JOURNAL

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FORESTRY COMMISSION.

No. 8: APRIL, 1929.

Editing Committee:
R. L. ROBINSON,
H. A. PRITCHARD,
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FRASER STORY.

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EDITORIAL.

Forest Policy.

As announced in the House of Commons on July 31st, 1928, the Government has indicated its intention of providing £5½ millions for forestry during the ten-year period, 1929–39. Except for 1929–30, when the grant is limited to £500,000, the money will be voted in approximately equal annual instalments. This provision, together with receipts, will provide annually from £650,000 to £700,000, and will enable a planting programme of 225,000 acres to be undertaken during the decade, that is to say, the planting rate will continue at approximately the present rate. In all £1 million is to be devoted to forest workers' holdings. Planting grants will be continued as hitherto. Provision is also made for expenditure on education, research and similar activities.

Appointment of New Commissioner.

Owing to ill-health Sir Leolin Forestier-Walker, M.P., has resigned from the Forestry Commission and Major Charles W. M. Price, Member of Parliament for Pembrokeshire, has been appointed to fill the vacancy. Formerly Sir Leolin answered forestry questions in the House of Commons, but this duty is now undertaken by Colonel Sir George L. Courthope, M.P., who became a member of the Forestry Commission in October, 1927.

THE THIRD EMPIRE FORESTRY CONFERENCE

By R. L. Robinson.

The Conference assembled at Perth, Western Australia, on August 21st, 1928, and after visiting all the States of the Australian Commonwealth and the North and South Islands of New Zealand, dispersed at Auckland on October 23rd. Some 34 overseas delegates took part in the whole tour, and were joined at various stages by 70 Australian and New Zealand representatives. The British delegates were Lord Clinton (Chairman of the Conference), Messrs. R. L. Robinson and H. A. Pritchard, Sir William Furse (Imperial Institute), Professor Troup, Major Oliphant, and Mr. James Richardson (Timber Trades Federation).

The greater number of the inspections were in the indigenous eucalypt forests, but as Australia is now exceedingly poor in softwood stands visits were paid to coniferous plantations wherever they could be conveniently reached. Australian conditions approach those of Britain only in Tasmania and in the more mountainous parts of the mainland and the coniferous species which have received most attention are the pines and in particular *P. insignis*, *pinaster*, *laricio* (Corsican) and *ponderosa*. The growth of insignis under favourable conditions, such as in the south east of South Australia, is very striking, plantations of seven or eight years being 30 or more feet high.

Of the eucalypt forests it is impossible in a short note to do more than refer to the extraordinary number of species (there are several hundred) and their adaptability to very wide ranges of conditions, to the great range in the characteristics of the timber, and in general to the case of natural regeneration. For the most part the native eucalypt forests have been exploited and burned without any thought for the future, and very few instances of efficient management and protection were seen. The most imposing forests which the Conference visited were those of the Karri in the south west of Western Australia and the mountain ash of the Cumberland Valley (Victoria). In both cases the trees approached 300 feet in height.

At Imbil about 100 miles north of Brisbane the Conference reached a point where the eucalypt forest came in contact with the tropical types, the latter containing fine but scattered softwoods, viz., hoop and bunya pines (both of which are Araucarias).

The New Zealand tour showed the Conference two very different pictures: the indigenous forests, which are being exploited with little replacement, and the extensive afforestation operations. The native forests with the exception of certain species, such as beech (*Nothofagus*) seem doomed, under present methods, to destruction (as in the case of the Kauri forests of the North Island) or to devastation (as in the case of the Podocarp forests of the South Island). In neither case has a method of regeneration yet been evolved.

In replacement of the indigenous supplies of timber very active afforestation is being carried out. These are centred mainly, but by no means solely, in the Rotorua thermal region of the North Island. The conditions here are very remarkable and uniform over a large district. The whole district is overlaid by a considerable thickness of pumice sand which, while apparently of little use for agriculture, grows trees in a remarkable way. The native vegetation is a low thin scrub (manuka), which is easily disposed of by burning or through which trees will force their way. The rainfall is ample and well distributed, frosts are occasionally troublesome in the hollows, but there are no rabbits and no fencing is necessary against stock in spite of occasional wild horses. In these conditions one- or two-year seedlings succeed admirably. The conditions may well make the mouth of a British forester water.

The species which have been used are *Pinus insignis*, which makes phenomenal growth, Douglas fir, larch, *ponderosa* and Corsican pine, the growth of which in all cases appeared to be first-class. Many other

familiar species such as Austrian pine, have been tried, but dropped, as well as unfamiliar ones, such as *P. muricata* and *Sequoia sempervirens*, which also grow extraordinarily well. Practically all the older plantations which were seen were in urgent need of thinning, but there is at present no market for the produce. It may be possible to use small poles for pulping, but unless some market can be secured it would appear that the cheapness of establishing the plantations may be more than counterbalanced by unremunerative thinning.

Under the above conditions the New Zealand Forest Service have succeeded in planting in one year (and almost in one patch) as much as 30,000 acres.

Labour costs are more than double those in Britain and in consequence there has been a considerable development of mechanical appliances, such as motor hoes for nursery weeding, suitable to the peculiar conditions.

The discussions of the Conference covered a wide range, and the resolutions arising therefrom deal with the following subjects :— Forest Policy, Australian Forestry, New Zealand Forestry, Education, Forest Technique, Imperial Forestry Bureau, Forest Products Research, Exotics, Technical Terms used in Forest Management and Trade Names of Empire Timbers. The Summary Report of the Conference together with the Resolutions and Reports of Committees (which covered each of the above subjects, except Policy) was completed on the same day that the Conference dispersed and should be published very shortly.

THE PAST AND THE FUTURE.

By JOHN D. SUTHERLAND.

We have had almost ten years' experience of administration under the Forestry Acts and the new term of a like period will soon commence.

I think the general impression throughout the country among those who know and the many who are interested but who do not know about our subject, is that the Commission has been successful and has not failed in diligence or in the effort to carry out the programme allotted in 1919. The past years, however, have been strenuous for all participants, and possibly a little of the enthusiasm originally existing in the members of the staff has somewhat abated, but, nevertheless, there exists throughout the whole Service a deep interest and a well-rooted sense of responsibility and of the desire to carry on the work with success.

There have been some lessons which should be steadfastly remembered. Land acquisition, the foundation of any programme, has come through various phases. At first, landowners had to be induced to lease or feu. Purchases were not encouraged and only authorised with some hesitation, and generally the terms offered by the Commission, whether for purchase or lease, could not claim any special attraction. In fact the Commission was seldom able to offer any inducement or any particular advantage to a seller or to a lessor unless it was the retention on nominal terms of the privilege of sport, which in operation has led to occasional complications. Owing to causes which have recently intervened, land is now more readily procurable. It will, I think, be generally agreed that it is more in the public interest that the Commission should purchase estates in the market or upon market terms, and manage and deal with them as may be found best after acquisition than to buy blocks consisting of only plantable land which remain part of existing or surviving estates. There is freedom in the former method in many directions, while the conditions and possibilities under the latter are somewhat circumscribed. It may also be confirmed that it is better to pay a fair price for good plantable land, when procurable, than to acquire areas at a low figure which are much more costly to establish.

At the same time if the exigencies of rural occupation are pressed the principle of undertaking schemes of afforestation of so-called waste land should not be ignored in the hill country of Wales or Scotland.

The original and continuous shortage in land and the uncertainty about the acquisition of it during at least six years has led to complications in many spheres of the work. In this connection nurseries had to be formed sometimes with undue haste and stocks of different species had to be created for particular areas which could not always be entered within the period anticipated. This has resulted in the overstocking of nurseries, and what is almost more undesirable, overcrowding, and as a consequence the retention of plants in ground which should have been released for a cleaning crop. This has had effect upon the cost of plants, and also, to some extent, upon the quality of the product. These experiences are past, and they ought to be avoided in the future.

We realise that special attention should also be given to the selection of seed for the propagation of plants, and this can be no doubt achieved in 1929–39, because so many sources of supply have been investigated.

With a view to maintaining a programme it has been necessary occasionally to utilise one or more species in substitution of the species desired. This has by no means been universal, but it unquestionably has arisen. In the same connection and for the same reason in the early years seedlings instead of transplants had to be used in plantations, and this, at all events in Scotland, should not be repeated except in areas and under conditions favourable to the introduction of seedlings.

There has also been an inclination to switch from one particular species to another species for reasons hardly commensurate to actual experience or to the characteristic or historical features of the particular tree and this has confused the forecasts of those who have had to provide the planting stocks in the nurseries.

There is a definite limit to the area which should be planted annually. It is limited by the extent of the whole individual area to be afforested, the labour available locally and the conditions of existing tenancies. Any unusual effort to make good an overhead programme by concentration on a specified area does not assure success. In the few instances where this was done in the early years in Scotland, the results in establishment and in the other operations essential to it have been more costly than they would have been if the properties were run upon a systematic, well-considered forest working plan at the beginning. There are other arguments, favourable to this contention, well known to foresters, and they need not be emphasised here, but spasmodic or discontinuous afforestment of large blocks of coniferous woods in any particular locality must involve risks besides creating for the foresters of the future an involved and rather unwelcome management and utilisation problem.

It may be claimed as the result of experience that the enclosure of plantations should be made with care, and that it is better to face a substantial capital investment in fencing than to make fences of an inferior type. The necessity for protection against rabbits and deer is more fully realised now than formerly, and it seems better to anticipate the need for netting right away than to trust to the activities of a trapper, particularly when the surrounding land offers unchecked sanctuary for rabbits.

Drainage has been found to be more essential to crop establishment than was originally envisaged, and it is highly desirable that the drainage scheme for every forest should be mapped out and due provision made not only to carry away surface water, but the more objectionable lodgments of water on flats which can only be released by discovery and opening of the natural outlet. The interception of surface water from these lodgments is, as well, of much importance. A drainage plan of the kind should be one of the first considerations of every forester and the execution of it should be undertaken well in advance of planting.

It may be understood that these observations definitely point in one direction, which is, that after entry to any property no planting should be sanctioned until a working plan is prepared.

It is unwise to form plantations in undue haste merely for the sake of carrying out an overhead programme. To be successful this must be based on a knowledge of the land after careful examination well in advance of planting and also in relation to the extent of land in hand.

These years have certainly proved that the forester must not be optimistic and that he should not be unduly urged into the completion of any work unless he himself is satisfied that it can be carried out with safety and due regard to the surroundings and conditions of each forest. In any event he ought to have a fair chance of presenting his case to the Technical Commissioner.

To-day we find the need for research in many directions, and we have to acknowledge the assistance already given by the officers of this branch of the service. Experiment in the field by the men charged with planting should, however, be encouraged, not because it may have been the subject of attention long ago or have some bearing upon authorised experiments, but because it gives proof that the men who embark upon the effort disclose, by the doing of it, a real interest in their job.

In conclusion may I suggest that in the service we should make for closer ties of friendship in conference and in private, and be less prone to criticise and more intent upon giving, when opportunity arises, of our best in knowledge and experience to each other. Everyone engaged in this great national enterprise could no doubt write a chapter on the last ten years, chapters of criticism or of satisfaction and of sage advice, but we must feel a thrill of gratification in the fact that we have all taken our share in the successful launching of a new and permanent industry in the old Homeland.

RÉSUMÉ OF REPORTS ON EXPERIMENTAL WORK.

By W. H. GUILLEBAUD.

1. TURF PLANTING.

Following on the favourable results of the turf planting carried out in the Divisions in P.27, a considerably larger area was planted by this method in P.28 and reports dealing with the results of the two years' work are now to hand.

General Results from P.27 Planting with Norway and Sitka Spruces.

Reports continue to be satisfactory. On the poorer soils direct planted spruce had very generally gone into check, showing little or no growth and bad colour, while the turfed plants had kept their colour. The nursery root system of the latter was still developing, and growth, though less than in the first year, was still appreciable. On good mineral soils there has been, as a rule, little difference in rate of growth, but the turfed plants had usually a better colour.

General Results from P.28 Planting with Norway and Sitka Spruces.

Results have been closely similar to those reported for P.27. In general, the poorer the soil the more marked was the benefit due to turf planting. On good soils there was little to choose between the two methods and in some cases direct planting has given slightly better results.

The weather conditions prevailing in this year provided a useful contrast to the previous year. In most districts there were considerable spells of dry weather during the growing season of 1928, but the turfs appeared to conserve the moisture well and there was little or no damage to plants except in a few areas in the south and east of England.

The reports are summarised in greater detail below.

Methods of Turf Planting.

In some Divisions the shallow turf with side notch planting is adopted while others employ the thick turfs, planting with the Belgian spade. There is no definite evidence at present as to which is the better method for given conditions and a series of comparative plots on different soil would be useful.

One or two reports mention the individual turf method where the cuts are not linked up to form continuous drains, in each case the latter method was preferred on account of the better drainage given.

Losses.

Spruce planting in P.28 appears to have been generally very successful and more than half the returns show losses not exceeding 5 per cent. by either turfing or direct planting. The average loss in 47 out of 50 turf planted areas was 5 per cent., ranging from 0 to 28 per cent. (the latter figure exceptional). The direct planting losses are more difficult to get at, in many cases these are not specified exactly and often there were

soil and site differences which made any comparison invalid. The range was, however, considerably greater, the failures varying from 0 to 95 per cent. Taking those results which appeared to be reasonably comparable, the initial losses averaged about twice as high (10 per cent. as against 5 per cent.) by direct planting, with individual differences running up to much higher figures, but balanced by many cases in which both gave equally good results.

Apart from any question of last season being more or less favourable than the average, it seems probable that the technique of direct planting of spruce has greatly improved and that there is less likelihood of wholesale losses at the end of the first year than has been the case in the past. It must be remembered, however, that on the poorer soil types the first, and even the second, year is by no means the end of the story. It is a matter of common experience that the death rate in direct planted spruce often rises steadily from year to year while it is rare for a turfed plant to die after the first season.

A particularly difficult class of land is formed by the flat and very wet sandy areas, usually covered by a rank growth of molinia, which occur in certain districts. Reports cover the turf planting of land of this type at Tentsmuir, Laughton and Bramshill. In each case direct planting, either in P.27 or P.28, or in previous years, has proved a failure, losses running up to 95 per cent. Turf planting, especially at Tentsmuir and Laughton has given remarkably good results, losses being from 1 to 5 per cent. and the plants a good colour and vigorous. At Bramshill the dry summer of 1928 made the success less striking, but in general, the method can be said to have solved the problem of establishing spruce on this class of land.

A curious exception to the general run of success with turf planting deserves special mention. At Radnor forest, with Norway spruce and Sitka spruce, and at Corris Valley with Sitka spruce, Mr. Sangar reported losses of from 25 to 40 per cent. with turf planting, when planting followed on within a month of cutting the turfs. In both areas where the turfs were cut two months or more before planting, losses were negligible and the operation was entirely successful. At Radnor forest the planting area was at an elevation of 1,600 feet; soil 4 inches to 5 inches on loam; vegetation, fine grasses, *Calluna*, *Vaccinium*, *Polytrichum*, etc. At Corris Valley the elevation was 900 feet; soil 9 inches to 18 inches over clay and the vegetation, *Molinia*, *Calluna*, *Vaccinium*. It is interesting to note that in both areas there were scarcely any failures in the direct planted controls. It is clear from reports from other Divisions that in many, if not most of the areas, planting followed immediately on the preparation of the turfs, hence some other factor must have been operative at Radnor and Corris to account for the heavy losses there.

Weeding.

Reporting officers are unanimous in stressing the saving in weeding costs resulting from turf planting, especially where weed growth is heavy. Actual figures given in twelve cases showed an average saving of 8*s*. 9*d*. per acre as compared with adjoining direct planted areas. It is clear

from some of the reports that on strong Molinia ground weed growth is so heavy that even the turf planted areas will require weeding in the second or third years. The use of large plants for turf planting on such ground is only advisable on well-sheltered sites. On the other hand, where weed growth is less rank direct planted spruce which may need no weeding the first year, will certainly have to be tended during subsequent years, while the turf plants may require no further attention. So much depends on the nature of the vegetation and the relative rates of growth of the trees on the turfs and on the natural surface that it is impossible to give an average figure for the saving in weeding costs effected by turfing. On most spruce sites the saving is likely to be substantial.

Frost.

In spite of the general occurrence of late frosts in 1928 most of the returns report no damage to turf planted spruce. In a few cases, notably in some of the operations in the North-eastern Division of Scotland and at Laughton in Division 5, turfed plants escaped injury while adjoining direct planting suffered severely from spring frosts. Mr. Annand also reported a few cases of frost lifting affecting turfed plants, but damage did not appear to be serious. Mr. Long recommends late planting in frosty localities in order to check early shoot growth.

Size of Plant and Use of Seedlings.

Several of the reporting officers express a preference for strong bushy transplants, *i.e.*, plants from 10 to 18 inches in height and losses in some cases are attributed to the use of spindly stock. In the South-western Division of Scotland blackgame are very destructive to small plants and on that account seedlings cannot be used in many areas.

Mr. Murray reports good results with selected three-year Sitka seedlings in Mull where there is no trouble from blackgame. The use of selected two- and three-year seedlings has also been successful in the Northern and North-eastern Divisions of Scotland and in Division 1. The extension of the use of specially raised stocky seedlings is much to be desired as, if successful, this will mean an important cheapening of the work.

Root Development.

All the reports lay stress on the greatly improved root growth of the turfed plants. The nursery roots continue to function and develop after planting, while in ordinary planting the plants have to rely almost entirely on the newly formed adventitious roots. Even where at present the shoots of the turfed plants are not appreciably better than those planted direct, the better root development of the former will probably tell in the next few years.

Cost.

Individual costs for preparing and placing the turfs were given in fourteen cases, the average cost amounting to 48*s.* 6*d.* per acre ; planting on the turfs averaged 18*s.* 6*d.* per acre. The cost of direct planting

varied from 20*s*. to 30*s*. per acre. Thus the difference between the two methods comes out about £2 an acre, against which can be set savings in cost of weeding and beating up. Further, the increased surface drainage given by the standard methods of turf planting is much to the good in wet areas and should be reflected later in the growth of the tree. One point emphasised in several of the reports may perhaps be mentioned here. Turf planting is no substitute for main draining on wet peat. The shallow turf drains play a most useful part in running rainwater rapidly off the area, but their effect on the drying up of the peat itself must be extremely small, and if deep drainage is neglected the planting is likely to end in disaster.

Other Species.

Small areas have been turf planted with Japanese larch, Corsican pine, *Pinus contorta* and Scots pine. Results have been somewhat variable, but where serious failures occurred there were usually contributing factors, such as the use in one case of two-year Japanese larch seedlings on mounds on mineral soil and in another case blackgame. At Glasfynnydd losses in turf planted Japanese larch were 8 per cent. as compared with 15 per cent. by direct planting, the colour and root growth were good on the turfs and there was a saving of 12*s*. 6*d*. per acre in weeding costs. In the New Forest, Corsican pine did very much better on turfs than on the flat, losses averaging 9 per cent. as compared with 34 per cent. on the flat. At Laughton, Corsican pine failed to the extent of 35 per cent. on turfs, but the surviving plants looked well. There was no control area direct planted in this case.

Conclusions.

In considering the general results of turf planting up to the present date the fairly extensive experiments of the Research Branch may also be included. These have dealt almost exclusively with poor types of peat, and the results may be summed up by saying that turf planting has given better results in every respect than direct planting, and that not only with the spruces but also with Japanese larch, Scots pine and *Pinus contorta*. This work has been greatly extended by the field scale trials now under report. The evidence is now sufficient to justify the conclusion that turf planting is the best method of establishing spruce on all soils which are difficult to drain. It is only on well-drained mineral soils and possibly on some types of readily drainable, crumbly peat that turf planting may not be desirable. Where weed growth is rank and weeding costs heavy, turf planting may pay even on easily drained soils.

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2. Oak Mildew.

As an outcome of certain successful experiments carried out in Kennington nursery and in one of the New Forest nurseries, Mycological

Circular No. 4 was issued in March, 1928, with instructions for the spraying of oak seedlings and transplants with ialine colloidal sulphur. The plants were to be sprayed monthly from the latter part of June to the latter part of August and unsprayed strips were to be left as controls. Reports were received from the following nurseries: Rendlesham, Lynford (Division 5); Apethorpe, Alice Holt and Woolmer, Chiddingfold, Hemsted, Hazelborough, Salcey (Division 4); Tintern (Division 3); Rhinefield, Wilverley, Shave Green, Amberwood and Godshill, Bere (New Forest); Rough Nursery (Forest of Dean).

The reports as a whole indicate that last year was not a bad year for oak mildew; at Lynford, for example, mildew was wholly absent. Where the fungus was present the spraying was usually found to be very effective. Only two cases were apparently negative, the spraying for some reason having failed to control the mildew. In the remaining nurseries the sprayed plants were described as being much healthier than the controls, and in nine out of eleven there was a decided increase in height growth. The sprayed plants were from 1 to 3 inches taller than the controls in most cases. The biggest difference found was in transplants at Chiddingfold where the sprayed plants were double the height of the unsprayed, 12 against 6 inches. In general, transplants appeared to respond more to the spraying than seedlings.

One feature of the reports is the frequent mention of mildew appearing in September, and it is possible that a late spraying may be desirable, to arrest mildew development on the Lammas shoots. Re-infection appears to have been general towards the end of the monthly intervals between spraying, and the unsprayed controls may have contributed to this re-infection. There is no reason at present for recommending more frequent spraying. The cost of the spraying in Division 4, including labour and materials, was approximately $8\frac{1}{2}d.$ per 100 square feet.

Further detailed experiments were carried out last season in Kennington and Rhinefield nurseries; these will form the subject of a separate publication, but may be briefly summarised here. The pedunculate oak plants at Oxford were sprayed with ialine sulphur, cosan sulphur, and flowers of sulphur, casein being used as the spreader after the first spraying. One plot was sprayed only once, the others were sprayed three times. The mildew attack was much less severe than in 1927 and the results were less spectacular. The difference in size of seedlings and size and number of leaves per plant was small, but the dry weight of the plants in the best spray (flowers of sulphur) was appreciably higher than in the control—1·44 against 1·10 gm.—showing that the spraying produced stouter plants. Similar results were obtained with sessile oak seedlings, but the attack was more severe, probably due to later sowing. The percentage of plants free from mildew was increased from 4 per cent. in the controls to 50 to 55 per cent. in the best sprayings.

In the New Forest the attack was evidently much more pronounced. Of the sprays used, ialine sulphur was the best (flowers of sulphur was not used here) and, as the following table indicates, three sprayings

during the season were much more effective than one. The plants were sessile oak.

Plot Treatment.	Percentage of plants free from mildew.	Mean height of plants. Inches.	Mean dry weight of plants. Grammes.
Control. No treatment	33	3·3	0·79
2 lbs. ialine sulphur, one spraying	45	4·0	0·92
2 lbs., two sprayings	55	4·5	1·02
2 lbs., three sprayings	81	4·9	1·21
Control. No treatment	33	3·4	0·82
4 lbs. ialine sulphur, one spraying	46	4·0	0·89
4 lbs., two sprayings	69	5·0	1·31
4 lbs., three sprayings	88	6·7	1·89
Control. No treatment	25	3·9	0·81

The single spraying was done on July 3rd; the two sprayings on July 3rd and 26th and the three sprayings on July 3rd, July 26th and August 15th. It will be observed from the data that three sprayings with 4 oz. ialine sulphur per 100 gallons have increased the height by 90 per cent. and the dry weight by 130 per cent.

Dr. Steven's observations on the experiments in the two nurseries are as follows:—

"The results in the two centres are not in complete accord but the following would be a safe recommendation for general practice until further data are obtained:—

(1) Ialine colloidal sulphur and flowers of sulphur are probably equally effective.

(2) Casein is better as a spreader than soft soap, even with moderately soft water.

(3) Strength of the sulphur should be 3 pounds per 100 gallons of water.

(4) Three sprayings may be regarded as sufficient: one when the mildew is first observed and then at monthly intervals."

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3. Control of Chafer Grubs with Carbon Bisulphide.

A number of nurseries are provided with injectors for applying carbon bisulphide to the soil in order to check attacks by chafer grubs. Reports on last season's results have now been received and may be briefly summarised.

At the Forest of Deer in the North-eastern Division of Scotland, the injector was used with complete success against *Serica* attacking Norway

spruce transplants. As the control was so effective in this case and the methods are described fully in the report, the following extract may be of general value.

> " In the autumn of 1927 it was noticed that the foliage of Norway spruce transplants in two small nurseries of the North-eastern Division (*i.e.*, The Bin and Forest of Deer) was assuming a very yellow colour in groups throughout the lines. Some of the plants were lifted and it was found that the fibrous roots had been eaten away and the larger ones badly nibbled. A small area of the nursery sub-soil was then dug over and a number of chafer grubs were discovered. A closer examination proved them to be the grubs of the brown chafer, *Serica brunnea*. In April, 1928, the grubs began to ascend towards the surface in large numbers: an area of approximately 80 square yards in the Deer nursery was hand picked and over 2,000 grubs were gathered. As most of the transplants in this nursery were to remain another year in the lines, it was decided to try to kill the grubs by injecting the soil with carbon bisulphide, and a Vermorel soil injector was obtained. The method of using the injector was as follows. The instrument was set to squirt the liquid out horizontally at a depth of about 8 inches below the soil surface. The point was inserted in between the plants in the lines every 3 feet and a stream of liquid squirted along the line of plants. Eight-gramme doses were used, which gave about 48 grammes of carbon bisulphide per square yard of nursery. No living grubs have subsequently been found in the area treated and no further damage to the plants has been observed. If further spraying is required, however, the injections will probably be made just outside the line of plants, as one or two deaths among the plants have been traced to the insertion of the point of the instrument too close to the plants. The commercial carbon bisulphide used is expensive and the cost of spraying the 1½ acres treated at Deer was about £5."

Mr. Felton reported that he had found the injector effective against both chafer grubs and *Agrotis*.

Mr. Sangar described his experience with the injector at Delamere as inconclusive.

Mr. Young considered that the injection method was of value in light infestations where there were not more than 10 grubs to the square yard—or less if fully grown. Two or three treatments are required as some of the larvae always survive. The method was not practicable in the case of heavy infestations, partly on account of cost and partly on account of the limited degree of control achieved. *Melolontha* was the principal species of chafer concerned, but *Serica* also occurred in lesser quantities.

