and March appear to be the worst months. Very little damage is done during the summer months when the voles are feeding on the fresh grass and other surface vegetation.

The extent of the damage done to plantations varies greatly. It is usually severe in irregular patches. It is necessary to consider separately (i) the number of trees attacked, and (ii) the number killed. In the severest cases almost every tree may be badly attacked. A typical example of damage done from November, 1931 to May, 1932, in a plantation at Benmore may be quoted. The area is nearly 200 acres in extent —P. 31 and P. 32. The number of trees seriously damaged varied from 10 to 100 per cent. The average for the whole plantation was not less than 40 per cent.

Fortunately, damage, even severe damage, may not result in the loss of the tree. The recovery which is being made by the spruces, particularly Sitka spruce, is an outstanding feature of the present situation. A large percentage of trees pruned by voles during the spring of 1932 have thrown out new shoots. Often these shoots did not appear until July, or even later; some of the shoots are still weakly and further observation is necessary before figures can be quoted to show the percentage of severely pruned trees which have recovered. The chance of recovery depends upon the species and age of the tree, the nature and severity of the damage, and probably the month in which the damage was done. Instances of trees completely girdled and subsequently making a recovery are comparatively rare, but partially girdled trees seldom succumb. Trees damaged at the roots are usually blown over and die.

Attempts have been made both to protect the trees from attack, and to kill out the voles. Trees may be saved to some extent by painting the stems with some preparation distasteful to voles. Several of the well-known preparations used against rabbits have been tried. If only a little of the preparation is applied to the stem the voles often climb

up and damage the leader and side branches ; on the other hand, if too much is painted the trees may be killed. The tarry preparations are most apt to be injurious, " Trepar " is the best so far tried. The expense of the preparation and its application prohibits its extensive use in plantations. It can be applied more cheaply to plants before planting than to small trees in plantations.

Poisoning and trapping have been tried but with the exception of small isolated patches, little real success can be claimed. Expense is again a controlling factor. The use of arsenic or strychnine was not permitted on account of the risk but phosphorus poisons and Liverpool Virus were tried extensively. Wholemeal bread is probably the most useful bait, as it is easy to handle, is usually taken readily, and is easily treated with poison. Repeated heavy applications of Rodine and Liverpool Virus to certain areas did not clear them, and there was little evidence to show that the amount of damage decreased appreciably. It is likely that many voles were killed but more came in from other areas. Probably for similar reasons trapping has not yielded encouraging results. The most useful type of trap in use is a cylindrical tin about 10 in. deep and 4 in. in diameter, open at the top but with the top edge bent inwards. About 2 in. of water must be kept in the tin, and the trap should be buried until the upper edge is level with a vole run. The trap is not baited. In peat areas, voles may be trapped by digging holes narrower at the top than at the base in the lines of the principal runs. A boy engaged on trapping has not succeeded in recording a catch of more than about 500 voles per week.

The natural enemies of voles—weasels, owls, hawks—generally increase noticeably in numbers when voles become plentiful, and help to keep the vole in check. Their increase is, however, slow compared to that of the voles. Past experience tends to show that vole plagues usually end quite suddenly, and this is due to the outbreak of disease and not to the work of animals or birds, or to artificial control measures. Little is known of the diseases and at present they cannot be introduced artificially.

It has been decided to adopt the following procedure in the plantations which were attacked during the period November, 1931 to May, 1932. Plantations one year or two years old will be left alone for one year until it is more evident how much beating up is necessary. In those older plantations where beating up is definitely required and where it would be dangerous to postpone it, a fast growing species will be introduced as soon as possible. Large plants will be used, generally on mounds, and where voles are still numerous the plants will be treated with "Trepar" or other similar preparation. On badly-infested land no new planting will be carried out until the plague is over.

BIRDS AND FORESTRY.

By J. MAXWELL MACDONALD.

The importance of birds in forestry may be conveniently considered under two heads, beneficial birds and harmful birds.

The most important way in which birds assist the forester is by eating insects that are destructive to trees. Cuckoos, finches and several other birds will eat the caterpillars of the nun moth which are hairy and probably very bitter. These birds are considered of the utmost importance in Germany where the nun moth is a devastating pest. Tits, thrushes, starlings, finches and a host of other small birds have for their staple diet the caterpillars of lepidopterous insects and the grubs of cockchafers. Tits are especially useful as destroying the caterpillars of the winter moth and the oak tortrix.

Owls, hawks and the smaller birds of prey feed on small rodents such as mice and voles which can be very destructive both in the forest and in the nursery. The larger birds of prey, such as eagles and buzzards, feed on hares and rabbits but cannot be regarded as being of first-class importance in forestry as they frequent mountainous districts and seldom come near woodlands. Wood-peckers feed on the larvae of the longhorn and other bark and wood borers, searching for them under the bark of trees. They occasionally go deeper for the larvae of wood wasps. The green wood-pecker which is the most common in this country generally confines its attention to ant hills.

Birds assist regeneration by carrying and scattering seed and should probably get more of the credit that is given to the wind for this. On the other hand, this may be harmful when weeds or undesirable climbers are disseminated.

Probably the most unpopular bird with foresters is the blackcock. He is very destructive to the buds and shoots of young conifers in Scotland and northern England, cutting back the shoots and giving the tree a bush-like habit which delays its emergence from the surrounding vegetation. This type of damage is, however, of a temporary nature, as the trees always get away in the end. Trees planted in 1927 and subsequently very badly damaged by black-game have now thrown off all signs of the damage and are growing vigorously. Crossbills destroy cones in the same way as squirrels, but they are somewhat rare and therefore of little importance.

A very vexed question is that of the proper relationship between forestry and game preservation. This falls under two heads, the preservation of game birds and the destruction of vermin. No game bird, with the exception of the blackcock and greyhen, is a serious menace to forestry. Black-game are not among the most popular or valuable game birds, although the blackcock generally gives a high sporting shot as his flight is always much faster than it appears. The forester is therefore justified in keeping black-game within bounds. The shooting tenant, however, need have little fear, as the blackcock is well able to

look after himself and shows no signs of becoming extinct. All other game birds are harmless and in some cases beneficial as destroyers of harmful insects (although there have been cases of grouse picking young shoots during deep snow) and should be preserved and encouraged.

The question of the destruction of vermin is a more serious one. On it depends the relationship between the forester and the game preserver. On the whole, it may be taken that the advantages of vermin in keeping down forest pests are balanced by their destruction of beneficial birds. It is true that stoats and weasels keep down the numbers of rabbits, but cases where fencing is avoided through the presence of stoats and weasels are not numerous. As they are very destructive to game birds the best policy is to destroy them. Birds which have no direct effect on the forest, but which should always be destroyed, are the greater black backed gull and the hooded and carrion crows, which are very destructive to the eggs and young of other birds. The chough, a rare species easily distinguished by its red legs and beak, should never be destroyed in mistake for one of the crows : its food consists of insects, and it is therefore, if anything, beneficial to the forester.

Great good could be done in forestry by encouraging the small bird population. A little food scattered in winter costs practically nothing and, although birds by themselves will never stop a serious outbreak of any insect, they are continually keeping the insect population of the forest within bounds and might easily be the cause of preventing a serious outbreak.

A PROFITABLE JAPANESE LARCH PLANTATION.

By A. GRANT.

The following notes, on returns derived from a Japanese larch plantation, are written in the hope that they may prove interesting to foresters on areas where there are no woods of a similar age or where such woods exist but no record of formation costs is available. The information tends to refute the impression apparently held by a section of the general public that forestry can never be a paying proposition.

Before dealing with the statement proper a brief reference should be made to the methods of conversion and disposal of produce from the plantation. There is a good local demand for material for rustic fences, pergolas and similar structures consisting of poles, posts, rails and fillings. Tops from 3 in. to 1 in. diameter are converted into rails and fillings and classified according to basal diameters while heavier material is made into stobs, posts or poles, according to current demand. The prices obtained for rails of 2 in., 2½ in. or 3 in. basal diameter, if cut to specified lengths, are ½*d.*, ¾*d.* and 1*d.* per foot respectively. When rails are bought by the 100 ft. or per ton a reduced rate is quoted. The local demand for fencing stobs is very limited, the chief outlet for this class of produce being home forest and neighbouring Commission forests' requirements. Full credit has been given in the appended statement for all material supplied for home forest purposes.

It should be noted that there is no suggestion implied in this article that a similar return should or would be obtained from all Japanese larch plantations of the same age as that under review. This particular plantation had certain advantages which tended to give an abnormal return. These may be stated shortly as (1) proximity and easy access to public road; (2) local market which readily absorbs all timber removed in thinnings in a state requiring the minimum outlay on conversion; (3) small area concerned.

The writer is indebted to Mr. J. Webster for the records appertaining to the plantation prior to its acquisition by the Forestry Commission and to Mr, J. A. B. Macdonald for figures relating to the standing timber.

Japanese Larch Plantation—Benmore Estate.

Notes regarding formation costs, revenue, expenditure and present volume to 23rd December, 1932.

Area.—2·25 acres.
Name of Plantation.—Puck's Glen. *Date of formation*—1907.
Situation.—East side of Dunoon-Strachur road, near 6th milestone.
Aspect.—S.W. *Exposure.*—Sheltered on N., E. and S.E.; partial shelter on S. and S.W.; exposed on W. and N.W.
Elevation.—From 51 ft. to 110 ft. *Slope.*—Moderate.
Soil.—Sandy loam over mica schist.
Previous Crop.—Oak scrub and rough grazing.

Method of Planting.—Pit. *Planting distance.*—4 ft. (triangular spacing).
Number of trees used per acre.—3,110.
Volume of thinnings per acre.—1,220 cu. ft.
Volume per acre under bark after thinning.—2,152 cu. ft.
Number of trees per acre after thinning.—369.
Average height of crop.—51 ft.
Girth at 4 ft. 3 in. = 22½ in.
Basal area per acre after thinning.—104·1 sq. ft. *Bark.*—14½ per cent.
Present volume of whole wood.—4,842 cu. ft.
Formation costs per acre.—£9 17*s.*
Revenue :—

	£	*s.*	*d.*
Value of thinnings sold by Benmore Estate, 1922–24, *less* cost of extraction and preparation = £21 17*s.* 2*d.* for 10 years, at 3½ per cent.	30	16	2
Value of thinnings sold by Forestry Commission, 1925 to 23/12/32, *less* cost of extraction and preparation = £233 18*s.*, for 4 years at 3½ per cent.	268	8	0
Value of felled timber in hand at 23/12/32 = 104 cu. ft., at 6*d.*	2	12	0
Gross revenue from whole wood (2¼ ac.) ...	£301	16	2
Gross revenue per acre	£134	2	9

Expenditure :—	£	*s.*	*d.*			
Formation costs at end of 26 years, per acre = £9·85 at 3½ per cent.	24	1	9			
Rent of 2*s.* per acre for 26 years, at 3½ per cent., £0·1 × 41·3131	4	2	7			
Cleaning and pruning costs per acre = 25*s.* for 9 years, at 3½ per cent. + 18*s.* in 1932 ...	2	12	0			
Taxes at 5*s.* per £1, or ·5*s.* on a rent of 2*s.*, or £0·025 each year for 26 years	1	0	7			
				31	16	11
Net revenue, per acre, to date				£102	5	10

All revenue and expenditure items have been calculated at 3½ per cent. compound interest.

FIRE PROTECTION.

By W. E. MARSHALL.

In the Forestry Commission one learns from experience of the danger of fire in woodlands, and one is reminded of it by the receipt of a wide range of literature on the subject. Being stationed on one of the Commission's most vulnerable forests, I am able to appreciate fully the risk of such fires. I shall dwell briefly on a few points which may be of interest to some readers in the protection of their areas from such a calamity.

The forest of Greskine to which I refer covers approximately 420 acres. The main L.M.S. Railway line runs the entire length of the area for a distance of some two miles. Banking engines are used on almost every north-bound train and these engines are a greater menace to our plantations than the most powerful on the line. The forest is divided into two sections separated from each other by about half a mile. This, of course, makes fire patrol a difficult matter, especially as the two most dangerous parts are roughly a mile and a half apart. The size of the area makes protection an expensive item and it is therefore necessary to practice the utmost economy consistent with safety.

Fire Beaters.—The fire beaters used are of novel type and worthy of mention, both from the economical and the efficiency point of view. The making of these provides a wet-time occupation for the workmen, and the material used may be light larch thinnings, pieces of waste wire and wire netting, and old sacks. Unfortunately, on this forest we are unable to secure larch thinnings for handles, and therefore have to purchase 6-ft. rake shafts for this purpose. First, we take a piece of old wire, preferably No. 8 (9) and 14 or 15 ft. long, and double it evenly; then place the loop end on a secured piece of iron or wood the same thickness as the end of shaft and plait the two wires together leaving about a foot of each unplaited for binding purposes. The loop end is then placed on the shaft 5 or 6 in. from the end, a small netting staple being driven in to hold it in position, then the plaited length of wire is shaped like a spoon handle on the end of shaft the two unplaited ends being wound tightly round, securing both ends to the shaft. A few more netting staples or a small quantity of tying wire puts a finishing touch to this part. The spoon shape of plaited wire is now covered with old wire netting and it, in turn, covered with sacking sown on with tying wire. This type of fire beater has proved very efficient, especially in dealing with long coarse grass, and having no loose ends it has not the tendency to lift burning embers and so relight fires. The only precaution to take is to keep the sacking damp. If kept in a fire dump erected with four stobs and a sheet of corrugated iron, these beaters should last a few seasons.