Mr. Watson, reporting on the use of an injector for treating experimental larch seed-beds in Beaufort nursery, could express no definite opinion as to its value. He mentioned two apparent difficulties, (1) in a moist summer the damage may be done before it is detected and the

injections may be useless owing to the migration of the grubs to adjoining apparently normal areas, (2) it was found that if the injector was used when the soil was moist the fluid did not readily diffuse but remained in the hole. He concluded that the best line of attack was to pick out the grubs when the soil was turned over. The species of chafer abundant at Beaufort was *Serica brunnea*.

Mr. Osmaston expressed doubt as to the value of the injector. He stated that in the case of a bad attack in a bed of larch a portion of the bed was left without injection: this portion was no worse damaged by chafer than the injected part of the bed and as many live cockchafers were caught in the injected portion as in the untreated area.

It is quite clear from the above reports that much work remains to be done on the subject of chafer control before the position can be regarded as satisfactory. It may be that the setting of the instrument is of importance and that the horizontal injections which were successful in the case of transplants in the Forest of Deer are more effective than vertical insertions. The spacing of the injection and soil moisture conditions are other points requiring attention.

The early spotting of the damage is an all-important factor, and two methods suggest themselves: in the first place an easily wilting plant such as lettuce might be sown between the lines in the case of transplants or drill sown seed-beds, or along the edges of broadcast seed-beds. These might serve as indicators of attack. Secondly, if there is any doubt as to the stage of the attack, trial holes should be dug in places to ascertain whether the grubs are still present. It is better to sacrifice a certain number of plants than to go to the expense of injecting areas of soil from which the grubs have already moved elsewhere. There is little doubt, however, that the crux of the problem lies in reducing the chafer population by intensive handpicking before the soil is either sown or lined out. The practical difficulties in the case of large nurseries, where the bulk of the cultivation is done by plough, are admitted.

SOME GENERAL OBSERVATIONS ON NURSERY WORK IN SCOTLAND.

By Mark L. Anderson.

It is now some nine years since the Commission commenced its nursery operations, so that the time is not inopportune for one not directly connected with nursery work to review the position, pass a few critical observations, and possibly throw out a few suggestions as to the probable future development of this very important branch of silviculture under the Commission.

Responsibility for the nursery work may be conveniently divided between the technical staff, which, from the Divisional Officers downwards, is responsible for the purely silvicultural side of the work, and the administrative staff which is responsible for the proper provision of the facilities which enable the technical staff to carry out the work.

When the Commission began its nursery operations in Scotland it relied upon the services and experience of a number of officers and selected foresters, who were well skilled in nursery technique and thoroughly qualified to make the best of the nursery facilities placed at their disposal. In Scotland for many decades past there has been a very high standard generally in nursery work, but the end of the war found us with a shortage of skilled men from which to select foremen and a very low standard of labour in this as in other occupations. This, taken in conjunction with the difficulties attached to the initiation of such a large scheme of operations as the Forestry Commissioners were undertaking, which prevented adequate supervision of the large-scale nurseries laid down, contributed to some extent to the poor results which were at first obtained.

Nursery technique is extremely complicated and success depends upon so many apparently trivial details, that many failures may be justifiably attributed to inadequate training of the nursery workers and nursery foremen. The large number of species handled may also have complicated matters and made supervision more difficult.

There is now abundant evidence everywhere to show that much progress has been made in general nursery technique. The labourers, and especially the foremen and foresters, are much more highly trained and more reliable. As time goes on the standard is bound to improve still further, especially when the experience of a large number of growing seasons has been accumulated and stored up. The storage, however, must go on in the persons of the members of the technical staff and not in the office files. The large number of experiments carried out by those in charge of nurseries and by the experimental branch, let us hope, has also led to considerable improvement. Much remains to be done in this line, however, and nothing is too trivial to be the subject of experiment. One of the most vital operations in the nursery is the actual lifting of both seedlings and transplants, and this is a matter to which attention might be specially directed.

Even if, however, the nursery staffs were trained to the highest pitch of perfection, progress in the Commission's nursery work might still be

very much impeded by lack of proper nursery facilities. Given a good site, reasonably good soil and climatic conditions, a good labour supply, liberty, and the means to bring his soil into good heart and bearing, and power to decide the species and types of plants which his nursery can best grow, any skilled nurseryman could guarantee good results *in course of time.* The provision of the above facilities and conditions is, however, the duty of the higher officials and involves questions of policy and administration. Whatever difficulties may have been in the way or whatever reasons there may be in extenuation, it is certainly true that the provision of these facilities has fallen somewhat short of requirements. This may be partly due to the constantly expanding programme of the Commission and partly to the uncertainty which marks the course of its own existence.

Most, if not all, of the original large nurseries of the Commission were deficient in some important essential, either soil fertility or the means of producing it, or shelter. In some cases shelter has been artificially formed with improved results. In two cases, at least, careful attention to soil amelioration has resulted in very marked improvement. Ashes, grit, manures and soiling-crops with constant working have brought about a great change. Even a good agricultural soil cannot be made into a good nursery soil in two or three years. Several years are required before the ground is fit to carry repeated crops of young trees. With infertile soils, it is doubtful whether good results will ever be possible with some species. It is significant that the best results with larch have been got with an old garden soil and an old market garden soil. If proper attention were paid to keeping the nursery soil in good order, a progressive improvement would undoubtedly take place.

It is to be feared that too often the main consideration in selecting the nursery has been the possibility of getting a large enough area of nice, even, uniform ground to be laid out in the approved fashion into uniform, rectangular breaks, rather than any question of soil fertility, shelter, etc. A pleasing departure from this procedure is to be seen in the Culbin forest and in one or two of the smaller nurseries. Outcrops of rocks in the middle of a nursery may look out of place but do not necessarily imply that the site is a bad one. The opposite, rather, is true.

One factor which has militated against good results is the over-crowding and over-stocking of the nurseries. Even with fertile soils this is wrong, with infertile soils it is disastrous. For transplants, and certainly for seedlings, a proper rotation is necessary. One-third of the nursery should always be clear of plants or seedlings and should be prepared by manuring and soiling crops for the following season. Artificial manures alone are not enough. Combination of soiling crops with artificial manures certainly helps but what nearly all of the nurseries require is organic matter in large quantities. Farmyard manure still forms the ideal manure and, used in combination with potatoes or some other vegetable crop, need not cost very much to apply, if available in quantity. For the more exacting species such as European larch, Norway spruce, broad-leaved trees, etc., good results cannot be maintained year after year, unless something is added to the soil to replace what has

been removed. This is clearly reflected in the poor results which the Commission has generally found with these species.

Another very important advantage of the three-year rotation system, apart from the possibility of soil improvement which it permits, is that it facilitates the handling of the nursery stock and enables the forester in charge to make the best use of his time and of the season. Ideally, during the planting season, he would have one-third of the nursery which had just been soiled and manured ready for lining-out purposes, one-third filled with transplants remaining in the lines, and one-third with transplants to be used in the forests. He can then do his lining-out at any time he finds best and does not have to wait until his transplants have been lifted. Nor has he to lift his transplants weeks before they are indented for, to make room for his new lines. When he has completed his new lining-out he can then put his now vacant transplant area under soiling crop to be ready for next year. Lifting and heeling in plants too soon is faulty technique and so is the keeping of plants heeled in after arrival, owing to there being no room for lining out.

With regard to seedlings, it is a matter for the higher authorities to decide, but, bearing in mind that seedlings require far more careful attention, greater skill and special soil conditions, would it not be good policy to have special seedling nurseries or special seedling sections in the larger nurseries, also to be worked on a three-year or, in some cases, a two-year rotation, but certainly with one year in two or one in three devoted to manuring and soiling crops ? At present, in many cases, the sowing of seed is delayed until all lining-out is completed, often too late to be entirely successful. If there were special seedling nurseries, sowing and other operations could be carried out at the best time in the most suitable weather. Again, sowings on new nursery soil are, as a rule, failures. In early youth, all species, except perhaps the pines, require a certain amount of shelter and a good deal of humus in the soil. The lack of available nitrogen, and especially the lack of raw material from which the soil organisms can make the nitrogen available, is a marked feature of most of the Scottish nursery soils, resulting in very short seedlings in bad growing seasons. Short seedlings mean lower production of fit plants, greater cost in lining-out and increase of the period necessary in the transplant lines. Humus and organic matter is needed in large quantities.

Finally, there is the matter of selecting the species to suit the nursery. This is a matter which will probably rectify itself in time, but it would be unfortunate if, through lack of proper attention to soil amelioration, certain of the more valuable but more exacting of the species were to be excluded from the Commission's operations, simply because they could not be cheaply grown in the nursery. The main argument against selection of one or two species for each nursery is the old one about the eggs and the basket. There is always the off-chance of some disease becoming epidemic, but when you spread all your species over all your nurseries there is almost a certainty of some species being a failure in one or more nurseries, so that in course of time the policy of spread is probably more harmful than a sound and intelligent selective

policy. In any nursery it is, of course, necessary to test a number of species before it can be decided which is the most suitable. After nine years it should be possible to come to some decision in regard to most of the Commission's nurseries. On the whole we can say that Scots pine and Sitka spruce are good nursery plants in most nurseries, and as a rule Japanese larch and Douglas fir make a good show nearly everywhere. Norway spruce and Corsican pine are difficult subjects. With the former it is not easy to strike a mean between size and hardiness. European larch is a really difficult problem which, it has been decided, merits special investigation. Selection and special treatment in the case of the last three species, at least, would probably be well worth while.

From time to time there has been much discussion as to whether it is better to have large central nurseries or small local nurseries. Where there are really sound arguments on either side, a combination of the two systems seems to be the proper solution. For instance, it may often be possible to locate a small or medium sized seedling nursery on a forest with a small area already completely planted, and thus justify the retention there of a forester. For the more exacting species like larch and Norway spruce and some exotic species, small selected nurseries may be advisable, at least for the seedling stage. Other species, especially when they are in general use over the country, lend themselves to treatment in bulk, and can be grown in large central nurseries where labour is less skilled and transport is cheap.

The Finance Branch religiously produce detailed figures relating to various nurseries run by the Commission, which call for some comment. The collection of statistics is a comparatively easy, if somewhat tedious proceeding, but their intelligent interpretation and utilization is another matter. There are a few things which can be deduced from statistics, provided they are complete in every way but there are many points upon which incomplete statistics throw no light whatever or, even worse, upon which they may be misleading. The value of the nursery statistics is that they form a basis of comparison of actual financial results and would thus be useful as a starting point in any investigation into the why and wherefore of observed differences. The investigation might of course, finally result in showing that the grading standard in one nursery was 50 per cent. higher than in another, or that the rate of wages was 5 per cent. higher, and so on. So long as the limitations of prepared statistics are understood, their publication cannot do much harm.

With the possibility of taking a longer view, the ultimate development of a higher nursery technique under the best methods of management and administration is assured. So long as the planting programme includes a large proportion of newly acquired land, it is essential to have an adequate supply of several species available at convenient centres, but it seems likely that the present policy of increasing the number of smaller nurseries attached to planting areas will be still further developed. The establishment of special seedling nurseries, even in small forest centres, might be recommended. Such a policy of specialization is made possible only by the increased skill of the technical staff, combined with the wise provision of adequate facilities for the work.

NOTES ON FORESTRY COMMISSION BULLETIN NO. 11: NURSERY INVESTIGATIONS.

By J. A. Lamb.

The bulletin contains a record of the results of the experiments carried out by the Commission's experimental staff, over a period of eight years. The aim of the experiments has been to test critically the relative value of different methods used in any nursery operation for any particular coniferous species.

It is felt that for the average nurseryman the bulletin might be described as ponderous, and it is difficult to express a definite opinion as to its value on account of the mass of data through which the reader has to wade. If, however, the data are to some extent ignored, the excellent summaries, at the end of each series of experiments, giving the conclusions arrived at from the data provided, give the general reader much of the information he requires.

Practically every phase of nursery practice is dealt with. The subjects of study include season of sowing, treatment of seed, method and density of sowing, size of seed, depth of sowing, tilth, weed problems, summer shelter, winter protection, manuring of seed-beds, season of transplanting, grading of seedlings, spacing of transplants, speed and method of transplanting; drying of roots during transplanting.

Many of the results obtained simply confirm experimentally what is already known and carried out in everyday practice, although there is some information which is new and certainly very helpful to the practical nurseryman. Several of the findings recorded in the bulletin are worthy of special attention and careful consideration. For instance, it appears that more attention might be paid, with advantage, to the depth of sowing, density of sowing, shelter both during summer and winter, and the importance of quality as against quantity of stock raised. In some cases the results are by no means conclusive, and the experimental data obtained indicate that the nurseryman must still judge for himself what is the most suitable and least costly method for his own particular set of conditions, and that no hard and fast rule can be laid down in general nursery practice.

Only good results could be looked for in most of the experiments as they were specially supervised either by an Experimental Officer, or a Forester, and skilled workers were employed in all the operations. With the exception of the "speed in transplanting" experiment most of the experiments were done under ideal conditions and with much greater care and deliberation than can generally be given, and time was of little or no importance. This, in my opinion, raises the most important question, namely, that of costs.

It would be very interesting to see a full statement of the accounts for these experiments, and to see the actual cost per 1,000 plants raised under the various and numerous methods. Owing to the number of years in which these experiments were carried out, the cost of supervision, time and labour costs, etc., would no doubt have reached a high figure. Although larger numbers of plants may have been produced under some

of the methods pursued in the experiments, the cost of these would probably be much higher per 1,000 than in the case of plants raised in the nursery by everyday general practice. It is quite likely that results in out-turn in a nursery would be improved by following many of the suggestions given in the bulletin, but more supervision and more skilled labour would be required, and these would all tend to increase costs. Even with these advantages the climatic conditions are often the chief governing factors as to whether results in any given season will be successful or otherwise. Each season provides its own weather problem in the nursery. We can even go still further and say that each species has its own problems year by year.

Apart from and in addition to the sowing of seed, raising of seedlings and transplants, there are other important operations which must be carried out during the year, and the success of these also depends on weather conditions, so that it is almost impossible to set definite rules of procedure for any nursery operation which would hold good and give uniform results in all cases.

Many of the suggestions contained in the bulletin are excellent but there might be considerable difficulty in applying some of them in general practice. For instance, there is the suggestion of covering Sitka spruce seed in the beds with sand, which, it is stated " accelerated germination notably and increased the production of seedlings to an appreciable extent "—this may be possible on a small scale, but the cost of procuring, transporting, and covering the Sitka spruce seed-beds with sand in a large nursery would appear to be prohibitive. Assuming 30 lbs. of seed were to be sown, which is quite possible any season, this would involve the covering of over half a mile of beds 4 ft. wide, and if there was some increase in the number of seedlings produced, the cost per 1,000 would at least be proportionally raised, and seeds which could not germinate under an ordinary shallow covering of nursery soil would in any case be likely to produce weakly seedlings. Very light coverings of Sitka spruce and larch seed-beds may often produce better results, but this could only be attained under ideal weather conditions. In this part of the country (Aberdeenshire), where winds are strong even in June, an extra covering has sometimes to be thrown on the beds from the paths after a high wind.

Losses in European larch could be reduced by later sowings and by retaining the shelter much later than is the general practice, but in Scotland severe losses are often caused by frost in the transplant lines in early autumn and late spring. In large scale practice, losses of this sort are difficult to guard against.

Losses due to drying of the roots during transplanting may be reduced by using a " puddling trough " when lining-out is being done during dry weather. By the use of the trough all roots are kept moist until the transplanting board is actually in the trench. This trough may be 10 ft. 6 ins. long by 1 ft. 9 ins. wide by 2 ft. high, outside measure, the effective trough being 10 ft. 3 ins. by 1 ft. 6 ins. by 9 ins. deep. In to this water and soil are put and mixed to give the required conditions. The trough holds six transplanting boards, which gives a safe margin.

As a rule by the time two spade men have the notch cut and ready to receive the plants, the fillers have generally three to four boards ready waiting for the carrier. These boards previous to the trough being used were generally laid on the ground inside or near the shelter, but this practice was found unsatisfactory at Seaton nursery as the roots of the plants were more or less dried, especially if there was much wind blowing. All the plant-loaded boards are dipped into the trough before being placed on the notch and this ensures the roots being kept moist.

With regard to the results obtained experimentally by the burning of the first crops of weeds in the seed-beds, which according to the bulletin is an unsatisfactory method of weeding, it is suggested that sufficient trials may not have been made. The decrease in germination of Sitka spruce and European larch may have been due to two causes, namely (1) by burning too long (one minute to 1 sq. ft. is much too long) or (2) the seeds may have been very lightly covered. The general practice is to wait until the weed seeds germinate before using the blow-lamp, and the scorching of these weeds acts as a safety test regarding the length of time the blow-lamp can be applied. The chief benefit of the burning of the weeds on the seed-beds is that only three men need be in attendance for this operation, the remainder of the staff being employed on weeding the transplant lines. As a period of at least 14 days is usual between the burning of the seed-bed weeds and the next hand weeding required for the same beds, good use is made of the 14 days period in the transplant lines, and should a favourable season follow, the weeds can be kept down much more easily and with considerable saving of costs.

Another important factor affecting the number of plants produced is the method and extent of grading. The grades appear to vary in the different nurseries. For instance, from experience I find that what I reject as a cull is passed as a grade II seedling in another nursery, hence the variations in the number of seedlings produced per 1 lb. of seed, and this relatively affects the costings. More importance should, I think, be attached to the grading of seedlings and transplants. The aim of the nurseryman should surely be that only a high standard of plant should be sent out, although this is at times a difficult matter, especially after a poor growing season. It may be a somewhat costly operation but it would appear better to have the losses in the nursery than on the planting area where the timber production may be very seriously affected by the use of inferior plants. Grading both of seedlings and transplants can be more easily carried out in the nursery than in the forest if there is a suitable shed or shelter to carry out the work without undue exposure of the roots.

The density of the sowings also affects the type of plant produced, and, as a rule, lighter sowings produce a better and stronger plant, but for most nurseries there is a minimum density beyond which you cannot go if winter frost-lift is to be avoided. The density, again, affects the costs, lighter sowings mean larger areas, which mean more weeding costs with smaller return of plants per unit area. These all add to the costs of production.

To sum up the situation it seems to come to this, *if the nurseryman fully satisfies the foresters on the planting areas the nursery costing returns show high figures.* If the nursery costs are low the forester returns his advice notes with such remarks as " plants are fair," or " poor quality," or " 20 per cent. weakly plants," etc. If the nurseryman can produce a high standard of plant at a low cost his objective has been reached, but he has much to contend with, and his path is very often a thorny if not a weedy one.

In conclusion, I should like to say that, in my opinion, there are many valuable hints in the bulletin which can certainly be put into practice, but conditions vary so much in each locality that it would seem almost impossible to lay down hard-and-fast rules of procedure for nursery work. Many points also have to be considered which, of course, could not be dealt with in the bulletin, such as rates of wages, skilled or unskilled workmen, distance from planting areas, means of transport, etc. All these have a cumulative influence in reaching the final results. Another important matter in successful nursery management upon which no definite conclusions or ruling appear to have been arrived at is the manuring of nurseries. The central nurseries have hitherto been worked at " high pressure " and sufficient opportunity has not been possible for green crops to admit of the application of manure. It is doubtful if any form of manuring is quite so effective as the application of farmyard manure, but it is now difficult to obtain at a reasonable price, and on that account there is all the more reason for a higher proportion of the nursery ground being put under soiling crops. Soil poverty itself will ultimately affect the quality and even the quantity of plants turned out.

DUTCH SOCIETY FOR HEATH RECLAMATION: CONFERENCE, 1928.

By W. H. Guillebaud.

The writer was appointed official delegate from the Forestry Commission to attend a Conference held at Arnhem, Holland, to commemorate the fortieth anniversary of the founding of the Society.

(1) The Society and its Work.

The Dutch Society for Heath Reclamation, or, to give it its Dutch title, the Nederlandsche Heidemaatschappij, was founded in 1888 with the object of assisting in the reclamation of the barren waste lands of Holland, which occupied at that time nearly 25 per cent. of the total area of the country. The Society began by training a staff of experts whose function was to give advice in land reclamation—principally the afforestation of heath lands. Later the scope of the work was greatly extended, the Society arranging to carry out reclamation work for its members and also concerning itself with agricultural problems, such as drainage, manuring, conversion of heath and peat lands to arable or pasture lands, fruit growing, etc. The breeding and distribution of fish in the canals and rivers is another branch of the Society's work. Courses are also given to farmers and landowners on the management of land.

As a rule the Society only does work for its members, who pay a minimum subscription of 3*s*. 4*d*. a year in the case of common members and 16*s*. 8*d*. a year in the case of patrons. At the present time there are about 9,500 members.

The working expenses of the Society are met from a capital loan of approximately £17,000, but when it undertakes work for its members an estimate is prepared to which 5 per cent. is added to cover the cost of administration, and before the work is commenced the landowner makes an advance for working expenses, the balance being paid by instalments as the work progresses.

Some idea of the scale on which the Society operates can be gained from the statement that during the last few years it has paid out an average sum in wages of £226,000 per annum. Complaints are sometimes made that the Society works expensively, but it is their definite policy to keep their work up to a high standard, and there certainly can be no doubt as to the success of their operations.

(2) Forest Conditions in Holland.

Holland lies on the western seaboard of Europe approximately opposite the south-eastern counties of England. With the exception of the extreme south, the land is low-lying and very flat. Large areas in the west which have been reclaimed are below sea-level.

The climate is somewhat similar to that of our eastern counties, but the temperature extremes in summer and winter are greater. The rainfall is about 28 inches and usually well distributed throughout the year.

The soils are principally Quaternary (*i.e.*, Recent) and either fluvial, glacial, marine or aeolian in origin. With the exception of the western provinces where the land is more or less clayey, the soil is typically a deep sand almost entirely devoid of stones, and, in the areas visited, not bleached and free from any trace of pan. In texture the sand varies greatly, every gradation existing between a fertile loamy sand and a sand of very coarse texture.

The vegetation on the, as yet, unreclaimed sandy tracts of Holland consists of almost pure heather with a substratum of lichen; in the moister and more fertile areas, *Erica Tetralix* and *Molinia* also occur in mixture with the *Calluna*. Whether these sandy tracts were ever under forest is uncertain, but there appears to be no record of tree growth within historic times.

In view of the predominantly sandy nature of the soil it is not surprising to find that Scots pine is the principal species, occupying 85 per cent. of the woodland area, the remaining 15 per cent. consisting of oak (largely as coppice), beech, mixed hardwoods, etc. During the past 20 to 30 years exotic species, chiefly Corsican pine, Douglas fir, *Quercus rubra* and Japanese larch have been planted on a considerable scale with, on the whole, good results.

The Dutch forests occupy 7 per cent. of the total area of the country, a considerably higher proportion than in Great Britain. Almost all the forests are young—under 40 to 50 years of age—and, as they are chiefly of pure Scots pine, there is not much variety about them. In 1921 there was a fairly general epidemic of caterpillars (Nun Moth and Pine Beauty Moth), which did a great deal of damage, the effects of which are clearly visible.

There appears to be an excellent demand in all parts of Holland for small poles, even down to the sticks of beanrod size, such as are removed in thinning young (12 to 14 years old) close-planted Scots pine woods. Even small lop and top is normally removed from the woods and sold for kindling, baking, etc. The principal market for pine timber is in the coal mines of Limburg in the south of Holland, and the whole of the forestry is virtually directed towards producing pitwood. The State owns only a few thousand acres of forest, the remainder is in the hands of private owners or communes, principally the former. The following are some of the more interesting aspects of Dutch Forestry either as seen on the excursions or obtained from the literature circulated to members of the Conference.

Preparation of Ground.

Full ploughing, following the burning off of the heather, is the standard method in use in Holland for preparing the ground for planting or sowing. Horses, steam ploughs or tractors are used, and the ground turned over to a depth of 16 inches. The subsequent treatment was, until recently, to sow a crop of lupins, which was dug in, and then to take one or more crops of rye, a dressing of 300 to 500 lbs. per acre of artificials being applied to the soil. After this, Scots pine was either sown or, more usually, planted as one-year seedlings 2 feet 8 inches apart.

Nowadays the tendency is to abandon the use of field crops on the poorer types of sand and to plant the Scots pine seedlings on the freshly-ploughed heath. Field crops are, however, still employed on the best soils, which are sown with hardwoods, often with Japanese larch, Douglas fir and grey alder, which are planted as two-year seedlings either separately or in mixture. Artificial manures are usually applied, often in very large quantities; for example, on an excursion to the Peel in southern Holland I saw a wonderful crop of rye growing on freshly broken up heath. In this case the soil had been dressed with 700 lbs. of kainit, 700 lbs. of basic slag, and 1,750 lbs. of lime per acre. It was stated that the receipts from the rye would cover the entire cost of the soil preparation, the ground being left in perfect condition for sowing or planting.

In the Peel, although the original vegetation was heather, in many of the lower lying areas *Molinia* quickly invades the young Scots plantations. The effect of clear felling the pine is to produce a luxuriant growth of that grass, and where such conditions prevail intensive drainage is regarded as essential. The drains are 2 ft. deep and 15 to 20 yards apart, costing about 27*s*. per acre to cut (the soil is a soft stone-free sand). (In parts of the New Forest, where conditions appear to be somewhat similar, it is possible that considerable improvement could be effected by more attention to drainage.)

Conifer Planting.

Scots Pine.—The use of one-year seedlings of Scots pine is apparently the universal practice when afforesting newly broken up heath land, the plants being spaced 2 ft. 8 ins. apart. All the plantations inspected were remarkably successful, blanks seemed to be non-existent and the plants were very uniform in rate of growth, so much so that this is a source of embarrassment when the crowns begin to meet. The trees appear to be all of the same height in the thicket stage and unless thinned out very early the crowns become spindly and growth is checked. When thinning has been delayed too long recovery is a slow business, and many of the older stands, especially those on private estates, looked very poor.

Most of the plantations visited appeared to be either of the 40-ft. or 50-ft. class, very little first quality growth was seen. Thinnings usually commence between the twelfth and eighteenth year, according to the rate of growth, they are repeated every four years, and are distinctly heavy. We were shown a number of recently thinned plantations about 25 years old, and in each case the canopy had been broken to an extent which it would certainly take more than four years to repair.

Corsican Pine.—This species has been planted chiefly on the sand dunes in western Holland, where it is preferred to Scots pine on account of its vastly better growth, and to Austrian pine on account of its virtual immunity from rabbit attack. Early attempts at planting out one-year seedlings failed, and the practice now is to sow the seed in the nursery, lining out at the end of one year and planting out as 1+1 or 1+2 transplants. The Dutch have experienced the same difficulties with

transplanting as we have, and losses of up to 60 per cent. and over are not uncommon. The growth corresponds in general to our quality Class III or 50-ft. class. I inspected one of the extensive Corsican pine plantations on the sand dunes north of Haarlem, the dunes here were high but the growth of the trees (about 20 years old) was very uniform, and the trees were growing well on the tops of the dunes. The usual fixation methods are employed, first marram grass and then the pine plants put in and covered with a layer of brushwood. Little information could be obtained as to the quality of the timber, but while Austrian pine timber was said to be as good as Scots, Corsican pine was regarded as much inferior in value.

Douglas Fir.—Both the green and the blue Douglas fir have been much planted in Holland, but there is the same difference between the rate of growth of the two species as in this country. Recently, sample plots were measured in 29 plantations, ranging from 19 to 67 years of age. The rate of growth in height appears very similar to that in Britain, and many of the younger stands are between our first and second quality classes.

The soils on which the Douglas fir has hitherto chiefly been planted are the better quality sandy loams and loamy sands; on coarse grained soils the trees develop a strong fanged deep going root system, but on fine textured soils the root system is superficial like that of spruce. There is apparently the same prejudice among Dutch timber merchants against Douglas fir timber as exists in this country, but the foresters are convinced of its value, and its use is continually extending. So far it appears to be free from serious disease, neither *Chermes cooleyi* nor *Rhabdocline Pseudotsugae* being known in Holland.

Other Conifers.—Japanese larch is coming increasingly into favour with Dutch foresters on account of its immunity from larch canker and is regarded as one of the most important exotic species. Sitka spruce, like Norway spruce, is unsuited to the sandy soils of Holland; it has, however, been planted with success in low-lying peaty flats.

Hardwoods.

Quercus rubra, the American red oak, is largely used in Dutch forestry, and the young sowings and older plantations interested me more than anything else that I saw on my tour. Given a fairly fresh sandy soil the tree succeeds admirably, but it will not stand much exposure or thrive on the drier and poorer sands. Perhaps the most interesting use to which this species is put is as an understory in pine plantations. The examples seen on the tour were all cases of 25 to 35 years old Scots pine plantations which had become very thin owing to the ravages of caterpillars, and had been sown in strips with red oak, common oak, beech, and sometimes also Douglas fir and Japanese larch. The general practice is to rake aside the raw humus—which usually lies thick under the pine—in strips $3\frac{1}{2}$ to 4 ft. in width and 6 ft. apart from centre to centre. The acorns are broadcast in the strips at anything from 250 to 350 lbs. per acre.

The sowings are usually very successful, and it is proposed to extend this method largely in order to establish hardwoods on the better types

of heath which at present carry stands of pine. The modern tendency is to regard pine as the most suitable pioneer species for afforesting the sandy heath, and then, after early and heavy thinnings, to introduce more valuable species, carrying on to the end of the rotation only a relatively small number of the pine as standards among the hardwoods. The hardwoods are usually introduced when the pine is from 35 to 40 years old. The marketing arrangements are so well organised that the thinnings always much more than pay for the cost of the sowings.

The sowings of red oak, seen in the Peel and elsewhere, were most successful, germination and growth were good, and the plants appeared quite free from mildew. Pure plantations in the Peel, some 22 years of age, were 30 to 35 ft. in height and the trees straight and fairly clean. The wood was regarded as inferior to that of the common oak, but at any late of better quality than pine or spruce. Along with the red oak some specimens of *Quercus palustris* were seen. These were not quite as tall as the red oak but straighter. This appears likely to be a useful species on sandy soils.

One of the merits of *Quercus rubra* is that it produces seed freely at a comparatively early age; all the younger plantations visited have been grown from seed collected from 35 to 40-year old plantations in Holland, and there is often a surplus for export to other countries (principally Denmark). The common oak, *Quercus pedunculata*, is used also on the better types of sand, and is sown following crops of lupins and rye with heavy applications of artificial manures. Curiously enough, scarcely any sessile oak has been grown as yet in Holland. Both common alder and grey alder, especially the latter, are usually planted as one- or two-year seedlings along with the acorns, and the value of alder as a nurse for oak is very generally recognised.

(3) Other Matters.

The Swedish delegate, Aminoff, read an interesting paper to the Conference on afforestation problems in Sweden, in the course of which he said that they were finding that the spruce forests established on their drained peat lands were exceedingly productive, yielding much larger volumes of timber than spruce on adjacent mineral soils.

With regard to the planting of the Calluna heaths in Sweden, these were first planted with spruce, which at once went into the check stage which we know so well in this country. The plants checked so long that there was a movement away from spruce and the heather soils were until quite recently planted with pine, and pine was interplanted among much of the spruce areas. Then the spruce in many of the earlier plantations got a hold and started to make quite normal growth, and now there is a very general swing back to spruce, not, however, pure, but with a considerable admixture of Scots pine and birch.

It is only possible to establish spruce on the better Calluna soils in Sweden, *i.e.*, on the mossy (*Hylocomium* Rich) soils, and especially on Calluna soils carrying a strong growth of juniper. On all except the latter type of soil the spruce, when planted, checks for the first 15 to 20 years before starting to grow normally.

Work of the Heidemaatschappij in Promoting the Sale of Small Thinnings.

In 1900-1905, when the first plantations of the Society reached the thinning stage, the difficulty arose as to how to dispose of the thinnings, which experience showed were for the most part unsaleable. The Society appointed a special officer and sent him round all the districts where small poles, sticks, etc., were used, to make a careful survey of the position. As a result of his report the Society created a department for dealing with the disposal of thinnings, which at first attempted merely to act as agents, putting the buyers in touch with the sellers. This was found to be unworkable, and the department started to function as middle man, disposing of the produce to the best advantage and deducting a percentage of the proceeds to cover expenses. A considerable sum was spent each year on advertising in agricultural and gardening papers, with good results.

The department also set to work to devise uses for its material, and found one admirable use in what are called Kleedarren, which consisted of six sticks each 6 ft. in length, of which three were fixed and three loose; these were used for drying field crops such as clover, peas, beans, flax, etc. By means of advertisements and special articles in local papers, with exhibits at shows, these were popularised, and now are in general use, about 40,000 being sold annually.

Another means of disposal was the appointment of carefully selected agents in centres of market gardens and agricultural industry. In most cases these sold only to order, but in some of the larger districts a dump was formed from which the produce was retailed. On the whole these ventures proved disappointing and most of the agencies have been closed. Many hopes were placed in charcoal as a use for small material, but it was found that the market for all types of small poles and sticks was so good that not enough wood was left over in most areas to be worth converting into charcoal, also the price of charcoal remains so low as to be scarcely profitable.

Much use has been made of sale by public auction, but, on the whole, with disappointing results. Auctioneers' costs and the formation of price rings combined to make sale by auction a hazardous venture, and most of the material is now sold direct through the Sales Department of the Society.

BEDGEBURY ARBORETUM.

By Sir John Stirling-Maxwell.

The estate of Bedgebury was acquired from the Lewis family by the Government towards the end of the war, largely on account of its standing timber, which was taken over by the Timber Supplies Department. After the armistice the house and pleasure grounds were sold and now accommodate a girls' school. The farms and shooting were retained by the Office of Woods and the woodlands, extending to 2,200 acres, were taken over by the Forestry Commission. The war had ended before the felling began.

The Directors of the Royal Botanic Gardens have long desired, as an adjunct to Kew, an area where conifers and certain other plants unsuited to the climate and smoke of London could be grown. The present Director asked the Forestry Commission for a site, and after various places had been considered Bedgebury was selected by Dr. Hill and his advisers as reasonably near London, suitable in soil and climate, and already stocked with a certain number of fine specimen trees. A committee was formed of representatives from both departments—Dr. Hill and Mr. Bean acting for Kew, and Mr. Pritchard and the writer for the Commission, with Dr. Borthwick as secretary. Later Mr. Dallimore, Mr. Felton and Mr. Guillebaud were added to the Committee, Mr. Guillebaud undertaking the duties of secretary when Dr. Borthwick left the Commission. An annual expenditure of £300 (£150 by each department) was authorized by the Treasury. It was agreed that during the period of formation the Commission should undertake the clearing and fencing of the ground, while Kew undertook to provide and plant the trees. The scheme includes a series of forest plots for the trial of trees of economic importance under forest conditions in quarter-acre and half-acre blocks. The expense of the sample plots will be borne by the Commission, but it will have the advantage of Kew's advice in selecting the species and varieties to be tried.

The arboretum extends to about 100 acres and lies in a gentle valley sloping down on either side towards a large pond; to the north the area includes the far side of the ridge. The soil is a fertile sand, very congenial to conifers. The site was occupied partly by a mixed wood of oak and conifers and partly by chestnut coppice. It is surrounded by other woods and well sheltered. The trees on the site itself included good specimens of Douglas fir, Western hemlock, Sitka spruce, Nordman fir, etc., about 50 years old, and some heavy Scots pine of about 80 years' growth. The best of the specimen trees were spared when the area was cleared. A belt of tall pines bordering a narrow walk was left along the summit of the ridge, but in spite of this precaution a good many of the old specimen conifers have succumbed to the severe gales of this autumn. This loss is not much to be regretted as the growth of such trees is usually checked by the removal of the matrix of wood in which they were embedded. A space has been reserved where rhododendrons and other shrubs can be grown under the half shade of oaks.

The pinetum is on the usual lines, single trees being widely spaced along broad avenues, which, as the ground is undulating, conform to the contours. The various species of pine, spruce, silver fir, cypress, etc., are so far as possible grouped together.

The forest plots referred to above which have not yet been planted have been given a site adjoining the pinetum. Trials of some typical races of the more important forest trees will be made here, though these will, of course, have to be supplemented by trials under different conditions elsewhere before conclusions of general application can be reached.

Species to be planted in the Forest Plots.

Conifers.

Abies cephalonica.
,, *grandis.*
,, *Lowiana.*
,, *nobilis.*
Cedrus atlantica.
,, *Deodara.*
Cupressus Lawsoniana.
,, *macrocarpa.*
,, *nootkatensis.*
Larix europea.
,, *eurolepis.*
,, *leptolepis.*
Picea asperata.
,, *jezoensis.*
,, *omorika* (1 acre).
,, *sitchensis* (3 races).
Pinus contorta (1 acre).
,, *contorta* var. *Murrayana* (1 acre).
,, *excelsa*
,, *laricio—corsicana.*
,, ,, *calabrica.*
,, ,, *pyrenaica.*
,, ,, *pallasiana.*
,, ,, *Cyprus.*
,, *monticola.*
,, *Peuke.*
,, *ponderosa.*
,, *sylvestris* (6 races).
Pseudotsuga Douglasii (4 races).
Sequoia gigantea (1 acre).
,, *sempervirens* (1 acre).
Thuya plicata.
Tsuga Albertiana.

Hardwoods.

Acer dasycarpum.
,, *pseudoplatanus.*
,, *macrophyllum.*
,, *platanoides.*
Alnus cordifolia.
Carya alba.
,, *amara.*
Cotoneaster frigida.
Fraxinus americana.
Juglans nigra.
,, *regia.*
Liriodendron Tulipifera.
Nothofagus obliqua (1 acre).
,, *procera.*
Platanus acerifolia.
,, *orientalis.*
Quercus Mirbeckii.
,, *pedunculata.*
,, *sessiliflora.*
Rhamnus purshiana.
Ulmus montana.
,, *stricta.*

The following poplars in a strip along the stream :—

Populus Eugenii.
,, *generosa.*
,, *marilandica.*
,, *regenerata.*
,, *robusta.*

It is rash to prophesy where trees are concerned, but 20 years hence this arboretum ought to take an important place among European ventures of the same kind. It starts a long way behind many private collections in this country, and in the matter of full-grown trees will obviously not in our time be able to compete with them. But there can be few collections in the temperate regions at once so complete and so even-aged and probably none in a more promising situation. For the study of comparative growth Bedgebury ought to be unrivalled. The Vilmorin collection at Les Barres acquired by the French Government is probably now, with its sample plots, the most complete of its kind in Europe as well as one of the earliest. Bedgebury will follow the same lines but in the matter of conifers there will be no comparison as the soil and climate of Central France preclude most conifers except those of the pine family from reaching their normal dimensions.

Bedgebury is most conveniently reached by car or bicycle from Tunbridge Wells station from which it is distant 10 miles. From Goudhurst station it is a pleasant walk of three miles.

Species already planted.

Abies amabilis.
,, *balsamea.*
,, ,, var. *macrocarpa.*
,, *brachyphylla.*
,, ,, var. *umbellata.*
,, *bracteata.*
,, *cephalonica.*
,, *cilicica.*
,, *concolor.*
,, ,, var. *pendula.*
,, ,, var. *violacea.*
,, ,, var. *Wattezii.*
,, *Fabri.*
,, *Faxoniana.*
,, *firma.*
,, *Forrestii.*
,, *Fraseri.*
,, *grandis.*
,, *holophylla.*
,, *koreana.*
,, *lasiocarpa.*
,, ,, var. *arizonica.*
,, ,, var. *coerulescens.*
,, *Lowiana.*
,, ,, var. *glauca.*
,, *magnifica.*
,, ,, var. *glauca.*
,, ,, var. *shastensis.*
,, *Mariesii.*
,, *nephrolepis.*
,, *nobilis.*
,, ,, var. *glauca.*
,, *Nordmanniana.*
,, *numidica.*
,, *pectinata* (*A. alba*).
,, *Pindrow.*
,, ,, var. *brevifolia.*
,, *Pinsapo.*
,, ,, var. *glauca.*
,, *recurvata.*
,, *religiosa.*
,, *sachalinensis.*
,, *sibirica.*
,, *squamata.*
,, *sutchuenensis.*
,, *Veitchii.*
,, ,, var. *olivacea.*
,, *Vilmorinii.*
,, *Webbiana.*
,, ,, var. *brevifolia.*
,, sp. No. 01509, Wilson.
,, sp. No. 10509, Wilson, green cone form.
,, sp. No. 20132.
,, sp. No. 1257.
,, sp. No. 20126 F.
,, sp. No. 50–70 F.

Araucaria imbricata.
Athrotaxis cupressoides.
,, *laxifolia.*
,, *selaginoides.*
Cedrus atlantica.
,, ,, var. *aurea.*
,, ,, var. *fastigiata.*
,, ,, var. *glauca.*
,, *brevifolia.*
,, *Deodara.*
,, ,, var. *aurea.*
,, ,, var. *robusta.*
,, ,, var. *verticillata glauca.*
,, *Libani.*
Cephalotaxus drupacea.
,, ,, var. *fastigiata.*
,, ,, var. *pedunculata.*
,, ,, var. *prostrata.*
,, *Fortunei.*
Cryptomeria japonica.
,, ,, var. *dacrydioides.*
,, ,, var. *elegans.*
,, ,, var. *Lobbii.*
,, ,, var. *Lobbii nana.*
Cunninghamia sinensis.
Cupressus arizonica.
,, ,, var. *bonita* (*C. glabra*).
,, ,, var. *bonita pyramidalis.*
,, *Duclouxiana.*
,, *formosensis.*
,, *funebris.*
,, *Goveniana.*
,, *Lawsoniana.*
,, ,, var. *albo-spica.*
,, ,, var. *Allumii.*
,, ,, var. *aurea Smithii.*
,, ,, var. Blue Jacket.
,, ,, var. *Bowleri.*
,, ,, var. *darleyensis.*
,, ,, var. *elegantissima.*
,, ,, var. *erecta aurea.*
,, ,, var. *erecta filiformis.*
,, ,, var. *erecta viridis.*
,, ,, var. *filiformis.*
,, ,, var. *Fletcheri.*
,, ,, var. *intertexta.*
,, ,, var. *juniperina.*
,, ,, var. *lutea.*
,, ,, var. *Masonii.*
,, ,, var. New Silver.
,, ,, var. *patula.*
,, ,, var. *Pottensii.*

Cupressus Lawsoniana.
„ „ var. *pyramidata alba.*
„ „ var. Silver Queen.
„ „ var. *Stewarti.*
„ „ var. *tamariscifolia.*
„ „ var. Triomphe de Boskoop.
„ „ var. *Watereriana.*
„ „ var. *Wisselii.*
„ *Leylandii.*
„ *lusitanica.*
„ „ var. *Benthamii.*
„ „ var. *filiformis.*
„ „ var. *glauca pendula.*
„ „ var. *majestica.*
„ *Macnabiana.*
„ *macrocarpa.*
„ „ var. *Crippsii.*
„ „ var. *fastigiata.*
„ „ var. *guadalupensis.*
„ „ var. *Lambertiana.*
„ „ var. *Lebretonii.*
„ „ var. *lutea.*
„ *nootkatensis.*
„ „ var. *argenteo-variegata.*
„ „ var. *lutea.*
„ „ var. *pendula.*
„ *obtusa.*
„ „ var. *compacta.*
„ „ var. *Crippsii.*
„ „ var. *formosensis.*
„ „ var. *gracilis.*
„ „ var. *hypnoides nana.*
„ „ var. *nana.*
„ „ var. *nana aurea.*
„ „ var. *Nobleana.*
„ „ var. *pygmaea.*
„ „ var. *tetragona aurea.*
„ „ var. ?
„ *pendula.*
„ *pisifera.*
„ „ var. *plumosa.*
„ „ var. *plumosa aurea.*
„ „ var. *squarrosa.*
„ „ var. *squarrosa sulphurea.*
„ *sempervirens.*
„ „ var. *horizontalis.*
„ „ var. *stricta* (*C. fastigiata*).
„ *thyoides.*
„ „ var. *atrovirens.*
„ „ var. *ericoides.*
„ „ var. *kewensis.*
„ „ var. *leptoclada.*

Cupressus torulosa.
„ „ var. *Corneyana.*
Dacrydium Bidwillii.
„ *Franklinii.*
Fitzroya patagonica.
Ginkgo biloba.
Juniperus californica.
„ *Cedrus.*
„ *chinensis.*
„ „ var. *argentea-variegata.*
„ var. *aurea.*
„ „ var. *dentata.*
„ „ var. *glauca.*
„ „ var. *glauca* (*stricta*).
„ „ var. *jacobiana.*
„ „ var. *japonica.*
„ „ var. *japonica aurea.*
„ „ var. *Pfitzeriana.*
„ „ var. *Reevesiana.*
„ „ var. *sphaerica.*
„ „ var. ?
„ *communis.*
„ „ var. *alpina.*
„ „ var. *alpina nana.*
„ „ var. *canadensis.*
„ „ var. *canadensis aurea.*
„ „ var. *cracovia.*
„ „ var. *nipponica.*
„ „ var. *oblonga pendula.*
conferta.
„ *excelsa.*
„ „ var. *stricta.*
„ *foetidissima.*
„ *formosana.*
„ *horizontalis.*
„ *macrocarpa.*
„ *monosperma.*
„ *morrisonicola.*
„ *Oxycedrus.*
„ *pachyphlaea.*
„ „ var. *ericoides.*
„ *phoenicea.*
„ *procumbens.*
„ *rigida.*
„ *Sabina.*
„ „ var. *hudsonica.*
„ „ var. *humilis.*
„ „ var. *Knap Hill.*
„ *scopulorum.*
„ *squamata.*
„ „ var. *Meyeri.*
„ „ var. *prostrata.*
„ „ var. *Wilsonii.*
„ *virginiana.*
„ „ var. *argentea.*
„ „ var. *Burkei.*

Juniperus virginiana, var. *Cammartii*.
,, ,, var. *elegantissima*.
,, ,, var. *glauca*.
,, ,, var. *globosa*.
,, ,, var. *Keteleeri*.
,, ,, var. *Kosteriana*.
,, ,, var. *pendula nova*.
,, ,, var. *pseudocupressus*(?).
,, ,, var. *Schottii*.
,, ,, var. *tripartita*.
,, *Wallichiana*.
,, Sp. (Wermoze).
,, Sp. No. 2
,, Sp. No. 1407, Farrer.
,, Sp. No. 1434.
Keteleeria Davidiana.
Larix americana.
,, Bayfordbury hybrid.
,, *dahurica*.
,, ,, var. *kamtschatica*.
,, *eurolepis*.
,, *europaea*.
,, ,, var. *carpathica*.
,, ,, var. *polonica*.
,, ,, var. *silesica*.
,, *Griffithii*.
,, *kurilensis*.
,, *leptolepis*.
,, *occidentalis*.
,, *olgensis*.
,, *pendula*.
,, *Potanini*.
,, *Principis Rupprechtii*.
,, *sibirica*.
,, sp. 49–1923 Vilmorin (2018 Hers.).
,, sp.
Libocedrus chilensis.
,, ,, var. *viridis*.
,, *decurrens*.
,, ,, var. *variegata*.
Phyllocladus alpinus.
,, *trichomanoides*.
Picea alba.
,, ,, var. *coerulea*.
,, *Albertiana*.
,, ,, var. *conica*.
,, *asperta*.
,, *bicolor*.
,, ,, var. *acicularis*.
,, ,, var. *reflexa*.
,, *brachytyla*.
,, ,, var. *latisquamea*.
,, *Breweriana*.
,, *Engelmanni*.
,, ,, var. *glauca*.
,, *excelsa*.
,, ,, var. *aurea*.
,, ,, var. *Barrii*.

Picea excelsa, var. *brevifolia argentea*.
,, ,, var. *capitata*.
,, ,, var. *Clanbrassiliana*.
,, ,, var. *conica elegans*.
,, ,, var. *dumosa*.
,, ,, var. *Fremontii*.
,, ,, var. *globosa nana*.
,, ,, var. *Gregoryana*.
,, ,, var. *Gregoryana Veitchii*.
,, ,, var. *humilis*.
,, ,, var. *inverta*.
,, ,, var. *mucronata*.
,, ,, var. *nidiformis*.
,, ,, var. *nudiformis*.
,, ,, var. *Ohlendorfii*.
,, ,, var. *pumila nigra*.
,, ,, var. *pygmaea*.
,, ,, var. *pyramidalis*.
,, *Glehnii*.
,, *jezoensis*.
,, ,, var. *hondoensis*.
,, *Koyamai*.
,, *likiangensis*.
,, ,, var. *purpurea*.
,, *Maximowiczii*.
,, *Morinda*.
,, *morrisonicola*.
,, *nigra*.
,, ,, var. *Doumetii*.
,, *obovata*.
,, *Omorika*.
,, ,, var. *pendula*.
,, *orientalis*.
,, ,, var. *aurea*.
,, ,, var. *compacta*.
,, ,, var. *gracilis*.
,, *polita*.
,, *pungens*.
,, ,, var. *argentea*.
,, ,, var. *Kosteriana*.
,, ,, var. *Moerheimii*.
,, ,, var. *Speckii*.
,, *rubra*.
,, *Schrenkiana*.
,, *sitchensis*.
,, *spinulosa*.
,, *Wilsoni*.
,, sp.
,, sp. (Kansu).
Pinus aristata.
,, *Armandii*.
,, *Ayacahuite*.
,, ,, var. *Veitchii*.
,, *Banksiana*.
,, *Bungeana*.
,, *Cembra*.
,, *cembroides*, var. *edulis*.
,, *contorta*.
,, ,, var. *Murrayana*.

Pinus Coulteri.
,, *densiflora.*
,, *excelsa.*
,, *flexilis.*
,, *funebris.*
,, *Gerardiana.*
,, *Greggii.*
,, *halepensis.*
,, ,, var. *Brutia.*
,, *koraiensis.*
,, *Lambertiana.*
,, *Laricio.*
,, ,, var. *calabrica.*
,, ,, var. *corsicana.*
,, ,, var. *nigricans.*
,, ,, var. *taurica.*
,, *leucodermis.*
,, *Massoniana.*
,, *montana.*
,, ,, var. *pumilio.*
,, ,, var. *rostrata.*
,, *Montezumae.*
,, *monticola.*
,, *palustris.*
,, *parviflora.*
,, *patula.*
,, *Peuke.*
,, *Pinaster.*
,, *Pinea.*
,, *ponderosa.*
,, ,, var. *Jeffreyi.*
,, *Pseudo-strobus.*
,, *pumila.*
,, *radiata.*
,, *resinosa.*
,, *Sabiniana.*
,, *sinensis.*
,, *Strobus.*
,, *sylvestris.*
,, ,, var. *alba.*
,, *tuberculata.*
,, *Taeda.*
Podocarpus alpina.
,, *chilina.*
,, *elongata.*
,, *macrophylla.*
,, *nivalis.*
,, *nubigena.*
,, *Totara.*
,, ,, var. *Hallii.*
Prumnopitys elegans.
Pseudotsuga Douglasii.
,, ,, var. *caesia.*
,, ,, var. *Fretsii.*
,, ,, var. *Moerheimii.*
,, ,, var. *pendula.*
,, ,, (One wash form).
,, ,, (Gamble).
,, *glauca.*

Pseudotsuga japonica.
,, *macrocarpa.*
Saxegothaea conspicua.
Sciadopitys verticillata.
Sequoia gigantea.
,, ,, var. *glauca.*
,, ,, var. *pendula.*
,, ,, var. *aurea.*
,, *sempervirens.*
,, ,, var. *albo-spica.*
Taiwania cryptomerioides.
Taxodium distichum.
,, ,, var. *imbricarium.*
,, ,, var. *mucronatum.*
,, ,, var. *pendulum.*
Taxus baccata.
,, ,, var. *adpressa.*
,, ,, var. *adpressa aurea.*
,, ,, var. *adpressa stricta.*
,, ,, var. *aurea variegata.*
,, ,, var. *Barronii foemina.*
,, ,, var. *Cavendishii.*
,, ,, var. *compacta.*
,, ,, var. *contorta.*
,, ,, var. *cuspidata.*
,, ,, var. *Dovastonii.*
,, ,, var. *Dovastonii aurea-variegata.*
,, ,, var. *elegantissima.*
,, ,, var. *elvastonensis aurea.*
,, ,, var. *erecta.*
,, ,, var. *erecta aurea.*
,, ,, var. *fastigiata.*
,, ,, var. *fastigiata aurea.*
,, ,, var. *fastigiata Standishii.*
,, ,, var. *fructu-luteo.*
,, ,, var. "Gibbs."
,, ,, var. *glauca.*
,, ,, var. *horizontalis.*
,, ,, var. *Jacksonii.*
,, ,, var. *neidpathensis.*
,, ,, var. *pendula.*
,, ,, var. *semperaurea.*
Taxus canadensis.
,, ,, var. *Washingtonii.*
,, *chinensis.*
,, *cuspidata.*
,, ,, var. *brevifolia.*
,, ,, var. *compacta.*
,, ,, var. *contorta.*
,, ,, var. *repanda.*
Thuya dolabrata.
,, ,, var. *nana.*
,, *japonica.*
,, *koraiensis.*
,, *occidentalis.*
,, ,, (*sibirica*).
,, ,, var. *elegantissima.*
,, ,, var. *Ellwangeriana.*

Thuya occidentalis, var. *ericoides*.
„ „ var. *filiformis*.
„ „ var. *Ohlandorfii*.
„ „ var. " Rheingold."
„ „ var. *Rosenthallii*.
„ „ var. *Spiralis*.
„ *orientalis*.
„ „ var. *aurea*.
„ „ var. *compacta*.
„ „ var. *elegantissima*.
„ „ var. *ericoides*.
„ „ var. *Hillieri*.
„ „ var. *Rogersii aurea*.
„ „ var. *semperaurescens*.
„ *plicata*.
„ „ var. *compacta*.
„ „ var. *fastigiata*.
„ „ var. *Hillieri*.
„ „ var. *semperaurescens*.