Fire Traces.—A fire trace has been cut by the railway company running parallel with the rails at a distance of 2 chains. Fire traces

have also been cut by the Forestry Commission at right angles to this one and separating each year's plantation. These traces are cleaned periodically usually in the first or second month of the year. The work is done by screefing. During the summer of 1932 we experimented with weedkiller to ascertain if the cost of maintaining the traces could be reduced while their usefulness remained unaltered or improved. The experiment so far has been quite successful, the cost being 1*s.* 4½*d.*, as against 2*s.* 2½*d.* per chain for screefing and showing good results on a rather rough trace. It is therefore reasonable to consider that if a newly cut fire trace were treated periodically it would show a substantial reduction in cost of maintenance and a marked improvement in efficiency.

It must, of course, be remembered that weather conditions play an important part in the effects of weedkiller, and also that on no account should it be applied where there is a likelihood of livestock drinking water drained through that particular section, or coming in contact with the sprayed part in any way.

Fire Belts and Rides.—The fire belt from the trace to the railway is burned clear of all vegetation whenever possible. Burning is made more easily possible through the benefit of a strip mown 9 ft. wide along the railway side of the trace. This strip in itself provides a further means of protection in the event of a fire breaking out on the belt, but it is also of very great assistance in the burning of same, for it allows a small squad to do the burning effectively and quickly, without the risk on windy days of grass carrying the fire across the trace to the plantations. A strip 6 to 8 yards wide is burned round the whole of the area on the adjoining tenants' land and with their assistance.

Parallel with the fire trace a wide drain runs the entire length of the more dangerous section of the area at a distance of anything from 40 to 60 yards from the trace. This drain serves two purposes, drainage and protection, for the latter it is cleaned regularly, all grass and other vegetation being cut well back from the sides. It is considered that the drain would in a normal wind prevent fire spreading should a spark alight over the fire trace.

A ride on this section running almost half-way across the plantation is kept green by mowing. The object of this ride is really to limit the progress of a fire when out of control and give the fighters a chance to confine it to a certain section of the area. It was mown at a cost of 2¼*d.* per chain, but it is anticipated that this cost will be reduced as the ground becomes cleaner

Fire Patrol.—Now while attention has been given to some vital points in connection with fighting fire, in my opinion complete protection cannot be attained from one or all of these. What really counts is a thoroughly reliable and efficient fire patrol. Fire patrol to my mind should not merely be a special patrol detailed for the express purpose of protection from fire, but consist of the whole of the employees on an area, no matter in what capacity they are employed. Every man should be made to feel that a certain amount of responsibility rests on his

shoulders where protection is concerned so that he will do all in his power at all times to keep the forest from destruction.

In the early paragraphs of this paper I here stated that the area to which my remarks refer is a most dangerous one. It also has a record of having so far suffered no actual damage from fire, and I attribute this not so much to the extensive precautions, though these in themselves are invaluable, as to the co-operation of the workmen as one complete fire patrol and to the friendly relations and helpful spirit which exist between the Commission and the adjoining tenants and landlords.

TREES AS LIVING THINGS.

By J. M. Murray.

In our work of planting and tending trees we become very much inclined to treat them as producers of stobs, props and of boards. How often do we think of them as living things ? In this respect the old customs and old ideas throughout Europe and the present-day ideas in some eastern countries show a different outlook. In the cast the marriage of men and girls to trees or bushes probably shows an idea on the part of the people that the trees or bushes embody a spirit, or at any rate, they are living things. In European countries and in England the practice of taking to a village a maypole originated from the idea that the maypole carried in it a spirit of life and that in May life was beginning to be stronger. In some countries it is customary for a man or a girl in gala dress to accompany the maypole as bridegroom or bride.

Superstitions connected with certain trees also point to the presence of a spirit within these trees. In the Highlands of Scotland rowan was used for the stalk and crosshead of a churn in order to prevent witchcraft. The spirit of the rowan was believed to remain in the wood and to fight against any evil influence that might come from without. Similarly, rowan trees were planted outside the doors of houses in the Highlands in order that witches in any form might not enter.

The following story may illustrate the idea of life within trees :—

A peasant in northern Europe was one day hurrying over a moor to get home before a thunderstorm came on and saw a stranger lying by the roadside. The stranger was fast asleep and the peasant knew that if he were left there he would suffer greatly. He therefore wakened him and the stranger on rising looked around, saw the threatening thunderstorm, and said : " I am indebted to you on this occasion, but at some time later I shall be able to repay you with interest. Should you find you are in any urgent need at any time, look around you and you will see a crooked birch tree. Say to the birch tree—' Come and help me, O Crooked One,' and help will be forthcoming." Shortly after this the peasant enlisted as a soldier and was sent abroad. All went well for about a year and then one day he was left in camp looking after the horses while his comrades enjoyed themselves in the neighbouring taverns. Suddenly homesickness came upon him. He looked around and saw a crooked birch tree ; he immediately thought of the stranger of the moor and repeated the words he had taught him. Immediately the stranger stood beside him and said :—" I have come but you have been a long time in calling and I thought you had forgotten. What do you wish of me ? "

The soldier told him his wants and the stranger turned to the birch tree and said : " Which of my children is the quickest ? " There came from the birch tree a voice saying : " I can travel as fast as a moorhen can fly." The stranger replied that that was not fast enough for his needs. A second voice said : " I can travel as fast as the wind," but the stranger

again said it was not fast enough. A third voice said: "I can travel as fast as a man's thoughts." "You are the messenger I want," said the stranger.

Turning to the soldier he told him to take off his cap and think of home. At the same time he told the messenger to take the soldier where he wanted to go and to give him a large bag of gold. The soldier at once took off his cap and immediately found himself in his old home dressed in his peasant's clothes. On the floor beside him was a bag of gold. It is said that he was not missed on parade and remained unmolested in his country home for the rest of his life.

The story is intended to indicate that there are spirits within trees and that trees are alive. It is hoped that these ideas may tend to make foresters think of trees as things other than producers of timber.

MISCELLANEOUS NOTES.

Abies in Carmarthenshire.

On the Dolau Cothi Estate, near Caio Forest, are a dozen *Abies alba* (*A. pectinata*) and *A. nobilis* spaced at irregular intervals, in a mature broadleaved wood, chiefly beech. These trees are on a northern aspect at the bottom of a sheltered valley at an elevation of 400–500 ft. above sea level. The soil is a clay loam with shale about 3 ft. deep and the geological formation is Silurian. The measurements of the best tree of each species are as follows:—

Abies alba, 110 ft. high and 6 ft. 8 in. girth at breast height.
Abies nobilis, 130 ft. high and 9 ft. 4 in. girth at breast height.

The branches of the former begin at about 6 ft. from the ground, but the first branch on the latter is about 55 ft. from the ground, and the crown only comes about 25 ft. down the stem from the top. This tree does not fall off a great deal in girth and I should say that it contains 200 cu. ft. of clean timber, but the timber of the *A. alba* would be very rough owing to the branches. Both trees have definite leaders but appear to have nearly reached their maximum height as each did not put on more than 1 ft. last year. Assuming these trees to be the same age as the beech they are nearly one hundred years old, but both have outgrown the other trees in this wood. They are in a healthy state, but a woodpecker has bored a hole in the *A. nobilis* at about 50 ft. from the ground, although this might have been started by a branch being broken off.

It is not possible to say if these species are suitable for natural regeneration as the soil conditions are unfavourable, there being nearly 6 in. of beech humus on the ground; a few *A. alba* about 15 ft. high, are growing in the open places but these might have been planted there.

Local inhabitants say that about twenty years ago the owner of this estate was offered a very good price for the *A. nobilis* by a firm of shipbuilders, who wanted it for the mast of a ship, but he refused to sell it.

L. T. Edwards.

Foresters' Meeting.

The Forest of Deer was chosen as the venue for the 1932 annual meeting of foresters in the North-Eastern Division. The meeting was organized by the District Officer and attended by the foresters from all the schemes under his charge. The party met at the forester's house at Deer on the morning of 10th August, and ideal weather conditions prevailed all day.

A 32 years' old N.S. and S.P. mixed plantation was visited first. There an animated discussion took place on the relative merits of various grades of thinning and methods of pruning the trees which will form the

final crop. The plot inspected had been saw-pruned up to a height of 7 ft., at the piece work rate of 4*s.* 6*d.* per 100 trees. This was agreed to be a fairly reasonable figure (only N.S. having been pruned), and one which might be expected to be repaid by the improvements effected.

The party then moved on to the P. 27, 28 and 29 areas, where the extremely exposed situations were commented upon. Scots pine was voted the species showing the most uniform progress, while the Sitka spruce was in some instances making remarkable growth. A 10-acre block of P. 27 N.S. was noted as being quite comparable with the Sitka spruce.

Planting and weeding methods and costs were here discussed, and the foresters were enthusiastic as to the results obtained by using a new type of planting mattock which came into use in the district during the 1932 planting season. It was generally agreed that where no rank heather crop covered the ground the new type of mattock was far superior to the general type of planting spade both as regards speed and the correct upright position of the newly inserted plant. The system of fire control lines and fire fighting appliances in use on this section also came under discussion.

The party then moved on to the section which was under the process of preparation for the P. 33 planting programme. Here a large-scale system of turf-cutting for planting was inspected. The method in vogue, cutting turf drains at 20-ft. intervals and spreading five lines of turfs from each drain was examined. The cost 10*d.* per chain piece work (each chain providing 64 turfs measuring 12 in. × 14 in.) was agreed as reasonable considering the type of land (recently felled woodland carrying a fair amount of brushwood).

The party then travelled to Lenabo, where different conditions were found to prevail. Until 1916 this was all agricultural land. Sitka spruce as a species for remarkably rapid and uniform growth has no rivals; this fact was duly noted, two plots which were planted in 1928 and 1930 respectively, with 2-year S.S. seedlings were inspected and compared with plots planted with 2 + 1 and 2 + 2 transplants. Moving on, a very successful poultry holding, run on strictly commercial lines, was inspected, and the stock thereon was greatly admired.

The day then drawing to a close, the party adjourned to an hotel in the historic village of Old Deer, where, after an excellent dinner, further discussion took place.

A. Ross.

The Morse Code in Forestry.

It sometimes happens that the forester suddenly finds he requires the services of one or two men in the squad, or perhaps the whole squad. They may be working half a mile away and up a 1 in 3 slope, hidden by mist or unseen in a plantation. In such a case if nature has endowed the forester with good lungs he need not worry. Should such not be the

case, however, mechanical means must be substituted and the following method is suggested :—

On sheets of foolscap with two carbons write the names of the men in alphabetical order. Give " Everybody " a line also. Assign to each name a letter and the Morse equivalent, keep the original copy, give the foreman one, and cut each line separately from the other carbon copy. Distribute to the relative men with instructions to get the Morse symbol fixed in the mind and to proceed immediately towards the sound of the whistle when they hear their particular symbol sounded, also to bring tools and lunches with them if the latter be not already consumed. The symbol for " Everybody " should be made known to each man. If the foregoing procedure be adopted it will result in a saving of time and prove particularly useful in times of emergency.

T. ALLAN.

SAVING TIME ON CLERICAL WORK.

This subject is one worthy of consideration in view of the fact that foresters as a rule desire to spend as much time as possible on work out of doors. Much trouble year after year could be avoided by the recording in permanent form and filing of necessary data bearing on some particular subject. An example is given below :—

Fence Requirements.

Type of fence.—Permanent rabbit and hare fence.

Rough specification.—Stobs 12 ft. apart ; 2 stobs 5 ft. long alternating with 1 at 5½ ft. with droppers between ; 2 wires, No. 8 gauge, at 16 in. and 36 in. from ground ; 1 wire, No. 10 gauge, 42 in. from ground, affixed to each 5½ ft. stob ; 42 in. mixed mesh wire netting sunk 6 in. in ground.

Timber. (All timber to be larch.)

	Per chain of fence.
Strainers 7 ft. by 6 in. diam. small end, say 10 chains apart... ...	0·1
Stays, i.e. stobs 7 ft. by 8 in. quartered, say 1½ per strainer	0·15
Stobs 5½ ft. by 7 in. quartered, average 12 yards apart	1·83
,, 5 ft. by 7 in. quartered, average 6 yards apart	3·67
Droppers 3½ ft. by 2 in. by 1 in., average 4 yards apart	5·5
Floodgates.	*Per foot of gate.*
Upright rails, 2½ ft. by 2½ in. by 1 in., at 1½ in. between each... ...	3
	Per gate.
Rails = in length to distance between strainers on either side of stream, by 4 in. by 1½ in.	2
Pole 2 ft. longer than gate, by 4 in. diam. small end	1
Gates. Bridle path, 7½ ft. Cart traffic, 9 ft.	
Rails 7½ ft. by 3½ in. by 1¼ in. Cart traffic 9 ft. by 3½ in. by 1¼ in.	3
Diagonals 5½ ft. by 3 in. by 1 in. Cart traffic 6 ft. by 3 in. by 1 in.	2
Gate ends 4 ft. by 3½ in. by 3¼ in.	1
,, 4 ft. by 2½ in. by 3¼ in.	1
Uprights 4 ft. by 3 in. by 1 in.	1
Hinge pieces 3½ ft. by 3½ in. by ⅞ in.	1
Extras.	*Per gate.*
For each gate strainer, 7 ft. by 7 in. diam. small end, to hang gate	1
For sheep dips allow extra 7 ft. stobs in place of 5 ft. or 5½ ft.	—
For uneven ground allow extra 5½ ft. stobs.	—

Metal—Galvanised.	*Per chain of fence.*
Plain wire, 10 G.	0·026 cwt.
„ 8 G.	0·08 „
Tying wire, 18 G.	0·07 lb.
Staples (*stob*), 8 G. by 1½ in.	0·28 „
„ (*dropper*), 12 G. by 1 in.	0·074 „
„ (*netting*), 12 G. by ¾ in.	0·116 „
Netting, 50-yard rolls, mixed mesh, 2 ft. by 1¼ in. and 1½ ft. by 2½ in.	0·44 roll.
Nails for floodgates, 3 in. by 8 G., per foot of gate 0·22 lb.	
„ *gates*, 2¾ in. by 9 G., per gate 0·32 lb.	

Separate tables could be constructed for each type of fence used or likely to be used. Better still would be the entering of requirements in schedule form. Suppose on a certain area the types used comprised the following :—

Permanent	rabbit fence	Abbreviation PR.
„	rabbit and hare fence	„ PRH.
„	stock fence	„ PS.
„	stock and rabbit fence	„ PSR.
„	deer and rabbit fence	„ PDR.
Temporary	rabbit fence	„ TR.
„	rabbit and hare fence	„ TRH.

Give a rough specification of each type as already shown.

Extracts in respect of wire, wire netting, strainers and stobs would read somewhat as follows :—

	PR	PRH	PS	PSR	PDR	TR	TRH	Per chain of fence.
No. 8 G. plain wire	0·08	0·08	0·20	0·12	0·20	0·08	0·08	cwts.
No. 10 G. plain wire	—	0·026	—	—	—	—	0·026	„
No. 12½ barbed wire	—	—	0·042	0·042	0·084	—	—	„
No. 18 tying wire	0·07	0·07	—	0·1	0·1	0·07	0·07	lb.
Wire netting ...	0·44	0·44	—	0·44	0·44	0·44	0·44	50-yd. rolls
Strainers, 6½ ft. by 6 in., D ...	0·1	—	—	—	—	0·1	—	Per ch. of fence
Strainers, 7 ft. by 6 in., D ...	—	0·1	0·15	0·15	—	—	0·1	„
Strainers, 10 ft. by 6 in., D ...	—	—	—	—	0·15	—	—	„
Stobs—								
5 ft. by 2½ in., D	—	—	—	—	—	7·3	—	„
5½ ft. by 2½ in., D	—	—	—	—	—	—	8·25	„
5 ft. by 7 in., quartered ...	5·5	—	—	—	—	—	—	„
5½ ft. by 7 in., quartered ...	—	5·5	9·5	9·5	—	—	—	„
6 ft. by 8 in., quartered ...	—	—	—	—	2·75	—	—	„
8½ ft. by 9 in., quartered ...	—	—	—	—	2·75	—	—	„

Suppose fence requirements were desired the procedure would be as follows :—

Determine the length in chains of each type of fence. Multiply the amounts under each column-head by the appropriate number of chains. Should there be more than one delivery point for any type the proportions relative to each would require to be calculated separately. Where lots of two or more different types of fence were to be delivered at one point instructions would be given to designate the lots by certain numbers or letters. By referring to the schedule the omission of any item is obviated and requirements are figured out with greater expedition. As the length of each type of fence is constant the slide rule or calculator may be used to advantage in finding the required amounts.

T. A.

Oak Weedings.

During oak weeding operations in Salcey Forest this season (1932), in the various planting years a small control area was left unweeded. The weedings done were carried out late in the season when the growth was very heavy, consisting mainly of tall coarse grass. In the current year's planting very little growth was noticeable in the plants in both the weeded and unweeded areas, and then only at the very end of the growing season. The plants used were small grade 1 + 2.

In one area (P. 31) there was a small growth of 2 — 3 in. noticeable in the plants, the growth in the unweeded area being the most marked. In the weeded area the plants suffered from frost damage, to some extent during the early part of this season. The plants used were small 1-year seedlings.

In another area (P. 31) there was an average growth of 9 in. noticeable in the plants, in both the weeded and unweeded areas, showing little difference in growth in either area. This area was not netted, and the rabbits nibbled off a large number of plants close to the ground, but practically all of these plants recovered, and some remarkably long shoots sprang up. The plants used were big grade 1 + 2.

In P. 30 there was a remarkable average growth of 12 in. noticeable, and particularly so in the unweeded area. In the weeded area the expense of weeding could have been dispensed with, judging by the result in the unweeded area. The plants used were big grade 2-year seedlings. By the use of strong seedlings a uniform crop had been obtained both as regards numbers and sizes of plants.

In P. 29 the best growth which averaged 6 in. was noticeable in the weeded area, the shoots of plants in the unweeded area being less prominent. In this area no weeding was carried out in the first year, and with a heavy crop of long coarse grass it was difficult to find the plants, but failures in both the weeded and unweeded areas averaged between 10 and 20 per cent. The plants used for planting were small 1-year seedlings.

It seems that by using big grade 2-year seedlings or big grade transplants, preferably 1 + 2, the area should not require more than one late weeding in the first year, except for possibly a light weeding late in the second year in cases where the undergrowth is very heavy. This late weeding in the second year when necessary, would be done mainly to prevent the fall of undergrowth on the plants which might result from snowfalls. It seems that weeding in the second year could often be done by walking down the rows of plants and just beating back undergrowth with the feet or by the use of sticks, instead of cutting back with hooks.

It has been found that the young plants have generally benefited by leaving the undergrowth as a shade until as late as possible in the season. It has also proved beneficial when weeding to leave a certain amount of undergrowth around the plants as a protection against frost in the following winter, first making sure that the heavy undergrowth will not be liable to fall over on the plants.

H. C. Dyer.

Ash Seed.

During the last few years I have had many enquiries with regard to the treatment of ash seed. I have found the following methods most successful on heavy soil. Collect the seed late in October or early November when quite ripe and liable to commence falling and spread it out on a dry floor so as to ensure its proper hardening. Leave it in this position until the following March or April. Prepare a pit suitable to take the quantity of seed collected, place a layer of good sand at the bottom of the pit, then fill in with alternate layers of seed and sand, and finally cover the whole with 3 or 4 in. of sand. If possible, the pit should be in a well-drained position to prevent it from getting waterlogged. Leave it untouched until October; if at this season it is possible to prepare beds or drills, mix the whole of the sand and seed together with an ordinary digging fork so as to part all seed properly, and make the whole easy for sowing.

The reason for sowing in October in heavy soil is to prevent the seed from germinating too early, which it is often liable to do if left in the pit until spring, and is only too often damaged by late frosts. I have found plants from autumn sowings much stronger than those from spring sowings. This method I have found most successful on heavy soil.

W. Cottenham.

Fire Notices.

From time to time the Forestry Commission have supplied different types of fire notices, which either soon perish or get torn down by the public. I would suggest that a good plainly worded enamel sheet should be used which, when erected on a good sound post, would last for years, saving much time and trouble. At present it is a case of renewing and pasting-up fresh notices annually, whereas an enamelled one would last at least twenty years. This, I am sure, would mean a big saving even if the initial cost were greater.

W. C.

Planting.

Each year as the planting season comes round one feels anxious to complete one's allotted programme. This, of course, is only natural-the land has been prepared, vermin exterminated and suitable plants available, one feels all is in order. One's planting can, however, be done too early—oak and European larch in heavy soils, for example. In the case of these species it has been found that by early planting the roots blacken and die before the growing season commences whereas plants put in in February or March commence to grow almost immediately. Far greater losses have been experienced from early planting than from planting in early spring. The least possible pruning of oak roots has proved most successful. In my opinion the best ages for oak in heavy soils are 2-year seedlings and 1 + 1 and 1 + 2 plants, and European larch 1 + 1 and 1 + 2 plants; older plants of either species have a tendency to die back and take much longer in making a good leading shoot.

W. C.

Exmoor and Quantocks.

I had the opportunity of revisiting Exmoor and the Quantocks when on holiday recently in Somerset. Unfortunately there was only time for a hurried inspection, but there was sufficient evidence of the result of my former labours to make me feel happy.

In 1920 Croydon Hill was a bare, bleak moor covered with heather, to-day it is a thriving young forest of Scots and Corsican pine. It is seven years ago since I saw it, and the other day when I motored over the hill I was simply astounded to see the dense thicket of trees, including Corsican pine 8 ft.–10 ft. high. Small areas of Jap. larch on the lower ground averaged 15 ft. high; it was very pleasing to look at. Critics may say that this height growth for conifers in 10–12 years is not so good, but do they know Exmoor and its bleakness. In P. 20 we planted 240 acres, chiefly C.P. and S.P. They simply hung fire for four or five

years, and it was rather disheartening to see them; to-day they are going ahead splendidly. It is a slow job this forestry of ours, but it is worth while in the end when good results are obtained.

The Quantocks area was even more pleasing than Exmoor, because of the much greater height growth. The range of hills consists of three coombs. We planted Douglas fir and J.L. and E.L. on the sides of the coombs and pines on the tops. The P. 21 and P. 22 Douglas fir and larches average 15 ft.–20 ft. high, and the pines (C. & S.) 8 ft.–10 ft., the plantings of later years are doing just as well.

G. W. Lowe.

Effect of Frost on Beech and Larch at Westbury.

May, 1932, was rather a bad month for frost, the worst occasions were on the 5th and 6th and the 25th and 26th. Almost all the beech which were in leaf on the 5th and 6th were frosted, while those which came into leaf later were frosted on the 25th and 26th. Plants completely covered by grass and those on clear ground did not suffer to any extent owing to their being retarded either by cold winds on the clear ground or the complete shelter when covered by grass. The plants chiefly affected seem to have been those of about 6–9 in. high, while those above this height escaped serious damage although the lower leaves were frosted. Possibly the amount of dew which collects in the grass accounts for this. No doubt the use of a larger plant of 12–18 in. would give better results as these in many places would be above the grass. The initial cost of planting would, no doubt, be a little more but this would be compensated for by a smaller percentage of failures and less weeding.

Beech planted on ground carrying a heavy growth of dogs mercury do not seem to have suffered at all. The fact that this plant holds very little water (dew) was no doubt the reason, as the beech planted among dogs mercury got away much better than those on the Downs.

D. R. Beaumont.

Supervision of Labour.

While it must be admitted with regard to labourers that there are often times when there is much to be desired it is quite as easy, if one is so disposed, to find fault with people in other walks of life. It is obvious that there are good and indifferent people in all occupations. Provided that those in charge of labour have absolute control they are in a position to correct labourers when necessary, and the method employed should meet the occasion. When things are not as they ought to be it is far better, as far as the person in control is concerned, to use the result of one's own experience and put matters right, than to hold forth about the uselessness of labourers. I am afraid in many cases that this " result of experience " is not utilized.

The quickest and best way to show people what you wish to have done is to give a demonstration and then not to leave them to their own devices, but to see that it is carried out in that way. It naturally follows that if the one issuing the orders is skilled he raises the standard of work of the labourers, also if one is practically efficient the difficulties that arise can easily be dealt with.

If criticism starts above the labourers and gradually gets down to them, an all-round improvement is the result. I do not wish to plead for excessive indulgence for the labourer, but we must all realize that the ultimate result of all our labours depends upon workmanship.

H. J. Saunders.

Destroying Voles.

Foresters have destructive vermin of several sorts to contend against, but there is probably none more to be dreaded than a plague of voles. To encourage their natural enemies is a precaution that can be taken on some areas, but where the preservation of game has to be considered it is out of the question as foxes, stoats, hawks and owls are sure to be destroyed.

The writer had once to contend against an attack of voles in an avenue of elms. The trees then were 8 in. to 9 in. in diameter. The plants were protected by a sleeve of wire netting from hares, and the grass had grown up between the netting and the trees and completely hid the vermin from their natural enemies. When it was noticed that the voles were there the netting was removed and the grass cleared away. There appeared to be a brood of 10 to 12 half-grown voles at every tree, some of the trees were completely ringed barked and others about half way round.

There happened to be some Stockholm tar and Thomas's smearoleum in stock and the trees were given a touch of one of these. The vermin disappeared during the night as mysteriously as they came.

Creosote oil or tar would probably be the means of ridding an infested area of the vermin.