Thuya plicata, var. *stricta*.
„ „ var. *zebrina*.
Torreya californica.
„ *grandis*.
„ *nucifera*.
Tsuga Albertiana.
„ *Brunoniana*.
„ *canadensis*.
„ „ var. *macrophylla*.
„ „ var. *pendula*.
„ *caroliniana*.
„ „ var. *compacta*.
„ *chinensis*.
„ *diversifolia*.
„ *Jeffreyi*.
„ *Pattoniana*.
„ „ var. *glauca*.
„ *Sieboldi*.
„ *yunnanensis*.

SALES OF TIMBER.

By W. S. FLETCHER.

A year ago there were hopes of a revival in the home-grown timber trade but demand, particularly for small and medium sized oak, has lessened rather than increased. Housing schemes are much fewer and therefore the demand for fencing is less. Reinforced concrete posts are far too much in evidence to please those of us interested in the sale of timber. Trade is not stagnant, but it has been difficult and often impossible to interest a possible buyer in any timber under 14 ins. quarter-girth. The only possible outlet for the small stuff is the local timber merchant.

In the absence of competition, prices are low. Extraction costs are still very high and in connection with this it must be pointed out that the rounding out of felled trees on many areas leaves much to be desired. Badly trimmed trees are difficult to haul and provide a good argument in favour of an extra penny per foot or an increase on the price per ton for haulage.

Twenty years ago native oak planks freshly cut sold at from £7 10*s.* to £10 per load of 50 cubic feet; scantlings at from 3*s.* to 4*s.* per cubic foot, with posts and rails 6*d.* less. At the present time oak planks of reasonable dimensions can be bought at £10 per load and scantlings, posts and rails round about 3*s.* per foot. It is certainly true that except for specials the prices obtained by the grower are less in many cases than those ruling in 1909. Even so, it cannot be said that the average English timber merchant is prospering as it is evident that the high costs of handling and manufacture make it extremely difficult to secure a margin of profit.

The producer abroad adapts himself to the conditions about him and it is certain that we must do likewise. Much of our timber is of poor quality and more of it small, but all sizes and all qualities bear the same cost of transport to the mill and often the poor quality material costs more to handle. Costs of felling are fairly regular in all districts; it is the cost of extraction that varies so much, and will always do so as geography plays its part as well as the lack of hauliers of skill and judgment.

To extract and haul timber to mills in the near neighbourhood costs say 6*d.* to 8*d.* per foot. To extract and haul to rail would also be somewhere around 6*d.* according to distance; rail transport can be taken at an average of 8*d.* and haulage from rail to yards will cost another 2*d.* per foot, making 1*s.* 4*d.* for timber sent by rail against say 8*d.* to mills within eight or nine miles. In view of these costs it is not surprising that small oak is not readily saleable.

For oak from 7 ins. to 11 ins. quarter-girth anything from 7*d.* to 10*d.* per cubic foot on the ground has been the selling price, with from 3*d.* to 5*d.* extra for larger material from 11¼ ins. to 14½ ins. q.g. A few sales at about 1*s.* 5*d.* per foot have been made, the oak being clean and 15 to 20 per cent. of it 14 ins. q.g. and up. Larger oak is always saleable

at any price between 1*s.* 6*d.* and 2*s.* 9*d.* per foot if the quality is good and the haul not too difficult.

Beech, where extraction costs have not been too high, has sold fairly well at from 7½*d.* to 1*s.* per foot felled. Good Spanish chestnut is in fair demand if free from ring shake, the price being from 1*s.* to 1*s.* 6*d.* for trees over 15 ins. q.g. and 6*d.* to 8*d.* for 7 ins. to 12 ins. q.g. Ash of average quality fetches from 1*s.* 6*d.* to 2*s.* per foot and much higher prices may be obtained for timber of really good quality.

Softwoods are not in great demand except larch which has sold readily at from 1*s.* 2*d.* to 1*s.* 6*d.* per foot. The price of Scots pine varies from 7*d.* to 8½*d.* per foot but the quality must be fairly good to get that.

The pitwood market has not been brisk owing to depression in the coalfields. Competition has been keen for the orders that have been going and the consequent drop in price has been felt by sellers and eagerly taken advantage of by the colliery proprietors. It is evident that until our great industries such as coal, iron, steel and shipbuilding are once more prospering trade will not be good enough to make the selling of small timber, together with some of the medium and superior timber, an easy proposition.

It is becoming more and more apparent that supplies of sizeable oak of good quality are very scarce. With architects specifying native grown oak, added to the opinion of all knowledgeable people that our native grown oak need fear no competition either for durability or beauty, it is possible that, provided adequate supplies are available, British oak will come to its own.

The question of supply is a most important one and was referred to recently by the proprietor of an important cabinet works whom I was interviewing, in company with an officer of the Forest Products Research Laboratory. We found it difficult to get information from him and finally he became impatient and said "What do you want? What is the use of your enquiry? Tell me where I can get supplies of good seasoned native oak and I will talk to you."

The main object of the native timber merchant is a reasonable one —to buy, to convert, and to sell, all within a year if possible. It is evident from the extraction and transport costs mentioned above that it needs an expert timber merchant to make both ends meet, let alone make a profit. In districts where there is no certainty of continuous supply to a mill on the spot little if anything can be done except to decrease costs of haulage and conversion, but where supplies can be maintained it is possible to improve methods. For example, why do so much cartage? Why spend so much money on material of poor quality?

To cut out transport costs as far as possible there is only one course and that is to erect a mill near the woods for converting the poorer quality material and to have a central mill not too far away for the first and some of the second grade stuff. Light portable mills are suggested to take to the woods or near there and not the "anything will do" gear, that is frequently put on this job. The poor second

grade timber and the lop and top could then be converted at a price that would pay. It is easy to see that with haulage at a minimum and rail costs eliminated in the case of the poorer classes of timber it is possible to increase the radius of market area for the converted material.

At the central mill the first and second grade timber would be converted in bulk, partially seasoned or completely dried and a continuous stock would be maintained from year to year. Stocks of material ready for use in an area where there is a good supply of timber at hand or near are inducements to manufacturers to erect their factories near supplies.

The milling costs would differ but slightly in each case. Given good gear for sawing and sufficient mechanical appliances to reduce the slow costly man power handling, timber conversion could be carried on at considerably less than it costs in the majority of mills to-day.

Estimates of the cost of conversion, handling and stowage could be given, but would be of little value without knowing particulars of the type of mill, specifications to be cut and the quality of the labour available.

That there is more in manufacture than many people imagine is certain and we have proved that often something that is not first class, if well manufactured, will hold its own with the best. In years to come, when the forests now being established are producing their hundreds of thousands of cubic feet annually, mills will be situated in the forests and material that is spoken of slightingly by the softwood merchants of to-day will be welcomed, its slight deficiencies covered up by its manufacture.

EUROPEAN LARCH SEED.

ENQUIRY INTO QUALITY OF DIFFERENT SEED LOTS.

By W. H. GUILLEBAUD.

Returns have been obtained from all nurseries in which larch was being grown and officers were requested to give the maximum, minimum and average size of plants of each seed lot and age, and also to add remarks on the appearance of the plants. The number of observations amounted to 182, spread over 38 nurseries in England and Wales, and 8 nurseries in Scotland.

Within the past four years seed has been obtained from the following sources :—

Switzerland ..	Vintschgau and Münstertal.
Italy	Cavalese district of the Tyrol.
Silesia	Sudeten.
France ..	Hautes Alpes (one lot only, described as medium quality).
Scotland	Moray, Moy Hall, Altyre, Barcaldine, Strathcona.
England	Hamsterley.

The supplying merchants for the foreign seed were Roner, Stainer, Jenewein, Wallpach-Schwanenfeld, Grünwald and Gebauer.

Although the amount of data appears very considerable, there are so many different ages and types of plants (*e.g.*, 2 + 1, 1 + 2, 1 + 1 + 1, and 2 + 2, 2 + 1 + 1, 1 + 2 + 1, etc.) and the variations in the growth of the same seed lot in different nurseries are so great that it is difficult to come to any very definite conclusion as between the imported seed lots. None of the lots gave a poor result in all nurseries, some that are very good in one nursery are described as poor in others, while the question is further complicated by damage by frost and *Meria laricis*. As far as the data go they do not disclose any definite or consistent difference between the quality of the various lots, with the doubtful exception of the Silesian seed supplied by Gebauer. The latter has been on the whole the least satisfactory, though even with this seed good results were obtained in some nurseries. The following example illustrates the different verdicts that may be obtained. Lot No. 25/28, Silesia (Sudeten), supplied by Gebauer, New Forest, Godshill, 1 + 1 + 1, size, min. 8 ins., max. 16 ins., average 12 ins. Divisional Officer's comment "Good growth and appearance, few being defective." Same lot number Altonside Nursery, 1 + 2, size, min. 5 ins., max. 19½ ins., average 8 ins. Divisional Officer's comment, "Very indifferent and ragged lot."

As regards the native seed, it is only within the last two years that much seed has been collected in this country, hence it is mostly 1-year and 2-year seedlings or 1 + 1 transplants which are available for comparison.

The sizes of the plants are given below.

Age.	Native Seed.				Foreign Seed.			
	Min.	Max.	Average.	No. of Records.	Min.	Max.	Average.	No of Records.
	Ins.	Ins.	Ins.		Ins.	Ins.	Ins.	
1 + 0	1	3¾	2	8	¾	2	1¼	20
2 + 0	5½	14	8½	7	2¾	9	4	9
1 + 1	5	11½	8¼	2	4	10½	7	19

In all three categories the native seed has given on the average the best results, the difference being very marked in the case of the 2-year seedlings. On the other hand. if the best of the foreign lots is compared in each case with the best of the native lots there is not a great deal to choose. See table below.

Nursery.	Seed Lot.	Age.	Min.	Max.	Average.
Chopwell ...	28/27 (Silesia) ...	1 + 0	2	·5	3½
Inchnacardoch	Morayshire	1 + 0	1	5	3
Dalby	27/28 (Swiss)	2 + 0	4	15	9
Tulliallan ...	Barcaldine	2 + 0	9	16	12
Stockley ...	27/28 (Swiss)	1 + 1	7	16	10
Drumtochty ...	25/59 (East Scotland)	1 + 1	5	13	9

There were also two lots of 2 + 2 transplants, one at Inchnacardoch from Moy Hall, Inverness-shire seed, size 17/30/24 and the other from Craibstone from the East of Scotland seed, size 4/18/9; both lots are described as very good plants though the latter are small for the age.

A comparison of the size of plants produced in the various nurseries showed that some nurseries grow better larch than others. In Scotland, Ratagan, Inverleith and Tulliallan appear to be good larch nurseries and Altonside a poor nursery. In England there are not enough returns from most of the nurseries to justify a comparison but Eggesford stands out as a good larch nursery and Fairoak and Lynford nurseries in which larch growth has been poor.

Conclusion.

The data do not warrant the conclusion that any of the merchants dealt with have supplied seed which has given either consistently good or consistently poor results as regards quality of plant produced, or that there is any appreciable difference between Swiss and Italian seed or between seed from low or high elevations.

On the other hand home collected seed does appear to yield on the average stronger and better plants than imported seed.

MEMORANDUM ON THE RAISING OF EUROPEAN LARCH.

By H. M. Steven.

There appear to be two reasons for low production of transplants per pound of seed of European larch. First, the germination is often poor, so that the actual number of seedlings produced per pound is low, and secondly a considerable proportion of the seedlings produced is defective. In the transplant lines the actual death rate is normally low, but again a high proportion of the resulting stock may be culls.

Improvements may be sought along the following lines :—

(1) The general use of methods of nursery practice which have been shown to increase germination, and reduce the proportion of culls both in the seedling and transplant stage.

(2) The use of larch seed from these origins which have given the best results both in production and quality.

(3) The better protection of the stock at all stages from damage by frost and *Meria laricis*.

The available experimental data on these subjects are summarised below.

Methods of Nursery Practice.

The data on this subject are given in Bulletin No. 11, and only the conclusions are now noted, and in the order given in the bulletin :—

(*a*) *Season of Sowing.*—The two controlling factors are the sensitiveness of the germinating seedling to frost damage and the adverse effect of surface caking to germination. Early sowings should be avoided in the north, and even in the south sowings before mid-April are not always safe. The optimum time will generally be the second half of April, a little later in the north.

(*b*) *Treatment of Seed.*—European larch seed responds to treatment more than any of our other common conifers, hence it should always be treated. In general the best results are obtained by simple soaking in water for one day at ordinary room temperature.

(*c*) *Method and Density of Sowing.*—Drill sowing does not increase the production and quality of the stock compared with broadcast, when the same densities are compared. Density of sowing, however, has a very marked effect; thin densities increase both the actual numbers and quality of seedlings produced. For good seed, and when the nursery conditions are favourable for germination, a density of 1 lb. of seed to 300 square feet is recommended for the broadcast method, and 1 lb. to 450 square feet for the drill method.

(*d*) *Depth of Sowing.*—Of our principal coniferous species, larch is the most sensitive to too deep covering, and production can be considerably reduced thereby. The covering should be not more than $\frac{1}{4}$ inch.

(*e*) *Tilth.*—Larch undoubtedly responds to good general tilth conditions. A well drained, but not too dry soil has given the best results. Surface caking reduced germination, hence the soil should be free from this defect to give the best results.

(*f*) *Summer Shelter.*—Provided the seedlings are established, high summer temperatures are not specially dangerous to larch. Rising 1-year seedlings should not be sheltered in summer unless during periods of high temperature, because this tends to reduce the size of the seedlings. Summer shelter after the first year is never necessary.

(*g*) *Winter Protection.*—European larch is not particularly liable to frost-lift; frost shoot damage will be considered in the section dealing with protection.

(*h*) *Grading of Seedlings.*—An elaborate system of grading is unnecessary. Unless there is marked variation in size, two grades, the good seedlings and the culls, the latter to be destroyed, give good results.

(*i*) *Spacing in Transplant Lines.*—Close spacing is not the cause of poor results, 9 or 10 inches by 1 inch increased to 1½ inches where longer stock is expected gives good results.

Seed from different Origins.

In Scandinavia, larch raised from seed of Scottish and Silesian origin gave better results in crown and stem form in the plantation stage than larch of Tyrolese origin, but there is little published information on influence of strain in the nursery stages. Certain differences in the results from seed of different origins have been noted in general practice, but it is sometimes difficult to be certain that the results were strictly comparable, owing to differences in the conditions even in the same nursery. For example, the incidence of frost damage is sometimes extremely local, one part of a nursery may escape and another be affected, and conclusions are not safe unless the plants from different origins are subjected to precisely the same conditions.

In 1925 and 1926 at Bagley nursery, Oxford, sowings were made of larch seed of different origins, there being a number of repeated plots for each origin. They have been studied at each stage, and the 1925 sowing was planted out this spring, so that there are data after the first year in the forest. The origins studied were Scotland (1925 only), Silesia, and the principal Alpine origins. In some instances seed of the same origin and crop was sown both in 1925 and 1926, so that information is available on the influence of age of seed. The following are the conclusions:—

Results from 1925 *Sowings.*

(*a*) The seed from eight Alpine origins and from Silesia was all of average or good quality as measured by the laboratory germination test, 37 per cent. to 53 per cent., and the gross production of 2-year seedlings was good, 7,000 per lb. or over in all cases except 25/10, Austria (altitude 3,280), J. Stainer, which gave 3,500 and 25/45, Switzerland (Vintschgau, altitude 3,281–3,937 ft.), J. Roner, which gave 5,000. The

seed from Silesia, A. Gebauer, gave a good return, 7,200. There were three Scottish lots : Loch Ordie and Ladywell, Dunkeld and Drummond Hill. The germination capacity of Loch Ordie seed was 13 per cent., Ladywell 29 per cent., and the other was not tested, but was probably also low. Ladywell gave a production of 7,500, Loch Ordie 3,200, and Drummond Hill 2,100.

(*b*) The percentage of cull seedlings varied considerably. Ladywell, Loch Ordie, 25/14 (Austria, mica-slate, etc., Wallpach–Schwanenfeld), 25/28 (Silesia), 25/45 (Switzerland Vintschgau), and 25/58 (Gneiss and granite, Silvaterra), had low percentages, 2 to 7 per cent., 25/17 (Switzerland, Münstertal), high, 43 per cent., and the remainder average.

(*c*) At the end of the transplant stage the notable result was the high production of good transplants from the Ladywell seed, 7,200, compared with 6,000, the highest of the other origins.

(*d*) At the end of the first year after planting out, the notable result was the low losses suffered by the plants of Scottish seed origin, average 8 per cent., compared with 18 per cent. for other origins.

(*e*) Observations were made to determine whether there were differences in time of flushing in the spring and ripening in the autumn in plants for different origins. No difference was noted in the seedling stage, but in the transplant those from Scottish origins ripened several weeks earlier than the others.

Results from 1926 *Sowings.*

(*f*) Seed from one Silesian and six Alpine origins was studied, but only one 26/1 (Austria, Cavalese, J. Stainer) was new seed. The season was more favourable than 1925, and higher gross production of 2-year seedlings was obtained. All were satisfactory, 9,900 to 12,200 except 26/1 (the new seed), which gave 3,700, 25/46 (Switzerland, Engadine, J. Roner), 3,100 and 25/58 (Silvaterra) 400.

(*g*) The proportion of culls was average in each case, except 25/46 and 25/58, where they were low, probably due in part to the thin densities resulting from the poor production.

General.

(*h*) The use of seed of the same origin and crop in 1925 and again in 1926 after storage for one year, afforded an opportunity to study the influence of storage. The season 1926 was more favourable to germination than 1925, and this was reflected in the results, the stored seed giving better results than the fresh except in 25/58, Silvaterra. This lot only gave a production of 400 from the 1926 sowing and no production at all was obtained at Bagshot. The poor nursery results in conjunction with a high laboratory germination capacity is inexplicable. There does not appear, however, to be much evidence with the exception of this one case to support the view that stored seed normally gives poor results.

(*i*) It has frequently been stated that the laboratory tests are not a good guide to nursery outturn in European larch. A study of the available data shows that there is not such close correlation between laboratory and nursery results in European larch as in other species. Nevertheless,

in general, seed of poor laboratory germination capacity give poor results in the nursery, and seed with good test figures good results, although 5 per cent. differences may not be reflected.

(*k*) The cause of the failure of the terminal bud to develop in many cases, thus producing badly shaped plants, is worthy of closer study.

Protection.

(*a*) *Against Frost.*—The principal danger from frost damage is in the spring of the season following sowing. During the last four seasons, two of them being notable for their late frosts, no damage has been done to rising 2-year larch at Oxford. The practice is to keep on the lath shelters continuously until the end of April, and then to put them on at night when frosts threaten. Our experience is that the late frosts seldom come unheralded. For several nights before a severe frost is experienced the night temperatures progressively fall. This, in conjunction with weather reports, give an indication when shelter is necessary at night in spring.

The lining out of 1-year seedlings of suitable size should tend to reduce losses from frost.

(*b*) *Meria laricis.*—In 1926 a severe attack of *Meria laricis* was experienced, and an opportunity was afforded to study its effect on larch of different seed origins subjected to different treatments. The season was a wet one, and the attack began on the rising 2-year seedlings in the middle of May, infection coming from old transplants, and was not correlated with frost damage. The lower leaves of the seedlings were attacked first, and the damage continued until August, the fungus following up the needles of the growing shoot.

To begin with it appeared that sheltered plots were less attacked, and this was studied but gave negative results. An experiment on method and density of sowing, broadcast and drill with four densities of each and four replications was infected, and there was no correlation between method and density and attack. The only plot which was better than the others was one replication of the densest broadcast, and this was obviously chance. Similarly, larch plants from seed sown at different dates and in plots subject to different manurings, were equally attacked, and finally plants from 12 different origins, Scottish, Silesian and Tyrolese, showed no difference in resistance. When an attack is severe, therefore, nursery treatment or origin of seed does not appear to make any difference.

Although the *Meria* checked growth and increased the proportion of culls, the damage was not very serious, and the subsequent development of the plants was good.

In 1927 and 1928 slight attacks began, but ceased after spraying with Burgundy mixture, although whether the spray was the effective agent or no was by no means certain, as the weather conditions were dry and probably did not favour the fungus.

Effective control of *Meria* has still to be devised, and the solution appears to be in spraying rather than in nursery treatment.

Summary.

The following items in nursery technique improve production :—

(*a*) Avoidance of too early sowing because of the sensitiveness of the germinating seedling to frost damage which may not be noted. Sowing during the second half of April recommended, later in the north.

(*b*) Seed should always be treated. Soaking for one day in water at room temperature, say, 60° F., is effective.

(*c*) Drill sowing does not improve quantity or quality, but thin sowing does. When seed and nursery conditions are good, 1 lb. to 300 sq. ft. give best results in the broadcast method.

(*d*) Deep sowing reduces germination. Optimum depth less than $\frac{1}{4}$ in.

(*e*) Well drained but not too dry soils gives the best results, while surface caking reduces germination.

(*f*) Do not shelter in summer unless during periods of high temperature.

(*g*) Frost damage is prevented by lath shelter kept on continuously from autumn until the end of April, and then applied at night when frosts are expected. Late frosts are generally heralded by dropping night temperatures before they actually come, and weather forecasts can be utilised.

(*h*) Scottish seed, provided it is of at least average quality, say, 30 per cent., gives the best results in production and quality of transplants and in low losses after planting. Silesian seed has also given good results.

WINDSOR NURSERIES.

By W. C. Squires.

When, in 1916, owing to the exigencies of the War, large areas of forest land had been denuded of timber for military and other purposes, it was apparent that measures would have to be taken whereby an adequate supply of plants would be forthcoming to replant the felled areas. Not only had the supply of plants to the Crown forests to be considered, but it was also essential that private nurserymen, whose nursery operations had been interfered with owing to their employees being called to the colours, should be in a position to accommodate their customers. The Crown authorities therefore decided to raise, on a large scale, seedlings of those species which would be most in demand for replanting.

With the exception of two small nurseries of six acres each, one of which had been long established at Bushfield and one at Swinley (formed in 1915), there were no substantial areas in the Windsor district under the control of the Commissioners of H.M. Woods available for such an undertaking. Measures were taken to secure a site suitable for the purpose, and it was arranged that a portion of Rapley Farm, on the northern side of the Bracknell-Bagshot road, should be acquired as it was most conveniently situated to answer the needs of a nursery in many respects, one of the chief advantages being its proximity to a main road.

This land was held on lease from the Commissioners of H.M. Woods by H.R.H. The Duke of Connaught, who kindly agreed that the area should be used for raising forest trees. It consisted of four large fields, containing together approximately 80 acres, intersected by a ditch from north to south and divided by a ride running due east to west. It is situated on the fringe of the Bagshot sand formation at an elevation of 280 ft. above sea level, and has a gentle slope from north to south. The land had become derelict owing to non-cultivation for some years, in consequence of which much of it was covered with birch scrub, a strong growth of gorse and heather, and an abundance of coarse weeds, such as thistle, ragwort, etc. The ditch, by long inattention to cleaning, had become choked by accumulated matter, causing the upper portion of the area to be waterlogged.

The operation of cleaning was at first undertaken by grubbing the birch scrub, gorse and heather, cutting the coarse weeds, and burning the whole of the rubbish, cleaning the choked ditch and draining the waterlogged land. The preparation of the largest field, about 25 acres, situated in the south-eastern portion of the area, was taken in hand in August, 1916, by first deeply cultivating with steam tackle and then harrowing. After collecting and burning the rubbish the ground was steam ploughed, again harrowed and cleaned.

To facilitate the keeping of proper records of the nursery, and the collection and haulage of plants to be carried out with ease, the land was then divided into rectangular plots of one-quarter of an acre each, labelled and numbered. Paths 4 ft. wide divided the plots, and rides

12 ft. wide were made at convenient intervals for cart traffic. This area, with the addition of Bushfield and Swinley nurseries already mentioned, totalled about 92 acres.

The land having been prepared, lining-out operations were proceeded with during the season 1916–17. Seedlings were obtained from Bushfield and Swinley nurseries and other sources, with the result that at the end of the season the stock of transplants was 4,409,000.