R. Butler.

Seed Preparation.

If seeds which are to be coated with red lead previous to sowing, are slightly moistened with crude machine oil, it will be found that the dressing will adhere much better to them than if they had been moistened with water. An old sack or sheet moistened with the oil and the seeds shaken about in this until they have a glazed appearance and the red lead sprinkled on them and rolled about again until they are covered with the dressing is all that is necessary.

R. B.

A useful Method of Planting.

There is a method of planting which has proved a success at Ampthill Forest, first by screefing, then loosening the soil well with the pick end and following this by planting with a spade. In this way trees up to 3 ft. in height can be planted without the soil being taken out and the cost of weeding is considerably less by using larger plants. By this method work can be started in September thereby filling in what is apt to be a slack season.

J. H. Craft.

Telegraph Poles.

The financial stringency and the absolute necessity of improving the national trade balance has reopened the market for home-grown telegraph poles. Nominally the market has always been open. The Post Office has sent round invitations to tender from time to time, but the proportion of home-grown poles bought has been infinitesimal. The chief difficulty has been the stringency of the specifications and inspections and the large number of rejects which has made the trade an unprofitable one. The true significance of the present revival of the trade has been a considerable easing of the specifications.

It would be idle to deny that there are few native woods of Scots pine which can produce poles in quantity which could compete with imported poles. These imported poles are selected from large areas of close-grown natural woods in northern Europe. They are beautiful poles, round, cylindrical and straight as a die. Some of the defects of home-grown poles can be avoided in future by more careful sylvicultural management. One would imagine, however, that the deviation from the completely circular section and a more tapering form will always be a feature of home-grown trees, Britain standing, as it does, in the way of Atlantic wind currents. Whether this last feature is necessarily a defect is doubtful. The question of relative strength and durability of the home-grown pole has yet to be tested, but a lower form factor should not be a defect so far as strength is concerned, rather the reverse. A tapering tree should offer better resistance to bending and sheering strain than a completely cylindrical one of the same volume.

These, however, are the least serious defects in comparison with the imported pole. Far more serious are the crooked tops and large dead knots so frequent in our neglected woods. There may be hidden deficiencies too, in the matter of strength. It is not likely that a lot of our wide-ringed pine is going to compare favourably with the close-ringed imported wood, though there is no reason why the moderate ringed material should not. So far as immediate supplies are concerned we must take the timber as we find it, and make the best of it by careful preparation. If, however, the market is to be retained as it should be regard to these points must be had in our treatment of our pole woods.

There are three categories of poles in the Post Office specifications

with carefully graduated sizes. Without going into details of the specifications, light poles vary from 16 ft. to 50 ft. in length; from 5 in. to 7 in. top diameter, and from 6 in. to 9½ in. diameter 5 ft. from the butt. Medium poles run from 24 ft. to 65 ft. in length; from 5½ in. to 9 in. top diameter, and from 8 in. to 14 in., 5 ft. from butt. Stouts run from 28 ft. to 65 ft. in length, and from 7½ in. to 10½ in. top diameter, with a diameter of from 10½ in. to 16¼ in. at 5 ft.

Light poles constitute the main demand. This year they represent more than two-thirds of the Post Office requirements. Poles of the smaller sizes should be readily obtainable from woods from forty years of age and upwards in large quantities, provided the woods have been properly tended. This is a market which is likely to be of the utmost importance to the Commission, and requires to be kept in mind from the start. It would be a mistake to adopt heavy thinnings in order to attain it early. Coarse grained timber will result, and be likely to get home-grown poles into disrepute.

Pruning from an early age onwards seems to be an essential preparation in most English localities, at least up to a height of 36 ft. Crookedness, which disqualifies so many poles, in the New Forest at any rate, is largely due to beetle damage. Another disqualifying feature frequently met with is flat-sidedness due to some obscure cause, possibly Peridermium. Whatever the cause it is abundantly clear that we can only get a high proportion of poles by watching and maintaining the general health of our plantations.

A matter of more immediate importance is the question of the preparation of poles. Many poles are rejected in practice which with a little more trouble in preparation would have been passed. The poles have to be peeled, which may cost anything from 1*d.* to 3*d.* per foot. This is a considerable item, and obviously a lot of money can be thrown away if the poles have not been well selected beforehand. They should be selected standing first, but subjected to further inspection before money is expended in dragging them to the peeling dump.

The method of having a dump at which the poles are peeled and finally submitted to inspection has been found best in the New Forest. Other districts may adopt other methods. Skids previously peeled (beetle protection) are laid out first and the twice selected poles are drawn across them. Even then if an obviously bad pole has got through it is discarded.

Last year various methods of peeling were tried. In the New Forest the draw knife was found most satisfactory. An old spade sharpened was also used in some cases, and proved a quicker tool in removing the actual bark, but was not so satisfactory as the draw knife in dealing with knots and excrescences. This year we are using a form of barking spud, about 2½ in. wide, slightly curved at its edge. It is used with a handle about 3 ft. long. This is worked at an angle of about 45 degrees with the main axis of the stem, the curve giving the right position for the blade to peel off the bark rapidly. This promises to be a quicker tool and quite effective in dealing with knots and excrescences; of course, it must be

kept well sharpened. This, indeed, is the secret of successful work with any tool, and as will be seen this work is not merely a matter of taking off the bark but removing some of the worst defects of the stem.

The poles are not taken straight to the creosoting tank as they leave the forest, but are first turned in a special turning machine. A brief description of this machine may explain the importance of this trimming work. The essential cutting element of these machines is a series of rapidly rotating knives on two long pivoted arms arranged so that the end with the rotating knives rests on the pole which is being turned. The poles rest between two rotating toothed wheels, which are set at an angle with the main axis of the stem. These wheels not only rotate the pole but feed it forward screw fashion under the knives. The knife arms rise and fall with inequalities of the stem. If any excrescences are very abrupt the knives are thrown up suddenly and refuse them, leaving rough patches on the poles with the inequalities exaggerated. Poles such as these have to be trimmed at the works at very heavy additional expense. It often happens that on account of some small defect of this kind a perfectly good pole is rejected. It is far more important that excrescenses should be removed than that the under bark should be taken clean away. Many of the imported poles come in quite brown with the underbark still on, but all knots and excrescences are invariably well trimmed.

In the New Forest peeling has been carried as far up the stem as was likely to prove useful—a matter left to the discretion of the peelers. The poles are not topped until the actual inspection, and then cut up to the height accepted by the Inspector. Often in that way a pole not acceptable as a 36 ft. for instance, is passed as a 30 ft., or in some cases it may be that a pole peeled as a 30 ft. can be accepted as a 32 or 34 ft. Two men crosscutting and two others turning the poles for inspection can keep pace with the Inspector. The Inspector numbers and stamps the poles as accepted, and enters them with the detailed measurements in his book.

D. W. YOUNG.

PLOUGHING AND PLANTING DORSET HEATHS.

During 1931, using a Caterpillar 20, with two deep-trac double furrow ploughs and one single furrow, 172 acres were ploughed.

Three methods of ploughing were tried. By the first method two double furrows were thrown together forming a ridge approximately 4 ft. 6 in. wide at base, which gave a planting distance of 4 ft. 6 in., plants being inserted at or near bottom of the ridges. The second method was full ploughing, *i.e.*, the same as for agricultural purposes; in this case plants were put in between the small ridges. Strip ploughing was the third method. Single furrows were turned up at a distance of 4 ft. 6 in., plants being inserted on top of the furrows as for mound planting. This was done on dry land.

It is difficult to decide at present which method will prove most satisfactory as at present all plants have a healthy appearance and have not been checked like plants on unploughed land. Drainage must be considered. Whilst the ridge and strip appear to be more satisfactory, full ploughing gives more aeration, but not quite the same amount of drainage. I might add ploughing in no way lessens the amount of draining to be carried out.

P. 32 methods have been slightly different. Full and strip, each to suit the different type of soil—full ploughing on dry and strip on wet. In each case furrows run to lower ground. The type of vegetation should influence the choice. The strip method is very satisfactory on wet and boggy land; a 10-in. deep furrow being thrown up provides a good mound, at the same time leaving a trench for drainage.

Although a certain amount of drainage is necessary on parts of the drier type, the full ploughing may be done to act still better by the operator cutting in at say every 30 or 40 ft. Drains are then made at little cost. Full ploughing has much in its favour but if a double furrow plough be used on wet land there is difficulty in keeping the implement down; a lot of ground is missed and the tracs are continually skidding.

There is not much difference in the cost of the two methods although strip ploughing would be far cheaper if something could be done to prevent the upturned furrows falling back into their original position or being thrown out too far.

Shelter and size of plants should be considered. In the ridge, shelter is provided if the ridges are made to run at right angles to the prevailing wind and large plants may be used. In full ploughing small plants receive shelter for the first year or two; good strong 2-year seedlings will probably be most suitable and in the case of strip ploughing also because the plants are exposed in every way. I think eventually different methods of ploughing will be adopted to suit the various soils.

S. W. Colwill.

Uses of Caterpillar Tractor.

During ploughing operations in advance for P. 34 I had to deal with a quantity of scrub Scots pine scattered over an area of about 8 acres, varying in age from 5 to 50 years, but very few trees of the latter age. As it was worthless stuff it was decided to haul it out using the tractor after cutting some of the largest roots. The equipment for this work was a 66-ft. length of half-inch flexible steel hawser looped both ends with thimbles spliced in loops, a length of strong chain, about 15 ft., and a pulley where the roots of large trees had to be removed. The work throughout was very simple and not costly. Operations included hauling trees off the area, burning brushwood and smaller trees and the whole operation cost approximately £2 per acre. The work done will to a large extent do away with *Hylobius* as only some of the smallest roots

are left in the ground. Root growth was interesting; in some cases tap roots had penetrated to a depth of 4 ft., then a check when secondary roots commenced near surface. Others had little or no tap root but all surface roots with clusters of small roots penetrating to a depth of 18 in.

S. W. C.

Oak and Larch Mixture.

An area of 10 acres was planted in 1919 with alternate rows of oak and larch, $4\frac{1}{2} \times 4\frac{1}{2}$ ft. The trees were weeded for 6 or 7 years and then it was decided to let the lot go ahead, and fight it out.

Last summer it was thought that something would have to be done if the oaks were to be saved, and a heavy thinning of the larch was undertaken. In most cases it meant taking out every other larch but that, of course, depended on the height of these trees and the condition of the oaks affected. Owing to the larch growing so much faster than the oak, and the very strong growth of bracken, brambles and coppice, the oaks were drawn up, and in some cases were not strong enough to stand up after the larch had been removed. It would appear that if the oak had been cleaned 2 or 3 years ago, and the branches of the larch cut back the oaks would have been stronger.

This area seems to point to the fact that a mistake was made by planting the larch and oak in the same year, as in an adjoining area of the same mixture the larch was planted 2 years after the oak which seems the better method.

In the above method it is most essential to save every oak, as when all the larch are removed and failures occur in the oaks, it may mean that the crop is rather thin. A much better method would be to plant 75 per cent. oak and 25 per cent. larch, pure oak in one row and oak and larch alternately in the next. In this way the oak crop would be assured and the thinning would be made much easier.

W. L. Christie.

Lining-Out.

Part of the lining-out programme for Tintern Nurseries for 1932 included bedding-out a quantity of 1-year Japanese larch, which were found to be very small from $\frac{1}{2}$ to 1 in. in height and contained a large number of dead ones and some badly damaged by cockchafer. The men were employed bedding-out these at 2*s.* 6*d.* per 1,000, the price to include sorting and destroying all "dud" plants. When about two-thirds of the plants had been dealt with the men complained they could not earn their wages at the price given and on checking the number bedded-out this was found to be correct. Instead of altering the rate per 1,000 or putting someone to grade the plants ready, a quicker method of bedding-out was adopted. As the bed had been previously dug a

V-shaped nick was made, the plants inserted and firmed and, instead of digging the soil up to the plants after each row had been planted it was just levelled off with the spade and the nick made for the next row. By this method the plants could have been bedded-out for about 1*s.* 6*d.* per 1,000, but the price of 2*s.* 6*d.* was allowed to stand to make up the deficiency in the men's wages.

In August the average height of the plants bedded-out in this way was 10 in. while the average height of those bedded-out under the usual method (i.e. digging the soil over after each row had been planted) was 3 in. and the percentage of deaths in these was about twice that of those bedded-out by the quicker method. The soil was of a light nature and the difference in height growth may be accounted for by the fact that not being dug over twice the soil remained firmer and held its moisture longer.

From the point of view of "economy" and where the soil is suitable the quicker method of bedding-out 1-year seedlings is worth consideration, although in a heavy soil or with large 2-year seedlings it may be detrimental to the root system, which however, has not suffered in the case of the Japanese larch mentioned above.

S. Hyett.

Fencing Economy.

On new acquisitions one often finds the fences and gates in a very bad state, sometimes there are no gates at all, and to purchase new ones for each place means a good deal of expense. Where small larch thinnings about 4 in. to 6 in. in diameter at the butt are available the expense of purchasing gates can be dispensed with by making what are called "heavers." By using larch thinnings sawn up into the required lengths and sawn through the centre by the circular saw one can make a good substitute for gates using three pieces for uprights, one at each end and one in the centre, and two stays; nail the stays from the bottom rail to the centre of the top rail to join up with the upright in the centre. Four or five rails can be used according to the height required. The top and bottom rails should extend to the extreme outside of the posts. On to one of these has been fastened a piece of fencing wire to form a loop for the rails to fit in and on the other post are fitted two blocks of wood, one about 4 in. higher than the other, for the top rail to rest on. When this end is lifted the wire on the other post still holds the heaver in position and it can be opened as easily as a gate. The cost of making ten of these excluding the cost of posts is as follows:—

	£	*s.*	*d.*
24 cu. ft. larch thinnings at 9*d.* per cu. ft.	0	18	0
Hauling and converting 24 cu. ft. at 6*d.*	0	12	0
Labour in making and nails	2	10	8
	£4	0	8

Had ten gates been bought ready made the cost would have been approximately 26*s.* each, or £13 without gate irons, so that a very considerable saving is effected. A. E. WALKER.

PLANTING VERSUS SOWING.

In 1929 about 22 acres of 1-year oak seedlings were planted, the spacing being 4 ft. × 2 ft. and at the same time about 32 acres of acorns were sown in drills 4 ft. apart, and it is interesting to note the difference in the growth of these plants. The seedlings were about 6 in. in height when planted and taking measurements of a thousand plants now, the average height growth is 10 in., that is 4 in. growth in 3 years; the cost of planting the seedlings was £3 5*s.* 0*d.* per acre. Measuring the same number of plants on the sown area the average height growth here is 16 in. and a much better type of plant; the cost of sowing was about £4 5*s.* 0*d.* per acre. Taking into consideration the cost of raising the seedlings in the nursery and transport, it is much cheaper to sow the acorns in the forest if the conditions are favourable and no damage likely to occur from mice or birds.

From the sowing of 1929 about 800,000 plants have been lifted for planting elsewhere, without disturbing those left for the final crop. Plants raised from seed on the area where they are to remain have a decided advantage over planted seedlings, as the plants are not disturbed and the root system is not checked in any way. By sowing direct we get a more vigorous type of plant than by planting seedlings, and every endeavour should be made when there is a good crop of acorns to collect as many as possible and when conditions are favourable to sow direct in the woods, in preference to planting 1-year seedlings.

A. E. W.

BRUSHING.

This may be an unfamiliar operation to many foresters, yet, with the advancing ages of newly established woods, it may be worthy of consideration. The operation should be applied to conifer woods in the thicket stage, and be restricted to the removal only of dead branches to a height of 7 ft. The type of tools used will depend on the conditions in the plantations, *e.g.* a stout pole will serve the purpose in pure larch. Where briars, honeysuckle and miscellaneous growth are found interfering with the crop a slasher will be needed but in the case of spruce or Douglas fir a hacker will be more serviceable.

The advantages of brushing may be summarized as follows:—

(1) It is a mistake to assume that plantations need no attention between final weedings and the first thinning; brushing as an intermediate operation should be practised. This gives an opportunity to remove anything detrimental to the crop, releasing it 3 to 5 years prior to thinning.

(2) Easier access into the woods to inspect and decide on their future treatment.

(3) A good circulation of air is introduced, so that fungi are less liable to thrive and humidity is reduced.

(4) Danger from wind-throw is lessened and the way prepared for early thinning.

(5) Danger from fire is somewhat reduced, at least a ground fire has no direct contact with dead and dry branches.

(6) The marking of thinnings and removal of produce are facilitated while the boles present a more marketable appearance.

(7) It is worth noticing that there is an improvement in the girth of trees brushed (after a period of a few years) as compared with similar trees unbrushed.

(8) A point of financial interest is that the cutting rates for thinning are reduced and the saving involved balances the expenditure on brushing.

The cost of brushing varies according to species, planting distance and the amount of miscellaneous material to be removed during the operation, but the following can be accepted as average rates per acre :— spruce, 32*s.*; Douglas fir, 30*s.*; pine, 28*s.*; larch, 23*s.*

I. ADAMS.

CONIFER THINNINGS.

Conifer thinning is one of the forester's important jobs and will become more so as time goes on. It must be properly dealt with from the start for by so doing one can train and preserve a maximum number of good healthy trees for the final crop. Marking trees before thinning should be done by the forester in charge as far as possible ; it is a job that requires a lot of time and consideration, to avoid mistakes which are difficult to rectify. It is therefore a good plan to get as much marking done as possible before the men start cutting. Cutting, grading and extraction can be carried out with unskilled labour. It is difficult here to say when, or at what age, a plantation will require thinning. As this will depend on the species, spacing and usually light demanders such as the larches will require first attention.

The following particulars may be of interest and perhaps exceptional. In C. 56 Tintern Forest a first thinning was made in 8 acres of Japanese larch P. 17 and the yield was approximately 2,000 poles 1½ in. to 3½ in. diameter weighing 14 tons 3 cwt. 3 qrs.; these sold at 27*s.* 6*d.* per ton f.o.r. brought in £19 9*s.* 6*d.* The costs of cutting and extraction to the rides were £4 5*s.* 1*d.*, resulting in a total net profit of £10 1*s.* 8*d.*, or £1 5*s.* 2*d.* per acre. A second thinning will be made shortly the suppressed trees being taken out and the canopy broken up a little with the object of favouring the best trees and having them as evenly spaced as possible.

Scots pine, Douglas fir and spruces will follow in turn according to conditions. Scots pine thinnings under pitwood sizes are of little value and should be cleared away as soon as possible from a protection point of view as they form a favourable breeding place for bark beetles. Douglas fir must not be allowed to get drawn up too much otherwise they may suffer wind damage after thinning.

Probably some plantations have been neglected in the past owing to lack of markets for the particular class of produce to be taken out. On the other hand some have suffered from non-silvicultural thinnings, i.e. taking out of poles for supplying orders for special dimensions only. The forester who has to take on the job will have a difficult task when marking future thinnings of such woods. He will find an irregular crop, that certain trees wanted have disappeared and others, perhaps a group of three or four standing close together, need separating. The problem then arises which to take and which to leave, sometimes one would like to take two but dare not on account of opening out the canopy too much and it will be difficult to obtain an even stocked area of good trees. Of course the obvious thing to do is not to allow plantations to get in this state. The safest rule is thin lightly and often irrespective of sales, if possible.

T. Lewis.

The Timber Feller.

Most foresters and foremen have a good knowledge of the timber feller or woodcutter as he is sometimes called, but should there be any who do not, the following may be of some interest. The woodcutter of the pre-war sort is one of the most useful men in the forest. He is a good worker having been trained in a hard school as woodcutting is very laborious. He knows his job from the cutting of rods (of which there are many kinds) to timber felling and is a good judge of most produce. For fencing material, cleft oak posts, etc., scrub clearing, cleaning or any job where edge tools are required he beats the general worker. He takes a pride in his tools and knows how to grind and sharpen them. His job at times is very difficult and dangerous but he seldom blows his own trumpet and is content with a fair deal. What I have tried to convey to the reader is the value of the woodcutter, which I am afraid is sometimes under-estimated.

J. Roberts.

Wire Strainer.

A useful wire strainer can be made from a piece of wood 2 ft. long and 4 in. diameter, yew is the best but any hard wood will do; try to get a piece with a knot at each end and shave it round as it will work easier. Bore a 1-in. hole, 3 in. from each end and get two iron rods about a foot long and $\frac{1}{3}$-in. diameter to fit the holes. The way to use the strainer is to bore a hole in the straining post, put in a gate hook, then put the bar

against the hook, twist the wire around the centre of the strainer fixing it against the post and bar and pulling it tight with the iron rods. It is not necessary to cut the wire at each pull. J. R.

Fire Tracing.

This operation requires every precaution to ensure safety especially on rides through young plantations. To those who have experienced difficulty the method explained below will I am sure be of great assistance and, if properly executed, should give no cause for anxiety during operations.

First, clean a distance of 6 ft. to 8 ft. from the first line of trees on both sides of the ride. The trimmings should be thrown into the middle but not in heaps, if strewn about will prevent a blaze and keep down the sparks which are bound to rise when burning. Get one dozen corrugated zinc sheets 6 ft. in length (which need not be new); two iron straps 3 ft. 6 in. long and two ½-in. bolts will be required for each sheet, and fixed 1 ft. 6 in. from either end. The straps should be cranked at one end forming a handle and pointed at the other so that they can be forced into the ground thereby holding the sheet in a firm upright position. Place the sheets six each side of the line of fire one on the end of the other, allowing a lap of 2 in. for each section. As the fire progresses so the rear sheets are brought forward. Where the ground is uneven watch should be kept for fire that creeps under the sheets; Douglas fir branches will be found effective for dealing with this. Choose a calm day and there will be little danger of fire getting out of control. Rides can be prepared before actual tracing is commenced. By detaching the straps and bolts the sheets could be used for other purposes when not required for tracing.

D. C. P. Wight.

Bedded-out Plants.

The advantage of bedding-out is that you get a larger number of plants per 100 sq. yds. and also a lower cost per 1,000 for transplanting, but unless plants (especially in the case of larches) are removed the following year they suffer from overcrowding, the result being long lanky plants with a root system insufficient to carry the plant when planted out and also a very large percentage of suppressed plants.

The method would appear to be good if plants are removed the following year, otherwise it is much safer and cheaper in the long run to revert to lining-out.

W. J. Humphries.

Cost of Planting.

There is little doubt that the cost of establishing plantations in many instances can be considerably reduced if more attention is paid to the selection of plants and more care taken in planting. Frequently plants of inferior quality are used, and it would appear better in some cases to delay planting for a year rather than use unsuitable plants. As regards planting this is not always done as well as it might be owing to the effort made to show a low cost per unit figure for Progress Reports, the result in many cases being a heavy percentage of deaths, much beating-up and an extra year or two of weeding.

The following small scale operations may be of interest as showing the advantage of using good plants and doing good planting:—

P. 31.—Three acres were planted with Douglas fir spaced 5 ft. × 5 ft. the plants cost 20*s.* per 1,000. The area was spade-planted in March with 1 + 2 selected transplants, average height 20 in., and since that date deaths have been less than 1 per cent., while weeding costs have amounted to 11*s.* 10*d.* per acre (1931, 3*s.* 10*d.*; 1932, 8*s.*). As the average height of the plants is now about 3 ft. 6 in. it is fairly safe to assume that no more weeding will be required; therefore the total cost of establishing the crop is £2 6*s.* 8*d.* per acre (planting 34*s.* 10*d.*, weeding 11*s.* 10*d.*).

P. 32.—An area of 1½ acres was planted with Japanese larch 5 ft. × 5 ft., plants 18*s.* per 1,000. The ground was spade-planted in March with 1 + 1 + 1 plants, average height 15 in. There has only been one death and weeding costs for 1932 amounted to 2*s.* 8*d.* per acre. The average height of the plants is now 3 ft. and as no more weeding will be required the cost of establishment has been 34*s.* per acre (planting 31*s.* 4*d.*, weeding 2*s.* 8*d.*).

W. J. H.

Measuring felled Timber.

In the hope of this being of some assistance to readers, I will endeavour to explain the subject in as helpful and simple a way as possible. In the first place it may be well to mention the necessary equipment. This consists of a small book ruled with horizontal lines for entering measurements, spacing being left wide enough for subdividing if required. Two new, or little used quarter-girth tapes are necessary, and a measuring wooden rod 5 ft. long with four planed sides, being clearly and exactly marked off in 1-ft. lengths on one side. An implement called a sword—home constructed by means of a strong piece of wire 12 in. to 15 in. long bent somewhat to the shape of the logs, with a small hook at the top bent at an angle of approximately 45°, which is inserted firmly into a handle 8 in. long. Two scribes are essential, one blade, which must cut well, being of curved or oval type to number the butt ends, the other for marking off measurements can be of any ordinary type. A pot of white or bright coloured paint completes the necessary outfit. On arrival at the work, the forester responsible does the booking,

and numbering on the timber butts. His assistants (usually two) measure the logs and quarter-girth lengths. First enter in the book in column 1, date of month and year, compartment number, name of wood and woodcutter, also species of timber for measurement. In column 2 the number of the tree is written, which must correspond with the number scribed on each butt.

I should mention here that on commencing work, the first log may be found to be below 9 in. quarter-girth. This is classed as pitwood, and can be entered separately near the end of the book, scribe numbered, and painted with a 2-in. round mark for future identification. From general observation ascertain whether the bole is of uniform growth from the butt to its top end; if so, this can be measured off straight away, which is usually the case in taking measurements of spruce, larch, and sometimes Scots pine. Set the full length down in column 3. In measuring oak and other hardwoods of 80 to 100 years of age, the size is by no means uniform. Take for example a log which may be of regular size for 12 ft., and then large branches may have been cut off reducing its size for a 5 ft. portion. These are called stops, and each is measured separately, and is indicated with the scribe by an arrow-shaped mark. Set down as previously the length and quarter-girth of the first 12 ft., taking second or even third measurements giving their respective lengths and girths, similarly placing them in the same vertical column directly underneath other log measurements. The aggregate of the two measurements referred to in Hoppus Measurement Tables gives the total cu. ft. over bark which insert in column 4. T. R. MORGAN.