During the summer of 1917 the cultivation of the remaining fields was taken in hand. As deep ploughing by steam tackle had not proved entirely satisfactory, owing to pan which existed in places not being broken, it was deemed expedient to trench the remaining area. This operation, though apparently costly (£20 per acre), proved eventually the cheapest method as less weeding was required, and the transplants benefited by the deeper moving of the subsoil. During the following season the remainder of the area was trenched and laid out in ¼-acre plots, and lining out of seedlings was carried out extensively, the stock of transplants at the end of the year amounting to 9,269,000. At this period the raising of seedlings on an extended scale was commenced, the season's production being four million seedlings. In connection with seed sowing a system of pre-germination was introduced by placing the seed in prepared trays and keeping it moist until germination was detected. By this means the germination percentage could be ascertained, and the knowledge gained was of great value in the allocation of seed-bed space.

Owing to the difficulty in securing sufficient men to carry out the necessary work in connection with the nursery, as so many had been called away on military service, it was decided to employ women to perform the lighter tasks, such as weeding seed-beds, weeding lines, etc. About two dozen were at first employed, but the number was increased later. To meet the needs of a useful working dress the women were provided with an outfit consisting of a mackintosh, gabardine smock, cord breeches, cloth cap, a pair of strong boots, and gaiters. This outfit was renewed periodically.

On the cessation of hostilities labour became more plentiful, but still the nursery operations were handicapped by the outside local demand for men for work which had been suspended during the war. The wages paid by the private contractors were largely in excess of those authorised by the Agricultural Wages Committee for our nursery employees. To overcome this difficulty, piece-work rates were instituted, so that the men might earn as much as the ordinary labourer employed in the district. This arrangement proved most satisfactory, and a good class of workman was thereby secured. Payment by results, providing sufficient supervision is supplied to prevent inferior work, is without doubt the most satisfactory method of carrying out nursery operations on a large scale. From 1920 onwards the nursery operations were able to proceed without interruption, and the transference of seedlings and transplants to Forestry Commission and other areas increased annually.

The peak of production was reached during the seasons 1922–23–24, when nearly 6,000 lbs. of seed were sown and 48 million seedlings raised. It is of interest to note that in September, 1924, the seed-beds (4 ft. wide),

if placed end to end, would have reached a distance of 27 miles, representing a continuous bed from Bagshot to London. From 1916 until the end of the tenancy of the nurseries in 1928 the total amount of seed sown was 17,600 lbs., resulting in the production of 109 million seedlings.

To myself, the work of organising and superintending the nursery from a small beginning to what eventually became a successful undertaking on a large scale was most interesting. The preparation of the land, seed sowing and careful attention at all stages to the seedlings and transplants, until they were in a condition to take their place in the forests of the future, was indeed a pleasant task.

DISTINGUISHING CHARACTERS OF FORMS OF DOUGLAS FIR.

By J. F. ANNAND.

It is well known that Douglas fir is distributed over a very wide area in Canada and the United States. Within this area two or three fairly distinct climatic zones are recognised in Canadian forest literature, and in all of them Douglas fir forms forest, either pure or in mixture with other species. It would appear that at least three distinct forms of types are distinguished as occurring in British Columbia, namely :—

1. The *Coastal* or "*Green*" form found in regions west of the Cascade and coast mountains.
2. The "*Dry Belt*" or *Inter-mountain* form sometimes known as the "Fraser River" or *Caesia* variety found between the coast mountains on the west and the Cariboo and Monashee Mountains on the east, and
3. The *Mountain Form* occurring in the Rocky Mountains and in the region known as the interior wet belt comprising the Monashee, the Cariboo and the Selkirk Mountains. This is not usually distinguished in this country from the Dry Belt form.

The green form of Douglas fir is the tree we find most suitable for our climatic conditions. Although it may be a little less hardy against drying winds, its superiority in rate of growth over the other forms more than compensates for this disadvantage. The dry belt type evidently comes from a climatic zone characterised by extremes of temperature—hot summers and cold winters, with a very low annual rainfall of 10 to 15 ins. The other forms from the interior also appear to thrive in a climate more continental in character than ours.

The material examined for the purposes of this note was grown in the seed-beds at Craibstone and Seaton nurseries. For comparison, use was also made of the Douglas fir trees raised from seeds collected by Mr. P. Leslie in different parts of Canada and planted out in small separate plots in Craibstone woods. These plants are now seven years old from seed and were set out as 2 + 2 transplants in March, 1926.

The Identification Number supplied with the Forestry Commission seeds was 27/5. The seeds, it is understood, were supplied gratuitously by Mr. Pack. No locality of collection was given further than "U.S.A." It has been found that the resulting seedlings, which are now two years old, are of mixed types. About one-fourth of them are of the desired green or coastal form, and the remainder, it is presumed, come from a locality corresponding climatically to the interior dry or wet belts in Canada.

The differences observed in the two types of seedlings in the seed-beds are as follows:—

Green Form.	Dry Belt or Inter-mountain Form.
Germination of Seed. Rather slow and irregular.	*Germination of Seed.* Uniform and more rapid.
One year Seedlings. Growth of one year seedlings continues until early Autumn and ripening of shoots prolonged.	*One year Seedlings.* In one year seedlings growth finishes early; shoots ripen very early in Autumn.
In one year seedlings leaves curl upwards towards tip of shoot, so as to entirely conceal terminal bud. Buds paler in colour than those of inter-mountain form.	The terminal buds of one year seedlings are large, reddish in colour, and not hidden by leaves which stand out stiffly in a horizontal position on the stem.
Two year Seedlings. In two year seedlings, the growth continues until late summer or early Autumn and shoots do not ripen until late in Autumn.	*Two year Seedlings.* In two year seedlings, growth finishes early and buds ripen long before those of coastal Douglas.
Two year seedlings, TALL.	Two year seedlings, SHORT—usually about one-half the length of the seedlings of the coast form.
Colour of one year old shoot— Yellowish green or orange green.	*Colour* of one year shoot— Silvery mauve or purple, occasionally brownish.
Shoots, smooth, rarely with any fissures or cracking of bark.	*Shoots*, even of one year seedlings usually fissured with short longitudinal cracks in bark.

The characters and differences given above are considered to be sufficiently constant to enable a forester to distinguish between seedlings of the green or coastal type from those raised from seed collected in the interior. There are other differences, such as the colour of the needle-leaves and their arrangement on the shoot, but in the seed-bed stage the colour of the leaves varies and it is doubtful if much reliance could be placed upon this character at the seedling stage. The colour of the one year old shoots and the behaviour (rate of growth, etc.) of the seedlings are most important points. Any seedling which has not got the characteristic smooth yellowish-green shoot of the coast type should be looked upon with suspicion.

The seedlings in the nursery beds have been compared with plants obtained from Mr. Leslie's seeds. The green form corresponds in all respects with plants raised from seeds collected by him in Vancouver. The other slow-growing type corresponds to plants raised from seeds collected at a representative centre in the interior dry belt, near the town of Kamloops on the Thomson River, but at a higher elevation. Mr. Leslie's seeds were sown in Craibstone nursery in the spring of 1922 and the plants were set out as 2 + 2 in March, 1926. At the end of

growing season 1928, after three seasons' growth, the average total height growth of the plants in two of the plots was as follows :—

From Vancouver seed.	From Kamloops seed.
7 ft.	3 ft. 4 ins.

During 1928 the Vancouver plants made an average height growth of 24 ins. against a height growth of 10½ ins. in the case of the dry belt plants.

[It would be useful if those in charge of nurseries in which there are plants of reputed dry belt type Douglas fir would ascertain how far they agree with the characters given by Mr. Annand and report in the next number of the Journal.—Ed.]

OUR OFFICE METHODS.

By M. E. W. MACKENZIE.

The Forestry Commission is one of the few Commercial Departments of the Civil Service and, so far, does not to any great extent suffer from the canker of "red tape." One would not expect it in a new department but we must guard against its introduction as time goes on.

Many people, for divers reasons, disagree with the principle of State trading, but obviously Forestry is an exception. Nevertheless our efforts and management will be the subject of close scrutiny and adverse criticism and it is essential that the department be run on strictly business lines.

Now it is in this direction that I think we might tighten-up our organization; its importance may not be apparent at the present stage but it will become increasingly imperative for our accounting, costing and records to be of the highest order. Take our present costing system. We have the weekly or fortnightly progress reports from which are prepared the monthly costing returns (merely an amalgamation of figures) and also the annual statements issued by Headquarters. The latter are comprehensive but the former deal only with labour costs. Each is good in its way but neither really ensures full control; the progress reports are submitted promptly and are indispensable but omit cost of materials, oncost, etc., and the annual statements are issued (unavoidably) months after the year to which they relate. What is required is a complete and prompt costing; this may be impracticable as covering the whole range of work but there is one operation, namely, "Preparation and sales of produce," which could be completely costed without delay by means of trading accounts. After all, the Commission's prime object is the preparation (in the broadest sense) and sale of produce and it would, I think, be far more profitable to cost this operation on satisfactory lines than to spend the time on the preparation of monthly costing returns which are little more than a duplication of the progress reports and, in any case, deal only with labour charges.

The actual procedure of produce recording might also be overhauled with a view to reducing clerical work. I would recommend the abolition of forms A.71 (foresters monthly produce account) and A.73 (return of unsold stocks) and the institution of produce ledgers in loose-leaf form to be kept by each forester concerned which would be subject to a quarterly (or even half-yearly) check at Divisional Office. The ledgers would have a folio for each class of produce and would show details (by fortnights) of produce prepared on one side and issues on the other. The information would be compact and in convenient form and monthly checking would be obviated.

Then there is the question of general routine, especially in Divisional Offices, which could, I think, be improved considerably by the introduction of up-to-date business methods. For example, the way in which rents are acknowledged is cumbersome. In Division 2 something like a thousand receipts are issued to some 250 to 300 tenants in the course of a year. Now each receipt contains the name of the forest, of the

tenant and of the property, the amount received (in words and figures) and the period. It has to be signed and dated and a counterfoil taken. This is the prescribed form, but why not use ordinary rent cards containing at the head brief particulars of the tenancy (including names and address of tenant, property, rental number, etc.) and having in the body five columns for due date, period, amount received, date of receipt and signature of receiving officer, respectively? Such cards could be used with window envelopes and would contain a request that tenants forward with their rents. The initial entries on the card would take as long to write as the ordinary receipt as now used but thereafter the acknowledging of the rent would be a very speedy matter.

Whilst on the question of rents I might mention the inadequacy of the collecting rental. The form prescribed for accounting is quite suitable for that object, but cannot conveniently be adapted for collecting purposes. Personally, I prefer a card index with a separate card for each tenancy—a loose-leaf ledger would be equally suitable. With rents falling due on multifarious dates, I find difficulty in ensuring that demands are issued at the proper time. With a prospective big increase of tenancies, the matter is well worth consideration.

Other routine work, too, could be considerably "speeded-up." Loose-leaf ledgers, window envelopes, up-to-date typewriters, inexpensive duplicating machines and better (*i.e.*, more appropriate) forms are a few suggestions which occur to me. "Economy" in stationery can be an expensive business if it results in wasted time, and I would strongly urge the careful consideration of this matter. It is disheartening to staff, working under pressure, to know that some, at least, of their time is being spent on work which could be eliminated by reasonable office equipment. We are now approaching the end of the first decade, and should be in a position to determine what we want and the best possible way of obtaining it.

The following comments on the above suggestions have been submitted by Mr. T. W. Cleland :—

As Mr. Mackenzie, in his article, "Our Office Methods," makes certain suggestions in connection with the Commissioners' costing system and on the system of produce accounts and records, I should like to offer a few observations.

As there must be progress if there is not to be falling back, it is well that Mr. Mackenzie should suggest improvements, but it should not be taken that the Commissioners need fear criticism upon their accounting and costing system in its present state. The contrary is the case. The Director of Forestry, South Africa, investigated the system personally. The following year his Accountant, who was in this country on leave, spent several days studying it. The Irish Free State asked that the Chief Clerk of their Forestry Department might make a report on our methods. Sir Malcolm Ramsay, the Comptroller and Auditor-General,

made the following statement to the Public Accounts Committee in May 1927 :—

> " They (the Forestry Commissioners) have a very complete and very inexpensive system of costing which enables them to compare costs in each forest under their control, and I believe it is very valuable for securing economy and efficiency."

The first suggestion with which I wish to deal relates to an important forestry operation which has not yet been costed. I refer to " Preparation and Sale of Produce," of which he writes : it " could be completely costed without delay by means of trading accounts."

I agree that it would be well if some financial machinery were devised to test the economy of the expenditure under this head. Trading accounts which, as Mr. Mackenzie knows well, are not cost accounts, would not help, even if, as is unlikely, they could be constructed. (The essential item of the cost of the standing timber is not easy to obtain.) Assuming that it were possible to construct a trading account, a gross profit or a gross loss would not necessarily prove high or low cost of preparation of produce ; high or low market prices might be the cause. Before the method of costing can be determined we must have a clear purpose in mind. If our purpose is to ascertain whether it would have been cheaper to sell timber standing rather than prepared, the cost of preparing and selling (with " oncost " added) is the vital factor. We should have to devise machinery to show whether the selling price of prepared produce could bear a deduction of such cost and yet exceed the market price of the timber if sold standing. If our purpose is to compare in different forests the cost of preparing produce by the cubic foot, there are many difficulties to be overcome : the cost will vary according to the species, the age of the trees, the class of produce prepared, and so on. The subject is not an easy one, but it is worth consideration.

On the subject of accounting for prepared produce, Mr. Mackenzie suggests the abolition of (1) the monthly account of produce prepared and produce disposed of which the forester renders to his Divisional Office, its place to be taken by a produce ledger kept by the forester and checked quarterly in the Divisional Office ; and (2) the return of unsold stocks which the Divisional Officer forwards monthly to the Assistant Commissioner. His first suggestion is, in effect, to substitute a quarterly for a monthly account. As all other accounts are on a monthly basis, why should this particular one be an exception ? If it ought to be quarterly, the arguments in justification could probably be applied to the others. The return of unsold stocks is for administrative and not for accounting purposes. Its purpose is to enable the Assistant Commissioner to see whether too much or too little timber is being felled.

The Commission's produce accounting procedure is still probably in the experimental stage. When exploitation of the new plantations commences, accounting for produce will assume great importance. Meantime experience is being gained in dealing with the Crown Woods.

THE PRICING OF PLANTS.

By T. W. Cleland.

In view of the recent publication of the Forestry Commission Bulletin No. 11—"Nursery Investigations," by Dr. H. M. Steven—an account of how the prices of plants are built up may be opportune.

Few, if any, of us will live to see to what figure the bill of cost of the plantations now being established will have mounted to when the timber is mature. Even if we do, the knowledge of the cost may be of no service, for who knows what world factors may change values in the next fifty years? In plantations, therefore, our main interest, so far as costing is concerned, must lie in initial expenditure. In nurseries, however, where the cycle of operations is confined normally to three or four years, we have the opportunity of building up prices.

A nurseryman who wishes to know what his plants cost to raise must keep certain records; and these must distinguish between the several species and ages of plants in his nursery. He must know the total areas of beds and lines, and the portions prepared each year: he must keep records of seed sown, of seedlings and transplants lifted, of seedlings received from other nurseries, of seedlings lined out, and of the stocks in the nursery at the end of each year. He must also classify his year's direct expenditure according to the different operations—"preparation of beds and sowing," "weeding lines," and so forth.

So far, direct expenditure only has been taken into account, but if plants are not to be sold at a loss there are two other items of expenditure which must be borne in mind. One is "oncost," a word not capable of precise definition, but used in this article to describe expenditure on rent, rates, use of stores, depreciation of buildings and administration. Such expenditure is necessary to the upkeep of a nursery, and must be paid for in the prices charged for the produce. The other is "interest on capital." The loan of capital which could otherwise be employed in the earning of dividends is a service which must also be paid for.

The nurseryman, after classifying his direct expenditure, will find it necessary to state it in terms of a "unit." The nursery expenditure on "preparation of beds and sowing," "weeding beds," "preparation of lines and lining out" and "weeding lines" should in each case be reduced to the expenditure on the "unit" of 100 square yards, while the nursery expenditure on "lifting seedlings" and "lifting transplants" should in each case be reduced to the expenditure on the "unit" of 1,000 plants.

As the method of pricing plants will be best understood from an example, it will be supposed that the nurseryman wants to price his Scots pine produce as 1-year, as 2-year and as 2 + 1 plants.

One-year Seedlings.—From his records he finds he used 144 lbs. of Scots pine seed at 15*s.* per lb. on an area of 6,100 square yards; that "preparation of beds and sowing" and "weeding beds" cost 13*s.* 2*d.* and £1 1*s.* 3*d.* respectively per 100 square yards. He estimates that an "oncost" of 20 per cent. on labour and material should be added for

rent, rates, administration, etc. He pays 5 per cent. interest on capital, and he finds at stocktaking that there are 2,500,000 Scots pine 1-year seedlings.

The bill of cost is made up as follows :—

	£
Seed—144 lbs. at 15*s.* per lb.	108
Preparation of beds and sowing—6,100 square yards at 13*s.* 2*d.* per 100 square yards	40
Weeding beds—6,100 square yards at £1 1*s.* 3*d.* per 100 square yards	65
Direct Expenditure	£213
" Oncost "—20 per cent. of Direct Expenditure	43
Interest on capital—£256 (£213 + £43) at 5 per cent. for an average of six months	6
Cost of production of 2,500,000 Scots pine 1-year seedlings	£262

Therefore the cost of production of 1,000 Scots pine 1-year seedlings (standing in beds) = 2*s.* 1*d.*

Two-year Seedlings.—The nurseryman's Scots pine seedlings are now a year older. During the year they have been protected against frost at a cost of £7, and they have required weeding which cost £1 1*s.* 3*d.* per 100 square yards. If some of the 1-year seedlings have been lifted for lining out, complications arise in arriving at 2-year costs, but it will be presumed for the purposes of the present article that the seed-bed was left intact. Losses through death have occurred ; instead of 2,500,000 the stock is now 2,220,000.

The position of the bill of cost (end of second year) is :—

			£
Brought forward from first year			262
Protection of Scots pine seedlings		£7	
Weeding beds—6,100 square yards at £1 1*s.* 3*d.* per 100 square yards		65	
Direct Expenditure, second year		£72	
" Oncost "—20 per cent. of Direct Expenditure. second year		14	
Interest on capital—			
£262 at 5 per cent. for one year	£13		
£86 (£72 + £14) at 5 per cent. for average of six months	2		
	—	15	
		—	101
Cost of production of 2,220,000 Scots pine 2-year seedlings			£363

Therefore cost of production of 1,000 Scots pine 2-year seedlings (standing in beds) = 3*s.* 3*d.*

2 + 1 *Transplants.*—One year later! What has happened to the 2,220,000 2-year seedlings standing in the beds a year ago? Several things, possibly. Some have undoubtedly died; some may have been despatched to another nursery for lining out there; others may have been lined out by our nurseryman, and others again may have been left in the beds. Where the contents of a bed are dealt with in several ways, complications are introduced into the bill of cost. Again, therefore, it will be presumed that the seed-bed was left intact until the spring, when all seedlings which stood the winter were lined out. They, it will be assumed, numbered 2,000,000. The work involved, then, has been the lifting of 2,000,000 seedlings at 1*s.* per 1,000, the preparation of 40,000 square yards of lines, the lining out of the 2,000,000—the two operations, taken together costing £1 per 100 square yards—and the weeding of the lines at 10*s.* per 100 square yards. At stocktaking there were 1,750,000 Scots pine 2 + 1 transplants.

The bill of cost may now (end of third year) be continued:—

		£
Brought forward from second year		363
Lifting of 2,000,000 seedlings at 1*s.* per 1,000	£100	
Preparation of 40,000 sq. yds. of lines and lining out seedlings at £1 per 100 sq. yds.	400	
Weeding lines at 10*s.* per 100 sq. yds.	200	
Direct expenditure, third year	£700	
"Oncost"—20 per cent. of Direct Expenditure, third year	140	
Interest on capital—		
£363 at 5 per cent. for one year	£18	
£840 (£700 + £140) at 5 per cent. for six months	21	
	39	
		879
Cost of production of 1,750,000 Scots pine 2 + 1 transplants		£1,242

Therefore cost of production of 1,000 Scots pine 2 + 1 transplants (standing in beds) = 14*s.* 2*d.*

It will be well to set out the bill of cost in summary form and to place side by side with it a statement showing how the 14*s.* 2*d.* (cost of 1,000 2 + 1 transplants) is built up. Thus:—

FIRST YEAR.

	Raising 2,500,000 Scots pine, 1-year.		Raising 1,429 Scots pine, 1-year.	
	£	£	*s.* *d.*	*s.* *d.*
Direct expenditure ...	213		2 5	
Indirect expenditure ...	43		0 6	
Interest on capital ...	6		0 1	
		262		3 0

SECOND YEAR.

	Converting 2,500,000 1-year to 2,220,000 2-year.		Converting 1,429 1-year to 1,269 2-year.	
	£	£	*s.* *d.*	*s.* *d.*
Direct expenditure ...	72		0 10	
Indirect expenditure ...	14		0 2	
Interest on capital ...	15		0 2	
	—	101	—	1 2

THIRD YEAR.

	Converting 2,220,000 2-year to 1,750,000 2 + 1.		Converting 1,269 2-year to 1,000 2 + 1.	
	£	£	*s.* *d.*	*s.* *d.*
Direct expenditure ...	700		8 0	
Indirect expenditure ...	140		1 7	
Interest on capital ...	39		0 5	
	—	879	—	10 0
Total cost of production (1,750,000 2 + 1)		£1,242	(1,000 2+1)	14 2

The factors which affect the price of plants are :—(*a*) Labour and material; (*b*) density of sowing and spacing in the lines; (*c*) germination; (*d*) mortality in beds and lines, and (*e*) indirect expenditure. Economy in labour and material will reduce the direct expenditure; dense sowing and close spacing in lines consistent with good nursery practice will raise outturn without appreciably raising cost; high germination and low death rate in the beds and lines will operate in the same direction; while cheap land and buildings and simple administration will keep down "oncost." In his Foreword to Bulletin No. 11, Mr. Robinson states :—"Of the factors entering into the cost, spacing in the lines is the most important." If two factors were to be selected the other would be the death rate in the beds and lines.

The first year in the life of a transplant has been seen to be expensive. Where a second lining out is undertaken the cost of the resultant plants will be very high. It is a question whether the production of 2 + 1 + 1, 2 + 2 + 1, etc., plants is worth while.

In a nursery which is conducted on commercial lines too great attention cannot be paid to the accuracy of stocktaking. The bill of cost may be most carefully prepared but if the plants raised are overestimated and the prices charged are fixed by relating the over-estimated numbers to the cost they will be fixed too low and a loss will be sustained by the nursery. On the other hand, where competition exists among nurserymen, an underestimate of the stock will result in higher prices being asked for than circumstances demand, with the possible loss of orders.

FOREST PRODUCTS RESEARCH.

The Forest Products Research Laboratory works in close co-operation with the Forestry Commission. Its primary purpose is to promote, in the national interest, the more economical use of timber. It was established as the result of a recommendation by the Imperial Forestry Conference, 1920, and acts under the Department of Scientific and Industrial Research. The Laboratory, which occupies a site of about 35 acres, is situated at Princes Risborough some sixteen miles south-east of Oxford. The Director is Mr. R. S. Pearson, late Forest Economist at Dehra Dun.

The Laboratory is equipped to undertake special investigations for timber users in this country and renders assistance by investigating the qualities of foreign-grown timbers—so largely imported into this country—as well as home-grown and Empire timbers.

To a great extent the work of the Laboratory is complementary to that of the Forestry Commission because the latter is principally interested in the growing of the forests and the Research Laboratory is mainly concerned with the utilisation of the timber which the forests produce.

The Laboratory is organised into various sections; those of administration, seasoning, timber mechanics, wood preservation, wood working, entomology and utilisation are to be found at Princes Risborough. The section of wood technology is housed at the Imperial Forestry Institute, Oxford, that of mycology at the Imperial College of Science, London, while chemistry investigations are conducted at Oxford and St. Andrew's Universities.

The following notes on the Laboratory's programme of work are abbreviated from a memorandum recently issued by the Department.

Wood Technology and Timber Physics.—Whether the timber is to undergo a complete investigation of all its qualities—of structure, seasoning, strength, durability, working—or is only to be investigated for some limited purpose, examination by the wood technologist is the first step to be taken. The limited purpose may be to identify the timber, or to indicate the possible uses of a new timber, or to discover some variation or abnormality of structure responsible for the failure of a particular sample of a standard timber. To assist in the identification and comparison of species, there are available at the Imperial Forestry Institute some three thousand hand samples of woods the identity of which has been established by botanical material obtained from the original trees, and from these the Institute and the Laboratory have co-operated in preparing type slides for the microscope, showing the minute structure. The immediate value of this work is illustrated by the number of demands each week made by the wood-using trades for the identification of unknown or doubtful samples.

Seasoning.—The next step in the general study of a particular timber is the examination of its aptitude for seasoning and the best means of achieving a satisfactory result. Some timbers season with ease, others with difficulty; and each must receive a treatment suited to its charac-

teristics. For seasoning under natural conditions this will affect the manner of piling in the yard. For seasoning under artificial conditions it will influence the method of drying in the kiln. Bad methods of seasoning are responsible for a large wastage of timber, perhaps only exceeded by losses due to decay.

Timber Mechanics.—The results obtained by the investigations in wood structure and seasoning indicate which lines of work in Timber Mechanics, Wood Preservation and Wood Working, may be required. For instance, if the wood is obviously suited to cabinet work, seasoning and wood-working tests may be all that is necessary though possibly some additional mechanical tests for hardness, tension and cleavage may be called for. On the other hand, for hammer-handles, certain mechanical tests alone may be required. But for timbers about which the fullest information is required, a full range of investigation is necessary, such as is being carried out for the home-grown timbers. In the Section of Timber Mechanics, the first step is to make mechanical tests on small specimens free from defects in order to determine what is called the inherent fibre strength of the species. The results are used in comparing one species with another, in determining the influence of defects when testing large-sized timbers, and in computing the influence of rate of growth, density and moisture content. The tests as carried out by this Laboratory are susceptible of comparison with those of the Laboratories of the United States, India, Canada, the Federated Malay States, South Africa and New Zealand, all of which have adopted as standard practice the use of the machines and methods of test first introduced by the Forest Products Laboratory of the United States.

Of the specialized mechanical tests, designed to prove a timber for some particular purpose, the most important that have been undertaken are those concerned with the use of certain home-grown species for pit-props. The results of the tests are chiefly in favour of most of the home-grown species tested, as compared with imported props. The impression that British grown timbers were unsuitable for use as pit-props probably arose first from the fact that during the War any and all timber was called into use and secondly, that the home-grown article has, in the past, been placed on the market poorly graded and poorly trimmed. This work has been carried out in collaboration with the Forestry Commission, who supplied sample props for practical tests in different mines. The tests on pit-props are of special importance to the Commission and other growers in this country in marketing the thinnings from their young woods.

Wood Preservation.—The programme of work in this subject comprises the study of the natural durability of different species of timber, the efficacy of different antiseptics, and the various methods of applying preservatives. One of its chief objects is to cheapen the process and thus widen its use. The work is closely co-ordinated with that of the Sections of Mycology and Entomology, which study wood destroying fungi and beetles, and with the Section of Chemistry, which studies the chemical alterations in wood substance caused by these agencies.

Wood Working.—In the effective marketing and utilization of a timber something more is required than an examination of the physical and mechanical properties described in the preceding paragraphs. It is necessary to say how a given timber will behave under the tool and to determine what set of the saw or knife, for instance, or what machine speed will give the best results.

Pathology (*Mycology and Entomology*).—A bulletin, "Dry Rot in Wood," drawn up in collaboration with Professor Percy Groom, F.R.S., the Building Research Board and H.M. Office of Works, has been issued by the Laboratory. The existing information concerning the cause, prevention and cure of an evil which is responsible for heavy losses and for no small number of accidents, should be known as widely as possible. The treatment of dry rot depends largely on the particular circumstances of attack attending each individual case, and in the less simple cases expert opinion is usually necessary. But prevention is better than cure, and given an understanding of the conditions inviting decay, there is no doubt that attacks of dry rot can be materially reduced by proper care in construction and by quite simple precautions. The study of the conditions and development of the organisms concerned, and the means of control is being continued.

Considerable success has attended the investigations on the Lyctus beetles which are causing serious trouble particularly to the furniture manufacturing trade. A demonstration has been given to the trade of a means of ridding their timber of this pest, by a steam sterilization treatment in the kiln. Important progress has been made in the study of the life-history of this pest. Previous workers have shown that *Lyctus brunneus* lays its eggs only inside the pores of hardwoods; research by the Laboratory further indicates that this is true also of *L. linearis*. The Laboratory has also been able to show that there is a definite relationship between the size of pores in the different species of hardwoods and liability to attack. This makes it possible to say that certain timbers can be attacked while others will be immune.

Chemistry.—Investigation of the hemicelluloses of timber is now being carried out at St. Andrew's University. The results have been published in the Biochemical Journal. The chemist on the staff of the Laboratory who works at Oxford is carrying out, in co-operation with the section of Mycology, an investigation on the alterations taking place in wood-substance during the progress of decay. The study of these alterations may indicate improved means of preventing decay.

Utilisation.—The Section of Utilisation is the link with the industry in building up cordial relations, carrying out commercial surveys to find out trade difficulties, and indicate lines of research, in keeping research work practical, and in getting the best value for the cost of research by securing the application of its results. The range of enquiries coming to this Section—of which over 400 have been dealt with within the past two years—is very wide, covering as it does almost all aspects of utilisation from the conversion of the log in the saw-mill to its numberless uses, including the use of waste material.

REVIEWS AND ABSTRACTS.

FURTHER INVESTIGATIONS ON EARLY AND LATE SPRUCES.

By Professor Münch.

(*Zeitschrift für Forst und Jagdwesen*, March, 1928.)

Earlier studies by Münch showed that in most young crops of Norway spruce great differences can be observed in the time of coming into leaf of the individual trees. For convenience, Münch distinguished five classes, late, fairly late, fairly early, early and very early. A space of over a month may separate the late from the very early spruce. Further, he showed, as was to be expected, that in frosty localities the late spruce escaped the spring frosts in great measure and so showed a much better growth than the early forms.

In the present investigation, Münch has studied the growth of early and late spruce in normal localities which are not affected by spring frosts and he comes to the interesting conclusion that while there is no very appreciable difference in their behaviour on fresh soils of good quality, on poor soils where the development of spruce is slow, the late spruce are definitely superior. A typical instance is a 12 year old plantation on poor soil where the average height was 4·4 ft., the late spruce averaged 5·0 ft. and the early spruce 3·5 ft. It may be remarked that the figures which Münch gives throw quite an interesting light on the early rate of growth of spruce plantations in Saxony. What he describes as normal plantations show the following average heights, 4 ft. at 8 years, 5 ft. at 11 years, 7 ft. at 13 years and 10½ ft. at 18 years. Even in his vigorous (*wüchsige*) class of plantation the trees are only 5 ft. high at 9 years and 8·7 to 9·5 ft. high at 13 years of age. There is ground here for encouragement for some of our own more or less backward plantations.

The lateness or earliness of spruce has been shown by Münch to be a genetic character, seed collected from late trees develop into plants most of which have the same character of late flushing. Comparative plots established in frost zones show this very clearly; in the late spruce plots the trees are tall and vigorous while in the adjoining early plots the plants have been crippled almost every year by frost. Further proof of the stability of the character is given by grafting experiments, twigs from late spruce grafted on to early trees remained in their wintery condition when all the other buds had opened and the shoots fully elongated.

Observations covering a considerable number of years appear to show that the late and early spruces may flower and develop seed in different years, thus the seed collection of one year may produce plants the majority of which flush late, while in another year the early flushing forms may wholly preponderate. For example, 1924 was a good spruce seed year in the Saxon Erzgebirge when the great majority of the trees producing cones were late spruce. In this year the heaviest crop was at the higher elevations and Münch is inclined to believe that this is a general rule, *i.e.*, that when the main cone crop occurs at the higher elevations the majority of coning trees are late spruce and, conversely,

that early spruce are the principal cone bearers at all elevations when the main crop is on the lower mountain slopes and in the valleys. There are, however, many years when both early and late forms of spruce appear to cone in equal measure; also, in a given year, one district, such as Saxony, may produce cones chiefly on the late spruce, while in other districts the early trees may be the chief source of the crop.

It is worthy of note that early or late flushing is a character which is clearly shown in the nursery; in localities subject to severe late frosts a great deal of injury can be avoided by using the late flushing form.

Münch has some interesting observations to make on the general question of the influence of weather conditions on the nature of the seed crop. Under special conditions, one physiological type of tree may be favoured in its flowering and fruiting where other types are hindered. Hence a given mast year, especially when it is a case of a partial as against a full mast, may produce seed which possess special characters which are more adapted to certain locality conditions than to others. It is possibilities such as these which make it so essential to repeat plantation experiments over a series of years. The failure or success of a given species on a certain type of land may be accentuated according to the batch of seed used and it is therefore dangerous to base conclusions on the results of a single year's work.

W. H. GUILLEBAUD.

INVESTIGATIONS OF THE DANISH FORESTRY SOCIETY.

(*Zeitschrift für Forst und Jagdwesen*, March, 1928.)

A review of some recent research work in Denmark contains useful information on several points of which the two following may be briefly mentioned here.

(1) Manuring experiments with ash. The work was carried out partly in backward ash plantations and partly in the nursery. The Danish worker Weiss succeeded in restoring into full vigour of growth and within a period of only five years an apparently hopeless 20-year old plantation of ash. Two treatments gave equally good results, viz.: (*a*) application of nitrate with simultaneous dressing of lime, and (*b*) covering the soil with twigs, lime also being applied. Manuring with phosphate or potash gave wholly negative results. The effect of the twig manuring was found to be due to an increase in the available nitrogen.

The nursery experiments which were carried out on a particularly fertile soil also showed that greatly improved growth of ash could be obtained by the use of nitrogenous manures such as Chili saltpetre, Norway saltpetre, ammonium sulphate, etc., while other artificials in the absence of nitrogen were without effect. Weiss concludes that the normal development of ash, both in the nursery and in the forest, depends on the presence of a constant and adequate supply of available nitrogen.

(2) Investigations on *Fomes annosus*. Culture experiments with this fungus have proved that there is a comparatively narrow range of soil acidity in which the conditions for the development of the fungus reach their optimum. The range is from *p*H 4·0 to 4·5, that is, markedly acid conditions such as probably obtain in most spruce woods at any rate, on the poorer mineral soil. The growth of the fungus is completely stopped at *p*H 3·0 and also at *p*H 6·0, that is, at very acid and slightly acid conditions respectively. The observations may explain why, on the one hand, *Fomes* rarely attacks trees growing on peat where the *p*H values are usually below 4·0, and on the other, as the Danish workers point out, why a heavy thinning, which tends to reduce the soil acidity, appears so often to check the ravages of the fungus.

W.H.G.

GREEN MANURING IN FORESTRY.

By Professor Süchting.

(*Zeitschrift für Forst und Jagdwesen*, June, 1928.)

The writer, who is Professor of Forestry in Hanover, is an enthusiastic advocate of green manuring on poor soils, especially those in which natural or artificial regeneration is difficult or impossible owing to accumulations of raw humus. The two species recommended are the perennial lupin and common broom. Some remarkable results have been obtained at Ebnath in Hanover, where the method is favoured by the circumstances that the raw humus can be disposed of readily to the local inhabitants. The method employed is as follows: The humus is removed—altogether if it can be disposed of—if not, it must be raked off in strips 4 ft. 6 ins. in width. A harrow is then run over the bared soil and finely powdered quicklime applied, the quantity varying with the nature of the soil (1 to 2 tons per acre), basic slag is sometimes also applied. The lime is harrowed in and the ground is then ready for sowing.

The seed, both of lupin or broom, must be inoculated with nodule bacteria and is sown preferably in a 12-in. band on one side of the cleared strips, the other side being planted with the trees. The seed is then covered by raking. The broom is sown in autumn, after the second harrowing, and lupin in the following April. The quantities sown per acre are broom, 2 to 6 lbs., and lupin, 4 to 10 lbs. If the lupin develop properly the tree plants will usually require protection, the simplest and most effective method is to trample down any lupin stems which are smothering the trees.

The method has been used with great success for raising oak, in one case, a first thinning was being carried out in a 13-year-old crop of oak, 19 ft. in height, the object of the thinning being to let enough light in to keep the lupin alive.

At Ebnath where Norway spruce struggles for 20 to 30 years against the heather, the results of the lime and lupin treatment are very striking as the following table indicates :—

Compartment.	Age.	Treatment.	Age Height. (Feet.)	Average length of last leading shoot. (Ins.)
21A	27	No lime or green manure (Calluna vegetation)	4·6	3·2
21A	17	No lime or green manure	2·8	2·0
21A	17	No green manure, but 36 cwt. lime per acre	4·3	3·5
21A	13	Lime and green manure	6·1	7·5
21A	13	,, ,, ...	8·4	9·8
29E	12	,, ,, (fenced) ...	7·9	17·3
29E	11	,, ,, (fenced) ...	15·1	22·4
29E	12	Lime and green manure, not fenced, Leguminosae destroyed by game	2·7	3·2
29E	11	Lime and green manure, not fenced, Leguminosae destroyed by game	5·3	6·3

The first two groups in C.29E, show the great effect of the green manuring upon the growth when deer are excluded by fencing and so prevented from destroying the broom and lupin. Investigations on the spruce root systems in manured and unmanured areas at Ebnath showed that while in both cases the root systems are typically shallow, in the manured areas the surface roots are covered with fine lateral roots all of which are mycorrhizal, the roots moreover lie in the mineral soil layer to a depth of 6 ins. below the surface. In the areas without green manure, the main lateral roots scarcely leave the humus layer and few fine rootlets are developed.

The method is unfortunately very expensive, but the writer points out that against the high initial cost must be set (1) the extensive and costly beating up required under normal planting methods, and (2) the overcoming of the prolonged check period, the average duration of which is at least ten years. Actual costs for the liming are given as follows for two forests :—

Cost per acre.	A.		B.	
	s.	*d.*	*s.*	*d.*
24 cwt. quicklime	31	0	24	0
Transport ..	6	6	11	9
Spreading lime	6	6	5	9
Harrowing in lime	8	0	12	0
	52	0	53	6

The total cost per acre is estimated as follows :–

	£	s.	d.
Removal of humus	8	16	0
First soil cultivation	0	10	0
Lime application	2	11	0
Basic slag	0	6	0
Broom and lupin seed	0	12	0
Inoculation	0	0	9
Sowing of broom and lupin	0	2	0
Total	£12	17	9

It will be observed that the work of removing the humus accounts for fully two-thirds of the cost. The writer considers that the benefit to the crop fully justifies the use of this method where the layer of humus is so thin that it does not require to be removed, but where there are thicker humus accumulations the method is obviously impracticable, unless cheap mechanical ways of removing the humus can be found ; Süchting is very hopeful that such will eventually be the case.

As far as the possibilities of applying the green manuring method to this country are concerned, there seems little prospect of being able to use it for growing spruce on peat as it is certain that the lupin would not develop properly under such acid conditions. On the other hand, it is worth trying on the heather soils of such areas as Allerston, where the ground can be ploughed. It is proposed to carry out experiments at Allerston this season with larch and also in the Forest of Dean in connection with the raising of oak.

W.H.G.

HUMIFICATION OF FOREST HUMUS.

By A. Nemec.

(*Zeitschrift für Forst und Jagdwesen*, July and August, 1928.)

These two numbers of the Zeitschrift contain a long and interesting article by Nemec who is attached to the Forest Research Station at Prague.

When tree needles or leaves fall to the ground in Autumn they undergo various processes as a result of which the plant tissues are broken down and humus substances are formed. Until recently no satisfactory method was known of separating these humus bodies from the still undecomposed plant remains, and so of estimating the degree of decomposition. In 1922, G. W. Robinson, of Bangor, discovered that by treating humus soils with a solution of hydrogen peroxide, the humus bodies were brought into solution while a residue of organic material remained, consisting of particles exhibiting normal cell structure. He proved that the peroxide dissolves only the amorphous break-down products of the plant cells and does not appreciably attack or decompose the cellulose tissues.

This method, which has been used by Nemec in the present investigation. is as follows : One gramme of air dried humus (passed first through 2 mm. sieve) is treated with 60 to 100 cc. of 6 per cent. hydrogen peroxide solution and kept at boiling temperature for 10 to 15 minutes. The solution is then filtered, the filtrate evaporated to dryness at 100° C., and weighed. The proportion of dissolved organic matter to the total content of organic matter in the sample can then be calculated. The result, expressed as a percentage, is termed the degree of humification (*Humifizierungsgrad*) of the organic substances in the humus.

Nemec found that the presence or absence of soil vegetation had a very marked influence on the "D.H." (degree of humification), and that the nature of the humus produced by the individual tree species could only be studied in stands where there was no soil vegetation.

The D.H. of the humus was low (44·15 per cent.) in pure coniferous woods with no soil vegetation and high (67·19) in pure broadleaved stands, young stands giving higher D.H. values than older crops. The values for mixed woods varied with the proportion of the different species and with locality conditions, all graduations occurring between raw humus and the most favourable forms of mild humus (mull). The mean D.H. value for mixed woods with no soil vegetation was 56 per cent.

Where soil vegetation occurred, the condition of the humus was found to be closely related to the nature of the vegetation ; the mosses in particular appeared to be useful indicators in this connection. The highest D.H. values (66·9 per cent.) were found associated with such mosses as *Mnium attine*, *M. undulatum* and *Brachythecium purum*, these are termed the Mull Soil mosses. The Litter mosses (Streumoose) mostly species of *Hypnum*, *Hylocomium* and *Plagiothecium* gave slightly lower values (52·6 to 74·1 per cent.). Next came the Dry Polster mosses with *Dicranum undulatum*, *D. scoparium* and *Polytrichum commune*, D.H. values, 35·1 to 65·2 per cent., and lastly, the Wet Polster mosses, characterised by *Sphagnum* spp. and *Leucobryum glaucum*, with D.H. ranging from 31·1 to 48·1 per cent.

The influence of other plants on the degree of decomposition of the humus was studied in relation to Cajander's principal types. Nemec found that humus samples collected under the lichen and heather (*Cladonia* and *Calluna*) types were of a raw humus nature and gave relatively low D.H. values (average 43·3 per cent.). Unfavourable humus conditions were also found under the *Vaccinium* vegetation of the Myrtillus type (average D.H., 51·8 per cent.). Conditions were improved where the grasses (*Aira* and *Calamagrostis*) of the Myrtillus type predominated (D.H., 66·5 per cent.), but the highest values obtained came from the Oxalis type where such plants as *Festuca*, *Milium*, *Oxalis*, *Luzula*, *Asperula* and *Brachypodium* occur. The mean D.H. of the Oxalis type was 74·1 per cent.

These studies on humification afford an interesting confirmation of Cajander and Aaltonen's earlier work on the degree of acidity and production of nitrates in the various forest types, which showed that, starting with the Cladonia type, there was a progressive decrease in acidity and

increase in nitrate production through the Calluna and Vaccinium types up to the Oxalis types.

The practical importance of this investigation lies in the new possibilities that are opened for a comparatively rapid determination of the degree of decomposition of woodland humus. For example, the effect of thinning upon the humus layers of the soil can now be studied with relative ease and accuracy and there are many other silvicultural practices on which this new method could probably throw light. The need at the present time is for workers in the field of forest soil research in this country.

W.H.G.

THE ACIDITY OF THE FOREST SOIL IN THE UPPER ERZGEBIRGE OF SAXONY.

By Prof. WIEDEMANN.

(*Zeitschrift für Forst und Jagdwesen*, November, 1928.)

This article describes a series of investigations in spruce forests growing at high elevations and on igneous rock formations, conditions which favour the development of a layer of raw humus over the soil. The determinations were carried out with Trénel's acidometer, which permits of rapid working and gave satisfactory results. The humus layers in the stands investigated were usually fairly thin—2 to 4 inches—only in one area was there as much as 10 inches of humus over the mineral soil. All the soils were very acid, the acidity being greatest in the semi-decomposed humus lying below the surface half inch of dead needles, and decreasing both above in the needle layer and below in the mineral soil. Wiedemann studied the effect on the acidity of removing the humus in strips and piling it into ridges on either side of the cleared strips. The bared strips were either left as they were or the mineral soil hacked up and mixed with the few remains of the humus.

Four sets of determinations were made in each forest: (1) in the interior of the stand, (2) in the strip opened up for regeneration, (3) in the open clearing close to the old stand, and (4) in an open plantation on a clear felled area.

A sufficient number of observations for the comparison of the cultivated and uncultivated areas was available only in (1) and (2) above, but these showed on the average a considerably reduced acidity in the humus in the piled-up ridges, the P.H. value of which was now approximately the same as that of the mineral soil.

With regard to the effect of light, Wiedemann found that the opening of the canopy effected by the rather light seed fellings scarcely reduced the acidity of the humus layers, while the clear fellings had a most marked effect even without soil cultivation. Young spruce grew least well on the undisturbed humus under the shade of the older trees. Heavy seed fellings, but still more clear felling, promoted the young growth extra-

ordinarily. The best young spruces were to be found on the strip-cultivated felled areas.

The author draws a number of practical conclusions from his observations, the most interesting of which relates to the old controversy between clear felling and natural regeneration under a shelter wood. He points out that in the area with which he was dealing the old stands of pure spruce constitute a menace to the activity of the soil. They are perpetually raining down acid products in the form of needles which are slow to decompose and form an isolating layer over the mineral soil. Consequently, on such localities as these, clear felling conveys very evident benefits upon the soil below. The truth is that according to the soil and climate, the duration of the laying bare of the soil, the form of soil cultivation and other factors, now the useful and now the harmful effects of clear felling will preponderate.

W.H.G.

THARANDTER FORSTLICHES JAHRBUCH, 1928.

For the year 1928 this Journal contains comparatively little of general interest, the majority of the articles referring to local subjects. The following extracts deal with some of the exceptions.

Weisswange and Gartner give the result of certain investigations made by them into the question of different races of Norway spruce in relation to the time of the opening of their buds in spring. The so-called " late " and " early " spruce have been observed so generally that it was thought desirable to endeavour to establish, if possible, whether definite races of this species existed that were characterised by different times of sprouting in the spring. The investigation took place in the spruce forests of Saxony on areas representing various altitudes between 2,400 ft. and 3,300 ft.

It was found that the greatest difference in time of sprouting occurs in young trees and gradually becomes less until about the twentieth year no difference can be observed. Little difference in the rate of growth of the early and late spruce could be observed, but the evidence pointed to a better growth amongst the late ones. The greatest difference found was at about fifteen days. Unfortunately nothing concerning the origin of the two varieties was discovered, and it appears doubtful if there exist races of spruce comparable to the races of Scots pine which are capable of reproducing their characteristics. It seems more likely that the difference is caused by individual idiosyncrasy which is liable to appear in spruce of any origin, but it is a subject that could only be tested satisfactorily by the growth and observation of spruce trees derived from seed gathered in various countries and elevations. The practical importance of the subject is of course in connection with frost damage.

Bernhard describes, in a well illustrated paper, the woods found on the slopes of the Taurus Mountains in Asia Minor. The chief species appear to be *Pinus pityusa*, *Pinus nigra*, *Cedrus libani*, *Abies Born-*

mulleriana and various junipers. These somewhat uncommon sounding names appear to conceal more familiar species, thus *Pinus nigra* = *P. pallasiana, P. pityusa* = *P. halepensis* and *A. Bornmulleriana* apparently denotes *A. cilicica*.

It is very doubtful whether the writer's contention that the above represent different species is correct and the article is consequently somewhat confusing. It would appear that *P. halepensis* is found on the lower slopes and this species gradually merges into *P. pallasiana*, which again gives way to *Abies cilicica* and *Cedrus libani* as higher altitudes are reached.

Great destruction appears to have been wrought in all woods near the railway, timber being taken for fuel purposes and, characteristic of the former Turkish regime, no effort has been made to save the forests from fire, cattle or goats. The author observes that unless measures are taken to prevent it the cedar of Lebanon will soon become almost extinct in this part of Asia, which will mean its almost entire extinction on native soils.

A. D. HOPKINSON.

FORSTWISSENSCHAFTLICHES CENTRALBLATT, 1928.

Forest Soils in Württemberg.

The reactions of the forest soils in Württemberg is the subject of a long paper by H. Rheinwald. The investigations were carried out over a wide range of conditions, and if the results are not altogether conclusive, the research has revealed some features of considerable interest. The soils are tested solely as to their reaction, and this was determined by the colorimetric process and also electrometrically. The acidity of the soils was indicated by the PH value so determined. Strongly acid soils were shown by PH values of less than 4·5, acid soils by PH 4·5–5·9, weakly acid soils by PH 6·0–6·5, neutral soils by PH 6·5–7·0, and alkaline soils by PH of over 7·0. The soils investigated included a wide variety of types lying over the following formations—Jurassic, Lias, Keuper and Buntsand.

In the upper soil layers, quite distinct differences were noted between the reaction of sand and loams on the one hand which were acid and limestone and marls which were weakly acid or neutral. The differences in the lower layers were less well marked. In the various layers, sands were more acid than loams and chalk soils than marls.

It was found that the reactions of the upper layers of the soil in stands of broadleaved trees were only weakly acid, while the reactions under conifers were in most cases more strongly acid. The range of acidity in the upper soil layers in the beech stands examined was from PH 4·9 to PH 7·2; in Scots pine the reactions lay between PH values of 3·7 and 6·2. It was also found that the acidity of the surface layers decreased after an area was clear felled; in the second year after cutting, it was found in several cases to have increased once more, the increase being ascribed to the development of a new surface vegetation.

A series of observations on the soil reactions of two different types, continued over a period of about eighteen months, gave some quite remarkable results. The first profile was under a close spruce stand, 40 years old. The surface vegetation consisted of a moss layer of *Brachythecium rugabulum* and *Mnium undulatum*. The soil consisted of 1-in. crumbling humus mixed with spruce needles over a fine sandy soil, greyish in the upper layers and yellow below. The second was under a beech stand with complete canopy. The vegetation consisted of tussock grasses. The soil profile showed a layer of beech leaves over $\frac{3}{4}$ in. crumbling mineral soil mixed with humus over a dark brown clay loam. Both were overlying Lias. The record showed a continuous though slight increase in acidity at all depths from the end of autumn on to March. This was broken in the first profile by a slight decrease in February. The record at the beginning of April showed a sudden fall in the acidity, which then gradually increased again. In one case, there was a difference of PH 1·4 within 17 days. The author does not offer an explanation of these changes. His discussion of the soil flora in its relation to the acidity of the soil is of some interest. He found that forest types—Cajander's and Feucht's—did not give any serviceable lead. Individual species, however, were shown to be of value as pointers; for example, *Vaccinium Myrtillus*, as we might have guessed, is an indication of acid or slightly acid conditions (PH 4·2–5·2) and did not occur on soils with a PH of over 6·0. *Mnium undulatum* was only rarely found on soils where the PH was less than 6·0. The range of *Oxalis* was from 5·0–7·4. A species such as *Hylocomium splendens* is of no value as a guide as it occurs over a very wide range of values.

Forestry in Bulgaria.

"Forests and Forestry in Bulgaria" forms the subject of an interesting article in parts 5 and 6, by K. M. Müller, of Munich, in which the forests of the east and south-east of that country are described.

The total forest area of Bulgaria is just under 7,000,000 acres or 26·3 per cent. of the total land area. There are thus about 1·4 acres of forest per head of the population.

In the east and south-east towards the Black Sea, there are pine hardwood forests, mostly of oak. In the high Balkan, beech forests predominate, while coniferous forests are found in the south-west.

As to ownership, the greater part is communal; the state-owned forests comprise about one-quarter of the total, then follow privately owned forests and lastly, forests owned by religious foundations.

Though the forest area is so large, it includes much that lies in remote and inaccessible regions, while the greater part has been neglected during the years of war through which Bulgaria has passed. As a result, part of the timber requirements of the country have to be supplied from Rumania.

In Bulgaria, each male subject on reaching the age of 18 is required, apparently instead of giving military service, to serve for two years on public works. The corps so formed are used in road making and very

largely in work in the forests. In this way a good deal is being done, mostly in exploitation and naturally the quality of the work is poor. Much of the timber is converted in mills owned by the state.