A NURSERY INCINERATOR.

The following particulars of an incinerator built at Fairoaks Nursery, may be of interest. The chief problem to be dealt with in this nursery, was the onion-rooted variety of couch grass, which formed dense mats among the roots of the trees.

This weed had been forked out of the earth to a certain extent, but was then left in piles or ridges along the paths. These were forked over during the last two years, and the weeds have since been carted out into the adjacent wood, where at the end of September there was quite a fair representation on a small scale of a mine refuse tip, containing some 100 or 150 tons of earth and weeds. As this dump was assuming somewhat alarming proportions and contained a large amount of the best top soil of the nursery, it was forked over, and quicklime mixed in with the earth, the weeds being destroyed in the incinerator. The construction of this was very simple, and cost in all about £4.

First a stone hearth some 10 ft. in diameter was made from flat stones collected locally in the wood, and on this a circular dry stone wall 2 ft. thick at the base and 4 ft. 6 in. in diameter inside the circle was erected to a height of 18 in., four gaps 18 in. wide being left, equally spaced round the circumference. On the top of this a number of old cart axles about

4 ft. to 5 ft. 6 in. long obtained from a local blacksmith for 30*s*. were arranged as fire bars. They were first spaced at 4 in. apart, but this proved too wide and they were closed up to 2 in. The stone wall was then carried up to a height of 3 ft. 6 in., and was topped by a turf wall to 4 ft. 6 in. We would have used stone all the way up if it had been available, while bricks would have been better still. A small gap about 9 in. × 12 in. was left above the fire bars on one side, to permit lighting and stirring the fire, which is closed when not in use by a flat scrap iron plate, as are also two or three of the bottom openings.

When the incinerator is burning, the draught is regulated by the amount of openings under the fire bars, the holes facing the wind being left open, and the others closed. As the hearth becomes filled with burnt rubbish, it is scraped and the ashes taken out and immediately distributed on the fallow ground in the nursery. If this is not possible, the ashes should be stored in sacks under dry conditions. The incinerator actually described had to be erected outside the nursery at the end, but when the present dump has been burnt over, it is proposed to move and re-erect it in the middle of the nursery to save time and labour in wheeling rubbish. It is useful to have a small drying ground adjoining the incinerator to give wet weeds a chance to dry out, but it has been found that the stuff will burn under almost any conditions always provided that heating is started with a good wood fire. The expenditure is so trifling, that I think it would pay to have several of these destructors in larger nurseries, allowing say one for each ten acres of nursery. The cost would be saved very quickly in time spent wheeling weeds about in barrows.

A. H. POPERT.

A NEW WOOD PRESERVATIVE.

An account is given in the *Indian Forester* (April, 1932) of a new wood preservative treatment, called the "Falkamesam" process, evolved by Popham and Kamesam of the Wood Preservative Section of the Forest Research Institute, Dehra Dun. It is a pressure process using an arsenical preparation, which it is claimed is not subject to the usual drawback of arsenical preservatives—namely that they are easily washed out of the timber if exposed to the weather; a further advantage claimed is that the process costs about one-sixth of the creosote treatment, and about one-fourth of the creosote-fuel oil treatment.

A comparison of this new process with others which also use arsenic was made to ascertain how much arsenic was washed out of test pieces and the Falkamesam process gave a 2 per cent. loss while the others showed a loss of 37 to 38 per cent. Field tests for durability underground are being made, but the authors are confident from past experience with other metallic salts, that the results will be satisfactory it is also pointed out that a water-soluble salt will perhaps stand a better chance of penetrating into the more refractory timbers than oils.

R. G. BROADWOOD.

Planting of Seedlings.

In Journal No. 11, Mr. A. P. Long gave us some interesting material on the planting of spruce seedlings. The experiments carried out on this area rather corroborate Mr. Long's statements. In the following note some details are given of three plots of 2-year Sitka spruce seedlings and one of 2 + 1 Sitka spruce transplants, planted on mounds. In all cases the type of ground is peaty with very little mineral soil, the herbage is of heather, scirpus, molinia and bog myrtle.

The ground was drained and mounded in May, 1931, and planted in May, 1932 (the 2 + 1 being planted in April, 1932). In the case of the seedlings the dibble method was used and the Mansfield spade for the 2 + 1 plants. The seedlings ranged from 3 in. to 8 in. and were planted during a cold, dry spell of east wind.

Plot 1.—In this plot the seedlings were planted just as we received them from the nursery, i.e. small and large as they came out of the planting bag. At the beginning of January, 1933, there was a death rate of 40 per cent., chiefly among the seedlings under 5 in. The living plants had an average growth of $\frac{3}{4}$ in. for the season.

Plot 2.—Selected seedlings from the same lot as No. 1 were used. These were chosen for strength of growth and strong long roots. In January, 1933, they had a death rate of 15 per cent. and the living plants had an average growth of $1\frac{1}{4}$ in. for the season.

Plot 3.—Adjoining Plots 1 and 2 is the one of 2 + 1 Sitka spruce. During the cold dry spell already mentioned, we had some hard frost in the mornings. This caused frost lift in this plot, the plants were firmed immediately after but still a few mounds were affected for the second time by frost. To this cause the death of 5 per cent. of the plants in the plot may be attributed. The average growth was 3 in. and the maximum 5 in.

Plot 4.—On an area adjoining Plot 3 I tried the 2-year seedlings on mounds, in which steps were cut to shelter the plant from the prevailing wind. At first I thought this method was going to be successful. After the dry spell the plants turned red in colour and both large and small died to the extent of about 50 per cent.

Summary.—In Plot 1 the small plants, owing to the roots being too near the surface, suffered from the drought and frost. In No. 4 both large and small suffered because the cutting of steps from the mound did not allow for deep planting. In No. 2 the plant roots were well down in the mound and were not injured by drought or frost lift. In many cases in Plot 3 the spade went through the mound, and made a hole in the ground underneath, the trouble in this plot was frost lift. If holes with dibbles were made and the plant threaded through as recommended in Mr. Long's article frost lift might be avoided.

J. Gordon.

Early Planting Methods.

The following observations, dated 1789, are interesting when compared with present day practice. They show that even at this early date there was a tendency to raise plants out of wet pits on to dry mounds where they would be clear of the surrounding vegetation. The original notes and the contract to which they refer are in the possession of Mr. MacLaren of Douglas, Lanarkshire, who very kindly put them at my disposal. In 1780 Mr. White contracted to plant one thousand acres at Douglas at the rate of 150 acres per annum, and to maintain the plantations for four years after planting.

"Mr. White, after viewing attentively the plantations at Douglas Castle, is of the opinion that one great cause of the Gray Woods not succeeding better is owing to the water lodging in the small holes made for the reception of the trees, and which has not only made it very difficult to plant them from the water spouting up in the faces of the workmen when they attempted to tread upon the plant with the foot, but after they were planted the long grass, by closing immediately about the tree, keeps it constantly wet so that they were liable to be cut by the frosts (in spring and early summer) freezing up the moisture that hung around the new formed tender shoot which has cut them off for some years in succession.

"To remedy both which misfortunes in all the succeeding work Mr. White proposes instead of the small holes above mentioned, to dig pits 18 in. diameter, first paring off the sod to the depth of 2 or 3 in. and, after taking out the earth to the usual depth, to bury the sod in to the bottom of the pit laying the grass side undermost, and after that is done, instead of letting the pit remain open to hold water, the soil to be returned into the pit so as to completely fill up the same, making a small raisement of earth above the common surface of the ground, upon which the tree when planted will stand dry, and by burying the old sod it will enjoy an area of 9 in. all round it for some years before the long grass will grow on the clean soil dug out of the bottom of the pit, and will admit a wholesome air about the plant which will keep it dry and prevent the frost from cutting it till it gets out of the reach of the long grass. For this extra labour of digging and planting Mr. White does not mean that Mr. Douglas shall be at any additional expense, only that instead of planting at the present distance which is 3 ft. he proposes planting the trees at 4½ ft. from each other, which he conceives will in this method of planting be quite thick enough as each tree will only have 2 ft. 3 in. to extend its branches on each side before it meets its neighbour . . ."

It is not clear where Mr. White intended to get the extra soil for the "small raisement of earth," presumably by borrowing from between the pits. The practice of increasing the planting distance to keep down costs is frequently met to-day.

J. Maxwell Macdonald.

Rhabdocline Pseudotsugæ.

There has been appearing in German literature a number of references to this fungus disease of Douglas fir. Apparently in Germany all forms of Douglas fir (blue, grey and green) are attacked and prohibition of introduction of any form has been advocated.

So far I have seen only one poor specimen of what was called green Douglas fir attacked. It was brought from the east coast of England and so poor was the growth that there was difficulty in distinguishing whether or not the tree was a green Douglas fir or a form intermediate between green and blue. The fact that the tree grew in an experimental plot planted as green Douglas fir was more convincing than the specimen or its bearer. There is a possibility that the fungus does attack green Douglas fir in England.

In S.W. division I have examined several plantations of blue Douglas fir attacked by the disease and in these the occasional green (or a long-leaved green form) stood out unaffected and healthy. At Glentress plants of green Douglas fir grew with their branches intertwined among diseased branches of blue Douglas fir and remained unharmed. The blue forms have been cut out. Intermediate forms have been picked out by the disease even when solitary among plants of the green form. How long this immunity will continue it is difficult to say. The disease is a dangerous one causing defoliation of all shoots affected.

The symptoms are most evident in spring. They appear first as a browning of the needles of the past year and it is not long before the shoots become bare. On examination the epidermis of an affected needle will be seen to be raised by an elongated pustule. So far the remedy has been to cut out affected trees. J. M. MURRAY.

PLANTING SPRUCES ON GRASS LANDS.

Certain types of grass-covered areas are difficult to deal with on account of checking the growth and late frost damage. In particular *Agrostis canine* sites may suffer greatly in this way. It would appear that the competition for water and the thick layer of dead grass tend to cause the check. The unhealthy conditions thus produced in the plants and the excessive radiation from the grass stems (a superficial area much greater than that of the ground on which they grow) tend to produce the frost damage. Weeding can be troublesome and costly where these conditions obtain. In course of time plants get away from the bad conditions but checks of this sort are disheartening, and particularly so where they occur on good land. Three methods of dealing with this problem suggest themselves.

The first is limited in its application to those areas on which the plough can be used. By means of a tractor-drawn plough, if it is possible to use it, a double furrow may be turned over. The plant is put in a slit made at right angles to the side of the inner furrow. It is necessary to

make sure that there is no gap between the bottom of the turf and the soil. It is seldom in very old turf that horse-drawn ploughs will be so satisfactory as those drawn by tractor.

The second method is to use turfs cast either from the side of the planting site or from special "drains" cut to produce them. This is the ordinary turf-planting method. The defects have been found to be sometimes a difficulty in casting a turf from soil and sometimes a risk from drought; some grasses grow through the turfs very quickly.

The third method is a modified pit-turf planting. In this case a turf 12 in. to 15 in. square is turned upside down in the hole from which it was taken. The method has been found to be successful in reducing check and frost damage. The plants remain a good colour, grow quickly and soon get away from the weed growth which only spreads in slowly.

Conditions of working and experience of the locality must determine which type of preparation is used.

J. M. M.

Blairadam Forest.

There came to my hands some time ago a book entitled "Account of the Blairadam Estate." The book was written in 1834 by Commissioner Adam and it gives the history of the estate from 1733 till that date. The Commissioner drew up at the same time a working plan for the woods and embodied in it details of his forestry experiences. The book is of special interest as Blairadam now forms one of the forests in the South-Western Division of Scotland and, despite the havoc consequent on the decay of family fortunes and the long continued unrestricted operations of timber merchants, many of the projects carried through a century ago can still be followed.

Only a point of general interest will be mentioned here. In a small wood known as Piery's Burn which was planted in 1774–75 there remained in 1834 a part which had not been successful. Instructions were given that the area should be replanted and that the factors which impeded growth, namely, strong heather, excess water and a mossy surface, should be removed. Draining was mentioned specially and later was carried out intensively.

So far as it is possible to ascertain by examination and by the conditions in an adjoining undrained section of the ground the vegetation had been dominated by *Calluna* with much *Scirpus caespitosus*. Similar sites are found to be difficult to afforest to-day. No contour draining was done and while the drains were close (irregular, 9 ft. to 15 ft. apart) and deep they would take a long time to be effective. The plants were set in pits made at the time of planting, and while this method was successful in most cases it was definitely unsuccessful here. There is no evidence to-day that trees had been grown on this ground.

When the land was required by the Commission the drains remained and the ground was moderately dry. What there was of excess water

was partly due to occasional blocks and partly to a general silting in the bottoms of drains. A slight cleaning was sufficient to produce drier conditions. There was a rank growth of heather over the whole area, but scirpus had mainly disappeared, sphagnum and mosses were beginning to develop in places.