The forest areas which Müller describes in his article are three in number. There is first the swamp forest of Longosa extending some 25 miles inland from the Black Sea south-west of Varna. This forest extends along the banks of the river Kamtschija and is partly under water all the year round. The forest consists up to 70 per cent. of elm (*Ulmus montana*), 20 per cent. ash and 10 per cent. of hardwoods such as oak (*Quercus conferta* and *Q. pedunculata*), lime, hornbeam, poplar, *Cornus* and *Crataegus*. The ash and elm reach heights of 80–110 ft. with girths of 8–13 ft. They are mature at about 120 years of age. The object of the management here is to favour the more valuable ash and to obtain instead of the present ratio, a proportion of 80 per cent. ash to 20 per cent. elm.

The second area which he describes lies to the south of the first at an elevation of 700–1,600 ft. It is of the dry mixed broadleaved type, and the principal species are *Quercus Cerris*, which is found in the valleys mixed with *Q. pedunculata*, on the dry heights with the sessile oak and on the intermediate slopes mixed with *Q. pubescens* and *Q. conferta*. It reaches heights of 80 ft.

Beech is found on the shady northern aspects and hornbeam is widely spread, reaching heights of 90 ft. and girths of 8 ft. at B.H., on favourable sites. Sycamore is found of good size on the lower slopes, while lime is found frequently in large clumps on southerly aspects in the oak forest.

The prices obtained in 1925 for trees standing in the forest worked out as follows: oak, 2*d*. per cub. ft. ($\frac{1}{4}$ g.), beech 1*d*., ash 2$\frac{1}{2}$*d*.

The third forest area is one lying at about the same elevation as the last along the Turkish border, in the extreme south-east. It consists of an extensive area mainly of oak.

Along the coast there is a belt of oak coppice; on the exposed eastern slopes the growth is scrubby. The high forest proper consists of the sessile oak, but is rather open and irregularly stocked.

Fomes Annosus.

In Part IV, 15th February, 1928, there are summaries by A. Howard Grön of two Danish papers in the *Dansk Skovforenings Tidskrift*, 1927; one of these, by Weiss and Mielsen, deals with some researches on the root-rotting fungus, *Fomes annosus*, and the other, by Weiss, reports some experimental work on the soil requirements of the ash.

It is now well known that *Fomes annosus* is probably the most destructive enemy of forest trees in Denmark, causing great losses in stands coming on to maturity and making the success of second crops a matter of grave doubt on infected soil. The authors have been working principally in stands of spruce and have been seeking by means of laboratory investigations to establish some relation between the growth of the fungus and the hydrogen-ion concentration of the soil. Their object in so doing was to find out whether treatment bringing about alterations

in the PH value of the soil, *e.g.*, heavier thinning, application of lime, etc., might afford a possible opening for attack.

The fungus was cultivated on 3 per cent. malt agar and its development, in relation to the PH value of the medium, measured over a period of 30–50 days. The authors found that the fungus reached its optimum development at PH values of 4·0 to 4·5, and that at values of 6·0 and over and 3·0 and under it cannot develop fully at all. They are not certain whether this holds true for natural conditions, but indicate that this may be possible because the soils in which the fungus does most damage are those under dense crops of spruce where the PH values are generally round about 4·0.

They also tested the effect on the fungus of copper sulphate and found that solutions of this salt in strengths of 0·1–0·2 per cent. have an absolutely fatal effect.

Soil Requirements of the Ash.

In view of the importance of the ash in Denmark and its poor growth on many sites where one would normally expect good development, a series of experimental plots was laid out in 1921, in a pine crop of 20-year-old ash in Zeeland. This crop was doing poorly, and yet was on a site which could be described as good ash ground. Two sets of plots were laid out; in each—

1 plot was manured with lime
1 ,, ,, ,, ,, ,, + nitrogen.
1 ,, ,, ,, ,, ,, + phosphate
1 ,, ,, ,, ,, ,, + ,, + phosphate.
1 ,, ,, ,, ,, ,, + ,, + ,, + potash.
1 ,, ,, left untreated.

In addition, the plots of one set were covered with brush and faggot-wood (Reisig) of beech to a depth of about 15 in. The plots were manured again in the two following years, but the covering of brush was not renewed.

It was soon apparent that some of the plots were doing much better than others, and very much better than the surrounding stand which was left untreated. As a result of measurements taken up to 1927 it can be stated that—

(1) The covering of the soil with brushwood has had a very favourable effect on the growth of the ash and on its general health (canker, etc., diminished). This applies to the plot which received no mineral manure as well as to the others.

(2) The nitrogenous manures increased the effect of the brushwood covering and in the uncovered plots has promoted growth and health.

The effect of lime and of potash is doubtful. Phosphates had an unfavourable effect.

Further investigation showed that the application of brushwood coverings caused a change in the physical quality of the soil which

increased in porosity and became better aerated. The reaction of the soil changed from PH 5·1–5·4 to PH 6·4–7·0 in the plot which was covered with brushwood but received no lime. These results have been confirmed by similar investigations in another part of the country.

The favourable effect of nitrogenous manures on one-year seedlings of ash in the nursery was also noted as the result of other experiments. It is stated generally that ash has an extraordinarily great nitrogen requirement and that its poor growth on sites where it might be expected to do well is generally attributable to insufficient supplies of nitrogen. The nitrogen requirement is so great that it is often hardly satisfied on soils which have sufficient nitrogen for other tree species and for most agricultural crops.

J. MACDONALD.

THE INDIAN FORESTER, 1928.

In view of the fact that very shortly we shall be faced with the problem of thinning large areas of young plantations, it is interesting to note a correspondence on thinnings which has been going on in *The Indian Forester* for the first half of last year.

Dealing with two Himalayan species, deodar and *Pinus excelsa*, of which the early thinnings are unsaleable, Mr. Smythies thinks that there is no evidence that an unthinned crop would in time exterminate itself, and he awaits proof of the contention that thinnings considerably reduce the rotations and thereby increase the annual yield and revenue more than sufficiently to pay the cost of thinnings. Further, he is of opinion that " before starting a long series of expensive thinnings in quite young crops, we want more evidence that such a policy is financially sound."

To decide whether an operation is financially sound, is the crux of the whole situation, for it entails in addition to the aforementioned points, the safety of the plantation during its later life ; some plantations may escape the calamities which thinnings are said to minimize owing to their situation, etc., but others may not, and it has certainly struck me that many areas of natural regeneration left alone for a long time have thinned themselves remarkably well, but in viewing such areas, perhaps we have been a little blind and indulgent to nature by not calling her attention to the many blanks she has left.

Returning to our plantations in this country and examining them for wind and snow damage, much of which would have been greatly increased by lack of thinnings (if one judges by the thin stems which have been affected), I feel that the " no thinnings unless saleable " school, will gain few converts.

Happily at the moment we have few species for which we cannot generally find a market at a price which will pay for the operation ; nevertheless should we be faced with the reverse conditions, then we may have to solve the problem of arranging our plantations to reduce to the minimum the thinnings in the early unsaleable years.

R. G. BROADWOOD.

REVUE DES EAUX ET FORÊTS, 1928.

Regeneration of the American Red Oak at Les Barres.

In the September issue, M. Pardé records a successful experiment in natural regeneration in the *Domaine des Barres*, where the red oak of America is described as possessing several advantages over the indigenous oaks on the poorer soils being more resistant to cold and frost, especially spring frosts, and to heat, sun-scorch and drought. The species grows very rapidly in youth, but is not superior in this respect after the age of 50–60 years. It seeds frequently and freely at Les Barres and is much less subject to mildew (*Oidium*).

The area dealt with was 1·85 acres in extent, stocked with red oaks planted about 1830. In 1924, the stocking included self-seeded oaks (indigenous), birch and some Weymouth pines. The red oaks were of a mean diameter measurement of $13\frac{3}{4}$ to $15\frac{3}{4}$ inches and formed a complete but rather open block beneath which a natural seedling growth of indigenous oaks, Scots and Weymouth pines and particularly of red oak had established itself.

Seed fellings were effected in the seasons of 1924–25 and 1925–26 and finally in 1927–28, only nine of the mother trees were left in the ground after the last cutting. In spite of some rabbit damage in 1926 and the exceptional drought of that year, the plant of red oak is complete. The seedlings are vigorous and only a few are affected by mildew, while nearly all the even aged seedlings of the indigenous oaks, except those of *Q. Cerris* have been attacked by this pest. Apart from the raking in of some acorns tossed into the places from which stumps were drawn and the rooting out of certain seedlings, coppice shoots and suckers of common oak and aspen, no work was done and no expense incurred, thus proving that under the conditions prevailing at Les Barres, the red oak can be regenerated without cost in the same manner as the native oaks and by the same means.

M. Pardé states that the timber, while of less value than that of the pedunculate or sessile oaks, is hard and difficult to work, splits easily, is not very durable and for burning, must be thoroughly dry. In these circumstances, the substitution of red oak for the indigenous species is recommended only in those parts of the forest where the soil conditions are inferior or in places subject to spring frosts, drought or where mildew is troublesome.

Forest Fires.

An interesting and informative paper on the subject of forest fires is contributed to the October issue by Mons. L. Lavauden, who, dealing generally with a subject of first importance to foresters throughout the world, goes particularly into the causes of forest fires and the remedial measures by which they can be combated.

Forest fires can arise from natural causes or by act of man and after exploding some of the more obvious illusions on the subject, the writer states that really the only actual *natural* cause is lightning.

Other dangers are dealt with in detail. It is stated that experiments with large numbers of pieces of broken glass of all shapes and colours and under most favourable conditions, have not resulted in the causation of a single fire. It is not suggested that the chance burning glass is an impossible occurrence, but any such cause must be very rare indeed. Human causes may be conscious or otherwise and the carelessness of smokers is a fruitful cause of trouble. The closely observed habits of smokers with spent matches and cigar and cigarette ends are recorded. As might be expected, the lighted match and the ordinary cigarette end are the most dangerous while a lighted cigar butt has not generally proved a danger except in a high wind.

Next under review come the manners and customs of sportsmen and the result of an exhaustive series of experiments with sporting guns and gun wadding goes to prove that the modern cartridge is innocuous. Under conditions in which newspaper or tow is used as gun wadding, forest fires can at times, be traced to this source. It is pointed out that sportsmen are often also smokers.

On the question of incendiarism, some ingenious methods are quoted. The usual safeguards receive attention, *e.g.*, the cutting of undergrowth, fire lines, the planting of non-inflammable species, etc. The *petit feu* or the burning of the undergrowth in winter when the fire itself is not dangerous and can be directed and controlled, is recommended as an inexpensive precaution in coniferous forests. Speaking of fire lines, we are reminded that the only point upon which foresters are agreed is that their efficacy is not certain. M. Lavauden has himself seen the lighted leaves of the cork oak fall 270 yards in front of a burning area and fragments of the bark of the Aleppo pine carried by the wind 440 yards. In France and North Africa the employment of non-inflammable species such as *Eucalyptus* and some of the Acacias is favoured, as these offer the additional safeguard of a safety screen in the event of crown fire.

The article concludes with a warning that the forest can neither prosper nor protect itself without aid and that its greatest enemy is always fire.

W. L. Taylor.

Australian Forestry Journal, 1928.

Control of Nursery Weeds.

The June issue contains on page 71 a description of an American method of controlling weeds in nursery seed beds. At the Savenac Forest Nursery in Montana, observation of the reduced weed growth in seed-beds resulting from the application of sulphuric acid as a preventive of damping-off led to experiments with sulphate of zinc for the reduction of weed growth.

The treatment adopted is to apply to four square feet of seed bed a solution of 8 grammes of zinc sulphate in 250 c.c. of water, *i.e.*, $1\frac{1}{8}$ ozs., in a quart of water to four square feet of bed. The application is made immediately after sowing and is found most effective against weeds such

as sorrel, timothy and clover, without being detrimental to the germination of Western white pine, Western yellow pine or Englemann spruce, the species raised in the nursery in question. The experiments under review were estimated to give a saving in labour costs which, at the rates of wages obtaining in this country, should approximate to 15*s.* per 100 square yards of beds, and it would seem that the method is well worth a trial, nevertheless bearing in mind the possible danger from the accumulation of zinc salts in the soil and the effect of various soils on the efficacy of the method ; both of these points are brought out in the article under review, which also emphasises the danger of using too strong an application, and points out the benefits derived from an increased yield of seedlings, which are additional to any saving on actual labour costs.

Control of Damping-off.

The September issue contains a reprint from the *Review of Applied Mycology* of June, 1928, of G. Delevoy's article which appeared on pages 497 to 505 of the *Bull. Soc. Centr. Forest Belgique*, xxx, 12, and which seems to be of sufficient interest and value to justify quotation in full.

" In this paper the author describes further tests conducted by him at Groenendael, Belgium, during 1926–27, into the relative efficacy of different methods for the control of damping-off of conifer seedlings (Scots pine, Corsican pine, Douglas fir, spruce and Japanese larch) (due mainly to *Corticium solani* and species of *Fusarium*, *R.A.M.*, vi, p. 450). The results obtained (which are tabulated and discussed in considerable detail) are briefly as follows :—

" Sheltering the plots with straw matting caused injury estimated at 50 per cent. to Scots pine, 29 per cent. to Corsican pine, and was not very favourable to spruce ; but it improved the stand by 17 and 29 per cent. in Douglas fir grown in unmanured and manured beds, respectively.

" Marked differences were shown in the effects of different manures. Stable manure slightly increased the injury to Scots pine, but a mixture of this with basic phosphate and kainit (1,340 and 180 lbs. per acre, respectively) gave an improvement of 29 per cent. with this species. With Corsican pine, however, this mixture reduced the stand, although a 6 to 15 mixture of the two mineral fertilisers with stable manure increased the stand when the seed was covered with sawdust (*loc. cit.*) by 50 per cent. Stable manure also gave 18·6 per cent. increase in Corsican pine and 18·5 and 60 per cent. in spruce in unsheltered and sheltered beds, respectively, the spruce seedlings being superior to those in beds treated either with the complete mixture (stable and chemical manures) or with the chemical manures only.

" The most important effects appear to be derived from the kind of covering used for the seed. A sawdust covering, $\frac{1}{5}$-in. deep, gave a 25 per cent. increase in the stand with Scots pine and 50 per cent. increase in the stand with Scots pine and 50 per cent. with Corsican pine, while with spruce this covering, on unmanured and

unsheltered beds, gave a 17 per cent. increase over that obtained with a sand covering of the same depth. On manured beds of spruce, sawdust gave results 39 and 9·5 per cent. better than sand in unsheltered and sheltered beds, respectively. Attention is directed to the fact that with spruce and Scots pine the sawdust more than compensated for the absence of manure. Fine earth and vegetable mould each gave better but less reliable results than a sand covering.

"Soil disinfection was definitely injurious, except when applied twelve days before sowing (2·6 per square yard), when the following proved beneficial: 2 per cent. formalin, 0·1 per cent. permanganate of potash, and 0·2 per cent. copper sulphate. With Scots pine copper sulphate gave 31 per cent. improvement, and formalin 26 per cent., while the permanganate of potash increased the number of plants by 15 per cent., but weakened them. With Corsican pine, 0·1 per cent. permanganate of potash with sand covering and mineral manure gave 11·5 per cent. improvement; with Douglas fir, formalin gave 49 per cent. improvement on unsheltered beds, while with spruce it gave 23·7 and 39 per cent. improvement on unsheltered and sheltered beds respectively. Permanganate of potash gave 14·4 per cent. improvement on unsheltered beds of spruce, while copper sulphate slightly increased the number of sheltered plants.

"That soil disinfection may have definite after-effects was indicated by the superior weight of Scots pine seedlings sown in beds treated in 1925 with formalin, copper sulphate or permanganate of potash ($43\frac{3}{4}$, $38\frac{3}{4}$ and $36\frac{1}{4}$ ounces, respectively, per 100 plants, as compared with $28\frac{1}{2}$ grammes in the control beds)."

O. J. Sangar.

THE FORESTRY QUESTION IN BRITAIN.

By Professor E. P. Stebbing.

Professor Stebbing's latest book is devoted mainly to a plea for more forestry and less afforestation; more attention to the poor state of Britain's existing woodlands and the amelioration thereof, and less expenditure in increasing our woodland area by the afforestation of bare or waste lands.

The first part of "The Forestry Question in Britain" is an attempt to explain to the man in the street the vital need for forestry and the enormous consumption of imported timber upon which this country is necessarily dependent. The second part is addressed to the technical man, though it is very free from technicalities, and will perhaps be more appreciated by the layman also.

Professor Stebbing has become a great optimist, and the ease with which he is going to improve our poor hardwood and coppice areas in a short space of time is very illuminating. Speaking of the attitude of the man "on the countryside"—the rural artificer—we are asked, is he willing to risk the disappearance of the types of produce which he and his forefathers have always used? Has the author ever tried to sell a typical South of England coppice wood? In bygone days there was a

steady demand for such wood, but now it is so much waste scrub. Nobody will dispute the plea for the increase and improvement of our hardwood forests, and there has undoubtedly been a craze for conifer planting in recent years. Softwoods in large quantities, however, are always necessities, and we greet with some alarm the assurance that to build up stocks of softwoods for emergency use in the event of a far distant war will be futile. On the outbreak of this hypothetical war a fleet of aeroplanes will invade the country, drop a few incendiary bombs, and away go our conifer forests in a puff of smoke

The Forestry Commission and the present forest policy come in for much criticism. We are blamed for the methods in which we acquire land when we should proceed with systems of profit-sharing with the landowners. We are blamed for the fact that we have to acquire certain portions of our estates which are either too good or too bad for afforestation. It is contended that the management of such lands is quite outside the scope of any of the older continental or other forest departments, and therefore should not be undertaken in this country. Why a forest department should not look after certain agricultural or sporting properties within its forest boundaries (provided that qualified estate staffs are available) is not clear.

The forest officers past and present are blamed for not forming proper oak woods by establishing oak and beech (even aged) mixtures, as has been done with such success in France. Professor Stebbing should make a close study of such even aged mixtures, especially in the Dean (which he quotes as an example). He can study his even-aged mixtures, and a sorry sight is the oak therein. Whereas oak is perhaps at its optimum (climatically) in France and is there able to keep up with the beech, the same is not, *ipso facto*, the case in England. The Commission is blamed for working to a fixed programme, and on a ten-year period, whereas it should be working on a longer period and to no fixed programme. Such, admittedly, would be a great saving of trouble both to those concerned with the acquisition of land and to those concerned with its afforestation. But what Government, other than one composed solely of technical foresters, would give such a free hand, especially to a new and untried Department? The Commission is blamed for pinning its faith to planting and making no use of direct sowing. The facts, of course, are that sowings have been tried, and on a fairly considerable scale in many parts of the country; in some places success has resulted, in others there have been sad failures. Experimental work in direct sowing of both oak and conifers is going on every season.

In making suggestions for a future forest policy, the author lays great stress on the fact that our existing woods—woods which may be of little immediate value, but which at any rate possess a true forest soil—should be given primary consideration. Even the smallest of copses should come under the eye of the Department, as (it is claimed) is the case in many continental countries.

With regard to the utilisation of commons and the difficulties of common rights, we are led to understand that a great many of these could very simply be brought within the scope of the Department for

afforestation ; a round table conference, a persuasive forest officer, and, hey presto ! the commoners will agree to all suggestions, and we can proceed to fence and plant up the waste land. " The useful phase of the common and its rights has long passed away," perhaps, but there are few right holders who will yet be persuaded to admit it.

The forest staff is going to have a very pleasant time, for important amongst its duties it must play cricket and football on the greens in the forest villages, it must shoot with the laird, and it must hunt with the squire. Very pleasant ; but in a pioneer service hard work is likely to achieve better results than cricket, football and sport. The book is full of extremely broad generalisations. We are told on page 110, " there is little new for the young forestry staff of Britain to learn in afforestation," and on page 33, " the wood, as a possible source of . . . income, or as a valuable asset to the nation, means nothing to the farmer." Speaking of the natural regeneration which is being conducted on a small scale in the Crown woods, we are told that this is the *only* real scientific forestry work being carried out in the country.

Mistakes in grammar and punctuation are numerous, and we leave the book with the uncomfortable feeling that we have still a long way to look before finding the solution of the " forestry question in Great Britain."

G. B. Ryle.

NOTES AND QUERIES.

Rabbit Extermination and Protection.

As is universally known, the rabbit is one of the forester's greatest enemies, and when numerous is the cause of a great deal of labour, both in exterminating them in enclosures and in keeping the area free from them after planting. As the writer has not heard of any instances where Renardine has been used on any of the Commission's schemes, it is the intention in writing this article to bring to the notice of others how this preparation can be used with beneficial results.

Renardine is a strong-smelling liquid preparation, made by Gilbertson and Page, Ltd., Hertford, Herts, and sold in two-quart tins. It is seldom, if ever, stocked locally, and usually has to be ordered direct from the above-mentioned firm. It is used on estates for protecting game coverts from foxes, and for closing out rabbits for a shoot. Renardine can be used as it is, but it is more economical to mix with paraffin 0·5 of each ; it answers the same purpose. Pieces of paper 6-8 ins. square are saturated in the liquid, and pushed into each hole in the burrow and closed, with the exception of one or two to let the rabbits escape. The rabbits usually leave the burrows the first night. The burrows are gone over the next day and the remaining holes closed, and some papers pegged on the outside with small sticks ; some tar sprinkled over the burrow is also a help. Normally, to get the highest amount of revenue from rabbits killed they would not be closed out and shot, as trapped rabbits fetch much higher prices than shot ones ; but on most places where there are

rabbits there are usually some awkward places, such as old quarries, old stone walls or dykes, heaps of stones or boulders, crevices in rocks and other such places. Some of these afford the best possible protection for rabbits, and it is a most difficult job to get them out of these places unless the greatest skill is applied. This is where Renardine is useful. Every corner of these places should be papered ; if some tar can be got and sprinkled about it will also be a help. The rabbits will shift, and either find their way into tackle or lie out where they can be hunted up with a dog and shot. With smaller areas, where it may be necessary to clear out rabbits quickly for any purpose, or where the clearing of them is likely to be expensive—viz., where revenue from rabbits is not likely to cover the expense—they can be practically cleared out with Renardine in the way as mentioned above. The area in that case should be gone over while the fence is in erection, and by the time the latter is completed the rabbits will have gone. Some tackle should be set, and any odd rabbits left will either find their way into it, or they can be hunted up and shot. The writer has seen small areas successfully cleared in this way.

Renardine is also useful for putting round the outside of enclosures where rabbits abound, as where they are numerous they are sure to try and get in some time or other. Generally rabbits try to get into enclosures by themselves, but the writer has observed on several occasions that they apply more drastic measures at times by " attacking " in force ; it would appear as if these attacks were organised, as it were, as, instead of single rabbits trying to get through, large numbers attack at one time. They will often attack a front of 200 yards or more, and will either scrape and burrow till they get through or are beaten in the attempt, and give it up as a bad job. It may be taken generally that if rabbits are really determined to get into an enclosure, practically nothing will stop them. If they cannot get over or through a fence they will burrow underneath it, often entering the ground a yard or more from the fence and coming out the same distance on the other side. These attacks may last for a period of two or three weeks, then stop as suddenly as they started, and it may be months before they attack again. When these attacks are on fences must be watched very closely, and looked at every day. " Scrapes " and other places where they are working should be fitted up with stones, etc., and saturated papers pegged every few yards along the fence. If a few tins can be got and tied on to the fence these will rattle and make a noise with the wind, and will also help to keep them off ; one or two small stones should be placed in each tin, and a hole made in the bottom to keep water from collecting in them in wet weather. Mixed mesh netting, as used by the Commission, does not always prove satisfactory, as young half-grown rabbits climb up and find their way through it without any great difficulty. In some parts of the country where rabbits are used to jumping over old stone walls, etc., which are around plantations, they acquire the jumping habit, and in many instances have been found to jump a 3-ft. wire fence without any trouble. This also applies to hares. In these cases a 3 ft. 6 ins. fence with 6 ins. overlap at top is almost essential.

Where rabbits are numerous they are the greatest pest that the forester has to deal with: he never knows when and where they may break into enclosures, and if they happen to get through in the summer-time when bracken or other vegetation is strong, it is a most difficult job to get them—therefore prevention is better than cure. The writer has used Renardine for years, and has found it a most useful preparation both for extermination and as a protective measure against rabbits.

S. H. A. PATERSON.

LIFE ON A FOREST HOLDING.

The life of the worker on a forest holding is an extremely busy and interesting one—that is to say, for the holder who takes a keen interest in his holding and the stock which he keeps. In describing the above an example is taken of a holder who has five to seven acres of arable land and a few acres of pasture, and who keeps a cow and a follower, a pig and some poultry. The holder has got to be an early riser if he keeps stock. In the summer-time, before he goes to work, he will usually go out to the field and bring in the cow, and he may also milk while his wife makes the breakfast. In the winter mornings his stock requires feeding, milking, etc., in the same way, and there is the byre to clean out. He then goes to his daily work, which is a varied and interesting one the whole year round, each season bringing its different work, too numerous to mention in this article, but may mean any forestry work, from preparing seed beds in the nursery to felling mature timber. Then, when he gets home in the evening and gets his dinner, he has still a lot of work to do. He usually has some firewood to saw and his stock to see to again, and in the spring and summer months there are various jobs always requiring doing on the holding. Someone is employed to plough and cultivate the ground, and the holder gets a day or two off to put his crops in, viz., oats, potatoes, turnips, etc. The two latter require a good bit of weeding and attention right through the summer until the hay is ready to cut. Haytime is usually the holder's busiest time, the whole family being out, the men doing the cutting with scythes and the women and children doing the tedding, turning, raking and gathering in, etc., and helping to build the ricks. It is a pleasant sight to see a colony of five, six or more holders and their families all as busy as bees. There is usually great competition amongst them as to who will have their hay up first. The women do a bit during the day while the men are at work for the Commission.