The method of planting adopted in 1927 was similar in many respects to that used by the earlier planters. Pits were made to loosen and get better aeration in the surface soil which was replaced and the plants then notched in. The roots were not placed deep.

The ground did not look promising and experience of similar types had shown that Sitka spruce tended to check on them. Scots pine, however, grew well for a time but older woods showed that it fell off later on. It was decided therefore to plant Sitka spruce as the main crop but to include Scots pine to the extent of 20 per cent. to act as nurses should the spruce check. The pines were planted closer than the spruces. Fortunately the pine has not been required as a nurse. The drains put in nearly a hundred years ago have been effective and the prepared soil in the pits has helped to produce a thriving crop of Sitka spruce and Scots pine. Had the early planters been content to wait till a few years after draining before planting they would have had good results.

J. M. M.

Sirex gigas AND ITS PARASITES.

As not much attention seems to have been paid to Sirex parasites in Scotland, it may interest entomologists to know that the large ichneumonid "*Rhyssa persuasoria*," has established itself in Argyllshire, the host being *Sirex gigas*.

My attention was first drawn to the presence of *Rhyssa* at Benmore, in July, 1931, while collecting material for a working plan report. An *Abies* log badly riddled by the exit holes of sirex was being examined when an ovipositor with sheaths attached was observed protruding from one of these holes, the insect probably having been devoured by a bird while in the act of oviposition. During the warm sunny days that followed numerous specimens were seen emerging from the logs, others were observed in the act of oviposition while a few males were captured hovering around logs from which females were emerging. In the clearing where the *Abies* logs lay 19 specimens were counted in one afternoon.

On splitting a portion of a log, 4 adult sirex (3 females and 1 male) and several larvae were brought to view one of the latter having a *Rhyssa* larva attached in the act of devouring it.

Although diligent search was made for specimens of *Ibalia leucospoides* not one was obtained, although tiny exit holes made in previous years could be seen, and which it is quite resonable to assume were made by these parasites. Dr. Chrystal in his "Studies of the Sirex Parasites" points out that where *Rhyssa* abounds *Ibalia* will usually occur sparingly

and *vice versa*, hence the probable absence of the latter from these parts. Three specimens (female) were captured in New York Wood, Ford, Argyllshire, which shows the parasite is not localized. These insects should be valuable in the control of sirex damage. D. Ross.

Care of Plants.

While good planting is necessary and must be enforced I think foresters are apt to neglect the sheughing of plants. I have noticed that where one finds three or four plants dead or sometimes half a line of plants, this can in most cases be traced not to bad planting but to the bundle being partly exposed in the sheugh. Often on hard ground it is difficult to get the plants properly heeled in but extra care and time taken in this respect is well worth while. It is also useful to keep the straw or bracken which the plants are packed in beside the sheugh so that if hard frost intervenes this material can be scattered over the plants. I have found this do more good than extra earth. W. L. Ross.

Planting Experiences.

It is generally agreed that a dull, moist day is the best for planting and the following facts may therefore be worth mentioning. In February, 1929, we were planting 2 + 1 European larch on an exposed face of the hill, the wind blew from the north, a cold frostly wind. On coming to the squad I found the men could hardly hold the plants, their hands being numb with cold. I shifted them down to near the bottom of the hill, about 500 ft. lower, where we continued to plant. Here it was more sheltered but still very cold, the plant roots drying up if exposed for a few minutes.

The curious thing is that both high up and at the lower elevation all the plants planted that day came away perfectly, no beating up was required but the area round about them required slight beating up, although planted in what we call good planting weather. I have noticed this happen on several occasions. W. L. R.

Screefing.

In planting in heather that is strong and rank difficulty is nearly always experienced afterwards by the heather screefed blowing on top of the newly planted plants. Care taken in seeing that the screef is cut clean off will help to prevent this. Even then after a gale, it will be found that a good number of plants are covered and if not freed will die or become weak. It is therefore necessary to send a boy over an area like this after the planting is completed as it saves a lot of beating up.

W. L. R.

Timber Chutes.

On many of the Commission areas plantations are in places from which the removal of thinnings is difficult owing to the roughness or steepness of the ground. This can be got over to a certain extent by the use of timber chutes. The drawback here is that the chute will only serve one or two compartments and is therefore hardly worth the cost. The solution then seems a portable chute. This type which we made here with ¾ in. × 9 in. boards was found to be very serviceable and to reduce the cost of removal to a quarter of the cost of dragging.

For strength the two side boards should extend 6 to 8 in. further than the bottom board, in erection the ends can then be fitted together. As the boarding as usually obtained from the sawmills varies from ¼ in. to ¾ in. it is wise to number the ends after fitting them in the course of erection; the branding irons will be found useful for this. The sections can be joined together when being erected by strips of wood 3 in. × ½ in. × 1 ft. Old fencing droppers can be used. The cost of 200 yds. of chute erected here was £8 13*s*.; labour accounting for £1 10*s*. and materials £7 3*s*. The latter item consisted of 600 ft. ¾-in. boarding, £6 12*s*. and nails 11*s*.

W. L. R.

LIST OF TECHNICAL STAFF.

Headquarters.

At 9, *Savile Row, London, W.*1.
Story, Fraser, Education and Publications Officer.
Guillebaud, W. H., Chief Research Officer.
Sangar, O. J., Assistant to Technical Commissioner.

At Imperial Forestry Institute, Oxford.
Macdonald, James, Research Officer, England and Wales.
Fossey, R. E., Assistant Research Officer.

At 25, *Drumsheugh Gardens, Edinburgh.*
Macdonald, J. A. B., Research Officer, Scotland.

England and Wales.

Assistant Commissioner's Office (55, *Whitehall, London*).
Taylor, W. L., Assistant Commissioner.
Wynne Jones, E., District Officer, Higher Grade (Acquisitions).
Pearson, F. G. O., District Officer.

Division 1 (*Chopwellwood House, Rowlands Gill, Co. Durham*).
Hopkinson, A. D., Divisional Officer.
Ross, A. H. H., District Officer.
Batters, G. J. L., District Officer.
Dicker, A. C., Probationer Estate Officer.

Division 2 (15, *Belmont, Shrewsbury*).
Long, A. P., Divisional Officer.
Fairchild, C. E. L., District Officer.
De Uphaugh, F. E. B., District Officer.
Best, F. C., District Officer.
Smith, R. H., District Officer.

Division 3 (*Beacon House, Queen's Road, Bristol*).
Scott, Frank, Divisional Officer.
Ryle, G. B., District Officer, Higher Grade.
Russell, W. D., District Officer.

Division 4 (55, *Whitehall, London*).
Felton, A. L., Divisional Officer.
Lowe, George, District Officer.
Stileman, D. F., District Officer.
Sanzen-Baker, R. G., Probationer District Officer.

Division 5 (*Long Causeway Chambers, Peterborough, Northants*).
Steven, H. M., Divisional Officer.
Muir, W. A., District Officer.
Connell, C. A., Probationer District Officer.

Division 6 (*The King's House, Lyndhurst, Hants*).
Young, D. W., Deputy Surveyor.
MacIver, L. E., District Officer, Higher Grade.
Yarr, W. J., Assistant to Deputy Surveyor.

Division 7 (*Whitemead Park, Parkend, Lydney, Glos.*).
Popert, A. H., Acting Deputy Surveyor.
Forster Brown, W., Deputy Gaveller (Mines).
Wylie, N. A., Probationer District Officer.
Roper, John, Survey Clerk.

School for Forest Apprentices.
Broadwood, R. G., District Officer, Higher Grade (Instructor).—Parkend, Lydney, Glos.

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Sutherland, John D., Assistant Commissioner.
Cameron, John, Land Agent.
Mackie Whyte, J.P., District Officer.
Webster, John, District Officer.

Northern Division (51, *Church Street, Inverness*).
Fraser, James, Divisional Officer.
Mackay, J. W., District Officer.
Beresford-Peirse, H. C., District Officer.
Oliver, F. W. A., District Officer.
Spraggan, D. S., District Officer.

North-Eastern Division (12, *North Silver Street, Aberdeen*).
Forbes, R. G., Divisional Officer.
Bird, D. H., District Officer, Higher Grade.
Cowell-Smith, Robert, District Officer.
Murray, D. V., District Officer.

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Murray, J. M., Divisional Officer.
Newton, L. A., District Officer, Higher Grade.
Whellens, W. H., District Officer.
Gosling, A. H., District Officer.
Macdonald, J. M., Probationer District Officer.

School for Forest Apprentices.
Watson, Harry, District Officer (Instructor).—Benmore. Argyll.

Foresters.

England and Wales.

Name.	*Grade.*	*Name.*	*Grade.*
Division 1.			
McGlashan, John	I	Gough, W. R.	II
Weir, A. B.	I	Hodgson, William	II
Bewick, W. J.	II	Gilson, R. L.	II
Anderson, J. T.	II	Simpson, G. A.	II
McNab, Colin	II	Liddell, Joseph	II
Division 2.			
Butter, Robert	I	Harrison, Percy	II
Jones, H. W.	I	Brown, G. H.	II
Shaw, J. L.	I	Cowe, J. F.	II
Anderson, J. W.	I	Lomas, John	II
Fraser, Robert	I	Edwards, D. T.	II
Roberts, W. G.	II	Jones, David	II
Harris, W. A.	II	Jones, Alfred	II
Division 3.			
Hale, W. J.	I	Pallett, R. E.	II
Williams, John	I	Wild, P. W. S.	II
Laney, Horace	II	Harrison, Phillip	II
Hollis, G. W.	II	Caddy, Thomas	II
Pritchard, Roderick	II	Edwards, L. T.	II
Jones, A. H.	II	Reid, Duncan	II
Squires, C. V.	II	Wellington, C. R.	II
Division 4.			
Aston, A. S.	I	Cottenham, W. C.	II
Dyer, H. C.	I	Gulliver, G. H.	II
Nelmes, F. J.	I	Aston, T. H.	II
Wallington, A. W.	II	Phelps, S. E.	II
Richards, G. H.	II	Saunders, H. J.	II
Butler, Robert	II	Kent, William	II
Johnson, A. E.	II	McKenzie, Colin	II
Division 5.			
Anderson, T. E.	Head	Johnson, Harry	II
Tribe, William	II	Everitt, F. W.	II
Hendrie, T. F.	II	Price, Alfred	II
Clark, J. S.	II	Parry, A. A.	II
Bewick, Robert	II	Smith, J. J.	II
Williams, J. W. M.	II	Wyatt, Lionel	II

England and Wales—continued.

Name.	*Grade.*	*Name.*	*Grade.*
Division 6.			
Forgan, William	Head	Gale, Bertie	II
Aston, O. R. T.	I	Colwill, S. W.	II
Parker, F. H.	II	Wallington, H. J.	II
Adams, J. H.	II		
Division 7.			
Smith, Frank	Head	Watson, Frank	II
Humphries, W. J.	I	Lees, George	II
Lewis, Tom	I	Morgan, T. R.	II
Walker, A. E.	II	Williams, D. N. (School)	II
Christie, W. L.	II	Roberts, James	II
Taylor, G. J.	II	Light, George	II
Adams, Isaac	II		

Scotland.

N. Division.			
Anderson, William	I	Macintosh, William	II
McEwan. James	I	Gunn, John	II
Murray, William	I	Kennedy, John	II
Mason, William	I	Cameron, Roderick	II
McClymont, William	II	Stewart, P. C.	II
Mackay, Kenneth	II	Mackenzie, John	II
Macdonald, Donald	II		
N.E. Division.			
Cameron, John	Head	Clark, F. J.	II
Warren, Alexander	Head	Allan, James	II
Sinclair, William	I	Mackenzie, George	II
Shaw, Robert	I	Ross, Allan	II
Lamb, J. A.	I	Allan, Thomas	II
Edwards, Johnston	I	Kennedy, J. M.	II
Mitchell, F. M.	II	Murray, G. J. A. M.	II
Robbie, J. D.	II	Mackay, William	II
McConnell, James	II	Kennedy, J. A. M.	II
Corbett, John	II		
S.E. and W. Division.			
Paterson, S. H. A.	I	Macmillan, Hugh	II
Simpson, A. N.	I	Ross, W. L.	II
Macintyre, J. F.	I	MacRae, Murdo	II
Cameron, Hugh	II	Grant, Alastair	II

Scotland—continued.

Name.	*Grade.*	*Name.*	*Grade.*
S.E. and W. Division—continued.			
Reid, J. M.	II	Drysdale, Alexander ..	II
Calder, J. M.	II	McDonald, J. D. ..	II
Fraser, A. M.	II	Watson, James ..	II
Graham, Alexander ..	II	Sinclair, Laurence ..	II
Cameron, Alistair ..	II	Ritchie, M. A.	II
Thomson, G. T. ..	II	Graham, J. McK. ..	II
Donald, R. R. (School)	II		

Research and Experiment.

Gray, W. G. (Oxford) ..	II	Mackenzie, A. M. (Headquarters)	II
Grant, Alexander (Edinburgh)	II	Maund, J. E. (Oxford)	II

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REGISTER OF IDENTIFICATION NUMBERS

FOREST YEAR, 1932.

The order of arrangement is as follows :—

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

32/1 3½ lb.; *Abies cephalonica;* 1931; Greece; gift from Grecian Government.

32/2 77 lb.; *Juglans nigra;* 1931; Kew; gift from Royal Botanic Gardens, Kew.

32/3 20 lb.; *Carya alba* (*Hicoria ovata*); 1931; U.S.A. (Indiana); Conyers B. Fleu.

32/4 2,178 lb.; *Fagus sylvatica;* 1931; Germany (Thüringer Wald); Schultze & Co.

32/5 11,089 lb.; *Quercus sessiliflora;* 1931; Bavaria (Spessart); H. Keller Sohn.

32/6 303 lb.; *Picea sitchensis;* 1931; Canada (Massett, North Graham Island, Queen Charlotte Islands); Canadian Government; 97·6; 93 + 2.

32/7 229 lb.; *Picea sitchensis;* 1931; Canada (Skidegate, South Graham Island, Queen Charlotte Islands); Canadian Government; 97·8; 91.

32/8 6 lb.; *Alnus cordifolia;* 1931; France (Corsica); gift from French Forestry Service.

32/9 3 lb.; *Acer pennsylvanicum;* 1931; U.S.A. (Blue Ridge Mountains, North Carolina); Conyers B. Fleu.

32/10 2 lb.; *Pinus contorta;* 1931; U.S.A. (Alaska); Long-Bell Lumber Co.

32/11 229 lb.; *Larix europaea;* 1931; Austria (Inn Valley, Northern Tyrol, altitude 1,970-2,620 ft.); J. Jenewein; 92·3; 58 + 1.

32/12 1,021 lb.; *Larix europaea;* 1931; Switzerland (Münstertal); J. Roner; 90·4; 43 + 4.

32/13 2,202 lb.; *Pinus Laricio;* 1931; Corsica (Valdoniello, altitude 3,300-4,000 ft.); J. Grimaldi; 98·8; 57 + 6.

32/14 20 lb.; *Abies grandis;* 1931; U.S.A. (Columbia National Forest, Washington); Manning Seed Co.; 94·1; 34.

32/15 4 oz.; *Cupressus nootkatensis;* 1931; U.S.A. (Alaska); Long-Bell Lumber Co.

32/16 1 lb.; *Picea nigra;* 1929; Canada; gift from Canada Power and Paper Corporation.

32/17 1 oz.; *Larix Lyallii;* 1931; U.S.A. (Lake Caroline, Wenatchee National Forest, Leavenworth, Washington, altitude 7,000 ft.); gift from Long-Bell Lumber Co.

32/18 2 lb.; *Abies nobilis;* 1931; U.S.A. (Ranier National Forests, Pierce County, Washington); Manning Seed Co.

32/19 6½ lb.; *Larix europaea;* 1931; Silesia (Sudeten); H. Hanel.

32/20 3½ lb.; *Alnus oregona;* 1931; U.S.A.; Manning Seed Co.

32/21 9 lb.; *Picea sitchensis;* 1931; Scotland (Murthly); Colonel Fothringham.

32/22 8½ lb.; *Tsuga heterophylla;* 1931; Scotland (Murthly); Colonel Fothringham.

32/23 178 lb.; *Picea excelsa;* 1931; Austria (altitude 660-1,640 ft.); J. Stainer; 98·7; 85 + 2.

32/24 50 lb.; *Alnus incana;* 1931; Austria (altitude 660-1,640 ft.); J. Stainer.

32/25 1 lb.; *Pinus Murrayana;* 1931; Canada (Kamloops, British Columbia); J. Rafn.

32/26 1 lb.; *Pinus Strobus;* 1931; Central Europe; J. Rafn.

32/27 1 lb.; *Pinus montana* var. *uncinata;* 1931; Denmark (Jutland); J. Rafn.

32/28 1 lb.; *Pinus montana* var. *pumilio;* 1931; Northern Alps; J. Rafn.

32/29 1 lb.; *Pinus austriaca;* 1931; Austria (Wienerwald); J. Rafn.

32/30 3 lb.; *Thuya occidentalis;* 1931; Canada; J. Rafn.

32/31 ¼ lb.; *Abies Mariesii;* 1931; Japan; J. Rafn.

32/32 ½ lb.; *Abies sachalinensis;* 1931; Japan (Yatsugatake); J. Rafn.

32/33 1 lb.; *Abies Veitchii;* 1931; Japan (Yatsugatake); J. Rafn.

32/34 2 lb.; *Abies pectinata;* 1931; Germany (Schwarzwald); J. Rafn.

32/35 1 lb.; *Larix occidentalis;* 1931; U.S.A. (Wanconda County, Washington); J. Rafn.

32/36 1 lb.; *Acer Negundo;* 1931; U.S.A.; J. Rafn.

32/37 3½ lb.; *Alnus cordata;* 1931; Italy; J. Rafn.

32/38 2 lb.; *Carya amara;* 1931; U.S.A.; J. Rafn.

32/39 3 lb.; *Betula verrucosa;* 1931; Denmark; J. Rafn.

32/40 104 lb.; *Carpinus Betulus;* 1931; Denmark; J. Rafn.

32/41 2 lb.; *Tilia americana;* 1931; U.S.A. (Pennsylvania); J. Rafn.

32/42 12 lb.; *Tilia grandifolia;* 1931; Czechoslovakia; J. Rafn.

32/43 7 lb.; *Tilia parvifolia;* 1931; Czechoslovakia; J. Rafn.

32/44 5 lb.; *Sophora japonica;* 1931; Italy; J. Rafn.

32/45 20 lb.; *Juglans regia;* 1931; Denmark; J. Rafn.

32/46 1 lb.; *Morus nigra;* 1931; Hungary; J. Rafn.

32/47 76 lb.; *Quercus rubra;* 1931; U.S.A.; J. Rafn.

32/48 2½ lb.; *Pinus insignis;* 1931; New Zealand; Vilmorin-Andrieux.

32/49 1 lb.; *Pinus ponderosa;* 1931; U.S.A.; Vilmorin-Andrieux.

32/50 ½ lb.; *Abies Nordmanniana;* 1931; France; Vilmorin-Andrieux.

32/51 ½ lb.; *Platanus occidentalis;* 1931; France; Vilmorin-Andrieux.
32/52 2 lb.; *Robinia Pseudacacia;* 1931; France; Vilmorin-Andrieux.
32/53 ½ lb.; *Betula lenta;* 1931; France; Vilmorin-Andrieux.
32/54 2 lb.; *Cupressus macrocarpa;* 1931; Australia; Vilmorin-Andrieux.
32/55 2 lb.; *Tilia argentea;* 1931; South France; Vilmorin-Andrieux.
32/56 3 lb.; *Thuya plicata;* 1931; South France; Vilmorin-Andrieux.
32/57 2 lb.; *Fraxinus americana;* 1931; South France; Vilmorin-Andrieux.
32/58 3 lb.; *Acer saccharum;* 1931; U.S.A.; Vilmorin-Andrieux.
32/59 ½ lb.; *Abies brachyphylla;* 1931; Japan; Vilmorin-Andrieux.
32/60 ½ lb.; *Juniperus virginiana;* 1931; France; Vilmorin-Andrieux.
32/61 2 lb.; *Juglans cinerea;* 1931; U.S.A.; Vilmorin-Andrieux.
32/62 5 lb.; *Quercus Ilex;* 1931; West France; Vilmorin-Andrieux.
32/63 10 lb.; *Quercus cerris;* 1931; France; Vilmorin-Andrieux.
32/64 2 lb.; *Robinia Pseudacacia;* 1931; Hungary; J. Rafn.
32/65 1 lb.; *Picea Omorica;* 1931; Serbia; Sarajevo Forest Department.
32/66 2 lb.; *Pinus Peuke;* 1931; Bulgaria; gift from Bulgarian Forestry Department.
32/67 5 lb.; *Ulmus parvifolia;* 1931; South Africa; South African Forestry Department.
32/68 185 lb.; *Pinus pinaster;* 1931; Portugal (Leira); gift from Portuguese Government.
32/69 10 lb.; *Pinus Laricio;* 1931; Cyprus (Troodos).
32/70 1 lb.; *Chamaecyparis Lawsoniana;* 1931; England (North); own collection.
32/71 27 lb.; *Quercus sessiliflora;* 1931; England (South); own collection.
32/72 2,590 lb.; *Quercus pedunculata;* 1931; England (South); own collection.
32/73 63 lb.; *Quercus pedunculata;* 1931; England (Midlands); own collection.
32/74 1,691 lb.; *Quercus Robur;* 1931; England (East); own collection.
32/75 1,002 lb.; *Quercus Robur;* 1931; England (East); Lord Bristol.
32/76 102 lb.; *Quercus Robur;* 1931; England (West); own collection.
32/77 1,269 lb.; *Fagus sylvatica;* 1931; England (South); own collection.
32/78 54 lb.; *Fagus sylvatica;* 1931; England (East); own collection.

32/79 30 lb.; *Fagus sylvatica;* 1931; England (West); own collection.
32/80 50 lb.; *Fraxinus excelsior;* 1931; England (East); own collection.
32/81 114 lb.; *Fraxinus excelsior;* 1931; England (South); own collection.
32/82 73 lb.; *Castanea sativa;* 1931; England (South); own collection.
32/83 132 lb.; *Castanea sativa;* 1931; England (East); own collection.
32/84 10 lb.; *Betula alba;* 1931; England (East); own collection.
32/85 56 lb.; *Acer Pseudoplatanus;* 1931; England (East); own collection.
32/86 294 lb.; *Acer Pseudoplatanus;* 1931; England (South); own collection.
32/87 36 lb.; *Acer Pseudoplatanus;* 1931; England (West); own collection.
32/88 100 lb.; *Acer Pseudoplatanus;* 1931; England (Midlands); own collection.
32/89 30 lb.; *Aesculus Hippocastanum;* 1931; England (West); own collection.
32/90 76 lb.; *Juglans regia;* 1931; England (South); own collection.
32/91 10 lb.; *Abies nobilis;* 1931; England (West); own collection.
32/92 8 bushels; *Pinus Laricio;* 1931; England (South); own collection.
32/93 1,000 cuttings; *Populus nigra;* crop year unknown; England (West); own collection.
32/94 204 lb.; *Pinus sylvestris;* 1931; Scotland (N.E.); E. S. Grant.
32/95 226 lb.; *Pinus sylvestris;* 1931; Scotland (N.E.); Mackenzie & Black.
32/96 225 lb.; *Pinus sylvestris;* 1931; Scotland (N.E.); G. Brown.
32/97 431 lb.; *Pinus sylvestris;* 1931; Scotland (N.E.); own collection.
32/98 11 lb.; *Pinus sylvestris;* 1931; Scotland (S.E.); own collection.
32/99 6½ lb.; *Pinus sylvestris;* 1931; Scotland (West); own collection.
32/100 41 lb.; *Larix europaea;* 1931; Scotland (N.E.); E. S. Grant.
32/101 18 lb.; *Larix europaea;* 1931; Scotland (N.E.); Mackenzie & Black.
32/102 345 lb.; *Larix europaea;* 1931; Scotland (N.E.); own collection.
32/103 207 lb.; *Larix europaea;* 1931; Scotland (S.E.); own collection.
32/104 2½ lb.; *Larix europaea;* 1931; Scotland (West); own collection.
32/105 6½ lb.; *Larix leptolepis;* 1931; Scotland (N.E.); E. S. Grant.

32/106 3 lb.; *Larix leptolepis;* 1931; Scotland (N.E.); own collection.

32/107 ¼ lb.; *Tsuga Albertiana;* 1931; origin unknown; gift from F. D. S. Sandeman.

32/108 5 oz.; *Abies balsamea;* 1931; Canada (Ontario); gift from Dr. E. V. Laing.

32/109 1 oz.; *Tsuga Pattoniana;* 1931; Canada (British Columbia); gift from Dr. E. V. Laing.

32/110 1½ lb.; *Picea alba;* 1931; Scotland (N.E.); own collection.

32/111 7 lb.; *Pinus montana;* 1931; Scotland (N.E.); own collection.

32/112 ½ lb.; *Pinus montana;* 1931; Scotland (S.E.); own collection.

32/113 5 lb.; *Chamaecyparis Lawsoniana;* 1931; Scotland (West); own collection.

32/114 3½ lb.; *Thuya plicata;* 1931; Scotland (West); own collection.

32/115 1 oz.; *Cupresses nootkatensis;* 1931; Scotland (West); own collection.

32/116 10 lb.; *Acer Pseudoplatanus;* 1931; Scotland (N.E.); own collection.

32/117 114,000 seedlings (2-year); *Fagus sylvatica;* crop year unknown; origin unknown; West Dean Estate.

32/118 111,000 seedlings (2-year); *Fagus sylvatica;* crop year unknown; origin unknown; English Forestry Association.

32/119 1,400 Transplants; *Fagus sylvatica;* crop year unknown; origin unknown; English Forestry Association.

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