The area of oats being small, it is usually cut on a Saturday afternoon, and put in a fortnight later if the weather is suitable. The hay is usually put in on a Saturday afternoon also. Sometimes a local contractor is employed to cart it in; others are sometimes lucky enough to borrow carts. Then there is thatch to cut and the stacks to thatch for the winter. As soon as this is done the potatoes are ready, and each holder usually grows a good crop of these. A good deal of time is required lifting them, mainly on Saturday afternoons, when the family is all at home, the women doing

what they can during the week. The potatoes require pitting, and this is usually done as they are lifted. Then come the turnips; only a small area of these is grown, and they are also taken in on a Saturday afternoon. After this crop is in, the holder is a little less busy, though he always finds plenty to do. In the winter months he has hay to take in from his stacks each Saturday afternoon to do his stock for a week, and between the feeding and looking after his stock, cutting firewood, etc., he is kept fairly busy. His mind is always fully occupied, and time does not hang heavy with him, which it would probably otherwise do in many of the outlying districts, had he not his many duties to perform.

This holder has his own bacon, milk, butter and eggs, and may be envied from many points of view. He does not get this, however, without having a good bit of work to do.

With a holding the size of which I have described, there is usually work for two men; a father and son or two brothers do quite well.

There is no healthier job than that of the forest worker, and no more congenial one. Taking everything together, the life of the holder is a fairly happy one. He is guaranteed so many days' work per annum for the Commission, but in many cases he gets work the whole year round, and he can usually get work for his family. He is free of the dread of having to shift at the "turn" like the agricultural worker; and, lastly, he has his holding to look after, which gives him a sense of responsibility which is good for every man.

S. H. A. P.

Douglas Fir: Most suitable Age for Planting.

Douglas fir, like other species, is planted at various ages, viz., 2-year seedlings, 2 + 1, 2 + 2 and 2 + 1 + 1 transplants. Two-year seedlings are very seldom planted as they are much too small and delicate for the ordinary work. 2 — 1 transplants are sometimes used, and as a rule do fairly well: they are usually fairly well rooted, and are of a good enough size for planting under average conditions, but in many cases are hardly as strong as one would like. 2 + 2 transplants are probably planted in larger numbers than any other age; they are well rooted and of a good size, but are liable to suffer somewhat severely from the shock of lifting from the nursery. They must be carefully planted, and even then a few deaths will occur. 2 + 1 + 1 transplants probably do best of all. They are exceedingly well rooted as a rule, and while not so big as 2 + 2 plants, are of a good size for planting out. They do not suffer much from lifting from the nursery, and they take root right away. In a normal season, planted in an average Douglas fir locality, practically no deaths will occur. They will probably cost about 4*s*. more per 1,000 than 2 + 2 transplants, and in the opinion of the writer they are worth it. They nearly always establish themselves in the first season, and practically no beating-up is required.

S. H. A. P.

BEDDGELERT: MOUND AND TURF-PLANTING OF NORWAY SPRUCE AND SITKA SPRUCE.

As I have not had the pleasure of visiting any of the schemes being carried out by the Commission, you cannot blame me for thinking that my little patch here is the most difficult in the Division.

At present we are trying to combat peat. The mountain slopes allotted to P.28 and P.29 are in three terraces of peat, and three slopes of rocks and boulders. In draining the peat bogs we aim at making use of all the turfs as well as loose soil from the bottom of drains. The turfs are laid out in rows 5 ft. apart with soil on one bank of drain, giving us five rows to plant. Sometimes we get soil on both banks, so this gives us six rows. After completing main drain we put side drains in so as to fill up space with turfs. We also put in a cut-off if necessary.

Having completed the first bog we carry our main drain through the first rocky ridge. This is more difficult, as the rush of water which we sometimes get here can move boulders which the workmen have been compelled to leave. These are carried down and block the drains when they reach the level. To prevent this I find it a good plan to zigzag the drain in this part, as it tends to decrease the enormous rush.

The tools used in these operations are a peat knife, spade, drain-drag, and pick or mattock. The drains cost 3*s*. 6*d*. per chain—3*s*. goes to draining and 6*d*. to planting. Planting can be done more cheaply and more easily on these turfs.

In P.28, Sitka spruce planted in turfs have made a growth of 3-5 ins., and have retained their green colour, while on wet natural surface they have made a growth of 2 ins. and have a yellow colour. In P.27 some on the banks of drains have made a growth of 8 ins., while one has made a growth of 20 ins. I don't find screefing any good here (a spruce area). The plants require all the shelter they can get, but weeding must be done to prevent them being smothered in the late autumn.

G. H. BROWN.

THE PROBLEM OF THE LOSS OF TIME BY WET WEATHER.

The loss of time by wet weather is a very serious problem in forestry, at any rate, in the western parts of England. Not only is there a large financial loss, but a spirit of discontent is fostered among the employees, who often have to wait for a long time under improvised shelters, and who are often previously wet through.

The moral effect of this idleness on the people of the surrounding district is also, I think, worth considering. Farmers often complain that they cannot get men to do their work, as the latter can get work for the Commission, and be paid for doing nothing during wet weather. This is, doubtless, correct. An excellent argument is also provided for those who are continually complaining about government extravagance and the inability of the State to make anything pay.

This loss of time may be rectified, I believe, in different ways, viz.:—

(1) Time lost owing to wet weather may be deducted from wages. This is impracticable, as well as unfair, as it is prohibited by the Agricultural Wages Act.

(2) " Wet time " to be deducted, but the weekly wage to be raised, commensurate with the estimated loss of time per week—say, 2*s*. per week or whatever it may be.

(3) The adoption of piece-work as far as reasonable.

(4) Alternative work of an indoor kind to be provided, *e.g.*, making tool handles, hurdles, gates, etc.

It is this last method, I believe, in which the most profitable solution lies. On some operations, of course, there is little loss of time by reason of the area being more or less sheltered, and work in standing woods available, but even then, this work becomes impossible when everything gets saturated and begins to drip.

I do not wish to enter into an argument with regard to the pros and cons of piece-work and day-work methods, but it is obvious to all, that, provided a piece-work rate for any job is fixed fairly for both sides, its adoption is a common sense way of meeting the difficulty. It is the experience of the forester that will count in determining the reasonable use of piece-work, both as regards knowing the men who have to do the work and also the price which will be economic. On the other hand, I have calculated the piece-work wages during the winter to be very little in excess of a regular day-work wage for more strenuous work. I have experienced this for several winters. But still, as long as the men get at least their day wage equivalent, piece-work is preferable.

One has to contend with a high rainfall in these hilly areas (this high rainfall is, on the other hand, of course, a considerable asset to the plantations), and to the people living in lower country, it often seems incredible when they are informed that any work was impossible on the hills. The rainfall here at 1,000–1,400 ft. is 70 ins. per annum, whilst the valley rainfall is only 35 ins. Under such conditions, it is obvious that much time must be lost.

Now, as regards alternative work being supplied for wet weather, the initial cost is bound to be high. I am referring, chiefly, to the work of making gates and hurdles with oak or larch respectively (this is the gate-hurdle in use in the West of England and not the wattle-hurdle of hazel). A small petrol-engine and a bench would have to be provided, and also the various tools used for morticing, nailing, etc. Further expense would be the cutting and haulage of the timber to the barn, shed or other sheltered place for conversion, and making the hurdles, etc. These hurdles are 6 ft. in length, and 4 ft. 6 ins. in height, and contain 10 ins. of timber, or say 1 cu. ft. approximate, and can be easily sold for 3*s*. a piece. This would utilize any larch available, and especially any small or inferior timber, instead of, as is usual, selling it at a very low price to a merchant " to get rid of it " for the purpose of preparation of the ground before planting. Even if no financial profit was made on the sale of such, the time would be profitably utilised and something of material value produced for wages paid.

We must consider that under the present circumstances, a very large sum is spent annually for no production whatever, and I have yet to see the gang of men who will make up for this in fine weather. Of

course, there is the view of the local tradesman, who may find the Commission a serious competitor and who may argue that the function of the Commission is not to act as merchant, and I do not advocate any unreasonable undercutting in prices, should the Commission undertake such work, but simply to be able to utilise profitably weather that makes ordinary routine work impossible.

D. N. WILLIAMS.

PLANTING OF OAK ON A COPPICE AREA.

On a coppice area, where old coppice can neither be sold nor given away, but has to be cut and burned, the preparation of the ground is an expensive item in the formation of a young plantation. It leaves however, a clear forest floor with a fair amount of humus, and, to all appearances, ideal conditions ; but the humus soon decays or gets blown away, and as the young coppice makes but little growth until mid-summer, the soil and plants are exposed to the drying influence of sun and wind. The soil cracks and the spade-cut opens, rendering the conditions anything but favourable for the successful establishment of the young plantation.

If the coppice can be cut immediately after the previous season's planting is finished, left to dry for a few weeks, then burned, and the young coppice shoots prepared in strips, the conditions are much more favourable. This stripping looks like adding additional expense to the preparation, but the old coppice can be burned at less than half the cost when it gets dried. The planting is done at 4*s*. per acre cheaper, as the planters need not use guiding sticks of any kind and the weeding is more cheaply done.

In the preparation of the strips the cut coppice is tucked closely into the side of the standing strip, leaving a clear space for planting. If the stripping is done in September, the coppice retains its leaves well into the spring. This shelters the young plants and keeps the soil from getting battered down by heavy rains, and prevents evaporation. It will soon decay, fall to the ground, and must naturally improve the mechanical condition of the soil. The standing strip shelters the young plants from the scorching rays of the sun and this must lessen excessive transpiration in hot weather. Less moisture may reach the ground by precipitation, but there is less loss by evaporation, and the plants suffer less from drought. There are also fewer failures and the plants make better growth than they do in the open.

No weeding is done in the year of planting, unless to remove a rank growth of grass or bracken, which grows up in places where the coppice is thin. The weeding is left until the following year, and if the plants are not interfered with by frost a commencement may be made about the beginning of June : the plants are then easily seen, the coppice not being in full leaf. The weeding is done every alternate year and costs about 12*s*. per acre. This early weeding allows a weakly growth of coppice to grow up along the lines, which is helpful in protecting young plants from late and early frosts.

There may be mistakes made in leaving too thick a strip of coppice, but there are probably more mistakes made in cutting back too much. This allows more light to reach the ground and encourages a rank growth of surface vegetation which is detrimental to the healthy growth of the plant.

As regards planting distance, I prefer 5 ft. lines as it lessens the cost of preparation, planting and weeding. The strips of coppice can be maintained for a longer period, probably until, they are outgrown by the height-growth of the young plantation. These cleared stips ensure a free circulation of air. The plants are happy in the side shade of the coppice, being practically free from mildew, while those in the open places are more or less smothered. The hazel coppice will keep down surface vegetation and will clear the young plants of branches, up to about 18 ft. better than a thick plantation of oak will clear its own species.

The plants used have been 1, 2 and 3 year seedlings, 1+1, 1+2 and 2 + 1 transplants. The 1- and 2-year seedlings have given the best results and are now much better plants than the 2 + 1 transplants. The plants should be fairly heavily culled, root pruning being reduced to a minimum and the roots let into the ground with as vertical a notch as possible. Early planting of the oak is to be recommended. "Plant before Candlemas and command success, plant after and entreat it," is quite applicable to planting the oak on these clay soils. But it is much better if the plants are put in before the soil gets sodden with the winter rains. This prevents puddling the soil when planting, and allows the frosts to loosen up the surface soil, thus preventing drying in the summer.

It is generally necessary to shorten the tap root of the oak, more especially the 2-year seedlings. If this operation is left until well into February or March, the root bleeds severely and rots back about 2 ins., and as the young plant puts out new roots close to the cut, which strike vertically into the soil, this rotting back cannot be conducive to the rapid establishment of the young plantation.

R. Butler.

The Keeping of Tools.

The importance of having good tools for forestry work and of keeping them in working order is generally recognised, but how often this attention is overlooked must be the experience of most foresters, especially when dealing with casual and untrained workmen. A good workman can be known by the manner in which he keeps his tools, especially if they are his own, and this is a point that deserves consideration. From my experience of early days, every workman supplied his own tools and therefore he had a personal interest in keeping them well and workable, the Crown doing any repairs or replacing breakages occurring in the work. When tools are supplied to the workmen, as under the present regime, they are not so well cared for. I have known new tools spoilt the first day of working through careless handling by inexperienced

workmen; and this will continue in some degree unless the workmen supply their own tools. They should be enabled to do this, I suggest, by being paid wages commensurate with the importance of forestry work, which is really skilled labour.

There are comparatively few workmen (I speak in local terms) who know how to keep edge and cutting tools, and most tools—with the exception of mallets, hammers and the like—in use in forestry work come under this description. It is painful to see a workman using a saw that neither clears nor cuts; or a blunt axe for instance; and yet many will give blow after blow with a cutting edge which has become blunt, thus losing over fifty per cent. in efficiency, and without realizing the unnecessary expenditure of energy at the end of the day by so doing, together with the corresponding poor results of such work.

All foresters, foremen and gangers should be capable of handling the necessary tools so as to be able to show any workman how to use them. They should also be able to keep, strip, set and sharpen felling, crosscut and hand saws of all kinds; no mean qualification, but a most important and necessary one, otherwise they will meet with difficulties sometimes in the work. When you are asked, "Can you do it yourself?" as some employees are not slow to do in these days—there is a certain satisfaction in replying by performing the work and handling the tool as it should be done, either axe, saw, scythe, hedgebill or any other tool. It also commands a certain respect, as the workmen then see that you know something about it.

All new tools with natural wood handles—untouched by varnish or other dressing—should be well saturated with linseed oil. This preserves the wood, and ultimately forms a "skin" which makes the wood impervious to wet, prevents blistering of the hands, and lengthens the life, bar accidents. The metal parts should be well rubbed with crude vaseline, grease or lubricating oil. Linseed oil should *not* be used on metal, especially on the webs of saws and the like.

All metal tools in use in winter and wet weather should be cleaned and greased before being put away. Spades, for instance, and nursery tools are not infrequently put away with soil adhering. This may not apply to sandy soils, but in clay and adhesive soils, it is a common failing, and workmen should be instructed against the habit, as with an acid clay soil it quickly spoils the surface of the metal by corrosion and rust. No metal tool should be put away damp, or if so, it should be wiped with grease or vaseline, and all tools should be hung on nails or pegs and classified, spades with spades, shovels with shovels, and so on. Axes and crosscut felling saws are best stored in special racks.

Where there are considerable stores of tools and materials I suggest a Store Book might be issued of strong paper, whereby tools, etc., issued to the workmen could be signed for, and written off when returned to the store. Where the responsibility rests upon the forester for the safe keeping of all stores and tools, this would appear to be a necessary and desirable arrangement.

ANTHONY SIMPSON.

Mound Planting in Gwydyr Forest.

During the summer of 1928 we laid out Belgian turfs on an area of about 35 acres, and having had no past experience at this work, we were naturally short of suitable tools. The area in question was mostly cotton-grass and molinia peat, and we commenced by using ordinary garden spades and draining tools. These proved very slow at first, but after an hour or two, considerable progress was made as the men got used to the work.

The following morning, however, the men turned up with an assortment of tools of all types and ages. Some of the men had a very old, but useful type of Welsh peat knife, with a curved blade about 18 ins. long, and with an iron handle 4 ft. long, fitted with an eyelet for a cross handle, similar to a modern hay-knife. Others had peat and hay knives of varying designs, and for slicing the turfs the most useful tool was of a peculiar shape, the cutting edge shaped somewhat like an anchor, with a cranked handle 5 ft. long. For cutting the sides, the local blacksmith made two spades from the metal shapers which support a two-feet light railway; these gave great satisfaction. They were quite straight with a blade about 18 ins. long, with a socket to which an ordinary spade handle could be fitted.

A few ordinary 5-pronged garden forks bent to right angles were very useful for lifting and placing the turfs. The turfs were cut 15 ins. square and 8 ins. deep from turf drains, 20 ft. apart, the drains being arranged as far as possible so that later on they can be deepened if necessary and led into the main drains.

The question of costs is still an open one, but on the work done to date the spacing of turfs 5 ft. by 5 ft. and planting will not exceed £4 per acre.

In planting this area tools again were many and varied. The Schlich spade, rabbiting spade and long handled semi-circular garden trowel proved most satisfactory; possibly a strong type of the latter tool would be the best.

During the summer of P.27 we laid out turfs on a small area, and in that year planted 2 + 1 + 1 Sitka spruce. An examination of the root system of these plants in the autumn of 1928 showed a better root development than plants which had been notched in direct by mattock planting. On examining a Sitka spruce which was planted in P.25 direct by mattock and burnt by railway fire in autumn, 1927, I was astonished at the root development. Five-roots, growing just under the surface, all measured over 5 ft. long, one being 6 ft. 6 ins., and it is difficult to say how much was left in the ground.

J. L. Shaw.

Concrete Fence Posts.

Presuming it to be no crime to write in a forestry journal upon a substitute for home-grown timber, I should like to suggest for permanent work the use of concrete for fence supports where straight-grained oak or

sweet chestnut is difficult to obtain. Quite possibly some of our foresters will dislike the idea of concrete posts, because it seems to imply the learning of yet another trade, but the posts can be made without difficulty providing clean gravel or, preferably, stone chippings and grit are available.

The mould required can be made by any local carpenter, and should consist of a platform, *e.g.*, inch boards nailed on joists ; this should be long enough for the posts to rest on, and sufficiently wide to take six to twelve posts. Dividing boards are placed across the platform so as to form sections for each individual post, the necessary taper from the base to the top of the posts being made. These divisions are held in place by the basal board, which is made to fit tightly and fasten. The top board is fitted on similar lines, but to give a finished appearance to the head of the posts a rounded mould, or, simpler still, a square block the size of the post, say 3 ins. × 3 ins., is split across the centre from corner to corner, forming two hypotenuse triangles ; these are screwed to the top board so as to mould a blunt wedge-shaped point to the top of the post.

The dividing boards should be bored according to the number of wires required. Great care should be taken to get all the holes in true alignment, so that iron rods may be slipped through the whole width of the sections ; also, to avoid trouble, the dividing boards should be numbered so as to be replaced, after discharging, in exactly the same rotation on the platform. Half-inch round iron bars are most suitable for making the rods ; these mould a hole sufficiently large for the use of any type of staple. If smaller holes are made there is a staple made by Rylands Bros. which is No. 6 gauge galvanised wire split longitudinally. Staples should be 6 ins. long to allow for passing over the fence wire, through the post and for clinching at the rear.

The proportion of cement to gravel and grit may vary according to the quality of gravel available. In this locality, where good stone chippings are obtainable, 6 to 1 of cement is satisfactory, the proportion of $\frac{3}{4}$-in. chips to that of stone, dust or sand, being 4 to 2. Reinforcement is necessary in some form of iron bars ; wire is not stiff enough to be recommended. Where cheap second-hand gas or water piping is to be obtained this is ideal, otherwise new round iron bars will have to be used. The number of reinforcements required in each post depends on the individual strength of the iron in use. Two lengths of gas piping are sufficient, whereas three or four lengths of $\frac{3}{8}$-in. round iron are necessary. The concrete should be mixed well and worked into the corners of the moulds when filling, otherwise the posts will be rough and unsightly with cavities.

The iron rods which mould the holes for the staples, if greased when put in, draw out much easier and can safely be taken out the following morning after filling. It is advisable to leave the posts in the moulds for two or three days before taking out and laying flat for completion of drying. A concrete post should have been made at least one month before it is required for use.

These posts, when erected, look well and will, unless very roughly handled, last a very considerable time. The cost for posts 6 ft. long

5 × 3 ins. at base, tapering to 3 × 3 ins. at the top, is very little over one shilling per post, all inclusive. The cost varies, of course, according to the proximity and prices of materials and labour.

Even though recommending the use of concrete for fence supports, I still prefer to use oak for straining posts. The disadvantage of concrete appears to be :—

(1) The posts cannot be made and ready for use under several weeks.

(2) Their weight goes against making supplies at one centre, where materials are obtainable, for transfer to other areas.

G. W. Hollis.

Elimination of Screefing in the Planting of Spruces.

I have found that the elimination of screefing, like most other things in the practice of forestry, has its advantages and its disadvantages. Happily, in this case, I think that the former outweighs the latter.

I will give a few facts noticed after the severe frosts and gales of 1927–28, and which refer to Dovey Forest at elevations of 1,000 ft. and over, with a rainfall of more than 80 ins. A small area of P.27 was screefed and planted with Sitka spruce 2 + 1, and during P.28 another area was planted, this time without screefing and also using Sitka 2 + 1, both sites having peat conditions and both in a frost area. After the storms and frost mentioned above it was found that the Sitka in P.27 were frost-lifted and a few entirely thrown out. This area had to be gone over and practically replanted. Up to the present the trees have not fully recovered.

On the P.28 area the trees were not affected at all by the frost and remained quite firm in the notch. At the end of the season the trees looked well. It must be remembered that P.28 was planted only a few weeks before the frost and the notch had not time to heal up. The cost of the P.27 planting was 17*s.* per thousand, and that of P.28 14*s.* 6*d.* per thousand.

Another area was planted in P.28, screefing again being eliminated ; this site was very exposed, and although subjected to more gales than frost the trees remained firm and are still a good colour.

Thus in favour of not screefing we get the following :—

(1) Prevention of frost-lift and avoidance of firming-up or re-planting.

(2) Trees are not affected so much by unfavourable conditions, and in consequence get a better start.

(3) Actual planting costs are reduced, at the same time giving better results.

The only disadvantage noticed up to the present is in weeding, and this only where there is heavy grass and small plants were used. The cost of weeding is bound to rise, because the workman cannot relieve the tree without using his hands or his fingers, and having to pull the grass

takes more time. The larger trees, with their leaders above the grass, have done much better, and did not require such careful handling. This slight rise in weeding costs can be overcome by reserving, as far as possible, the larger grades for sites carrying heavy grass.

In conclusion, I would suggest that the same experiment be tried in connection with the planting of Douglas fir on exposed or semi-exposed areas. Here again, frost and gales have done damage, causing a lot of extra expense, which I think could be prevented by the elimination of the screef.

R. FRASER.

WEEVIL-TRAPPING.

There is little need to advertise the subject of this note. I believe every one of us has at one time or another racked our brains as to the ways and means of reducing our costs to make them fit the estimates, and reducing protection costs is no exception to the rule. My efforts last summer to reduce protection costs led me to observe one or two interesting facts about pine weevils which I have not yet seen in print, and I pen these notes in the hope they may be as a little tributary to a swelling stream, for such, I believe, is the reason for the existence of a Journal like this.

The early part of last spring was warm and dry. A large part of Hemsted Wood, of which I then had charge, had been recently replanted, principally with Douglas fir, and although conifers formed but a very small proportion of the previous crop, it was not long before the new crop showed signs of weevil attacks. For the best part of a week I had men engaged in preparing and laying down traps, both bark and billet. For a while the end justified the means; large numbers of weevils were caught, and much damage was, for the time being, either checked or prevented. Here I might add that most of the weevils were caught in the bark traps, the others proving quite ineffective and were soon discarded. But it was soon evident that this game was not going to last. In spite of the fact that the traps were constantly renewed and extended, the damage done began to increase, without any appreciable increase in the numbers caught. As I had already spent a lot of money on protection, chiefly against rabbits, it was now a problem of how to combat effectively the mischief without having to put anyone else besides the rabbit-catcher on the job. A remark of the rabbit-catcher himself, a very intelligent fellow, gave me the clue. It had been his habit, before leaving the wood at night, to look at some traps near the gate through which he went out, and on one occasion while doing so, saw a weevil alight on his hand. He did not know then that weevils fly and, excited with the discovery, told me the next morning. It suddenly occurred to me that weevils, like most animals and insects, are social and nomadic in habits, and that opinion was confirmed by the fact that on more than one occasion they suddenly disappeared from one region, where they had done much damage, and reappeared elsewhere, half a mile or more away. We then tried the plan of moving the traps frequently, according to how the weevil damage showed itself, and it had the effect anticipated. More weevils were

caught and, what was just as important to me, the necessity of frequent renewals of the traps were obviated.

These are only the observations of a single year. I hope, now that I am in an entirely new district, to renew the experiment again this year, when the lack of a plentiful supply of material for trapping will put it to a much severer test than before.

I have also other reasons for writing this. I have the idea, perhaps wrongly, that attacks from insects and fungi increase rather than diminish as each year passes, and one is suddenly jerked up now and then with the report of a newly-discovered pest. I often think that the preventive and remedial measures are generalised too much, and I learn little or nothing of how other foresters fare with their pests, and to what extent they are successful in combating them. Not only do I want to estimate the lessons of others, but I do want to get my own estimate corrected. I want to learn.

In conclusion, my observations lead me to venture the opinion that most of the literature I have read on forest entomology deals too much with insects as individuals, instead of treating them as members of a community. By way of illustration, I wish to draw attention to the change which has overcome the study of botany. Thanks to the labours of Warming and Tansley, far greater attention is given now than ever before to the study of ecology. Is it too much to ask for a more proportionate view ? I hope not.

R. B. Gilson.

Hints to young Foresters and Foremen.

While all the older foresters will have these things at their finger tips, some of the younger men may find them useful. One of the most important rules to study is, of course, economy. This can be done without cutting, say, piece-work rates to the lowest farthing. While it is the duty of every forester and foreman to get his work done as cheaply as possible, there is nothing to be gained by paying too low prices. If you get prices down too low, you will get less satisfactory work. The men will have to work much faster to earn a fair wage, and consequently the work suffers. This will be noticeable when the men have had, say, two wet days at the beginning of the week and are trying to make up their wage on the remaining days. I think you will find it more profitable to pay a fair price and have the satisfaction of knowing your work is being done properly, than pay a very low price and have the men taking advantage at every opportunity to skip over their work. (By a fair price I mean, the price the job is actually worth and one that is fair to man and master alike.) At the same time, you must not give way on price, make up your mind to fix it yourself, if once you give way with price on one job, you will be expected to on another. You can, and must, reason with the men, and this can be done without giving way.

When starting a new job for which you want to fix a piece-work rate, I find it very helpful to put one reliable man on it first, see what he can

do in a day on day-work, then regulate your piece-work price accordingly and put your gang on it. Always remember that every man expects to be able to earn a little higher wage on piece-work than on day-work. One thing you must watch is, that they spend the same time on the piece-work as they do on day-work. Men leaving work at 3 p.m. have not spent enough time on it.

While it pays sometimes to do certain work day-work, and some must be done day-work, it is nearly always better to get it done piece-work. It is all right to do certain jobs day-work, but stick to piece-work where possible.

While in nearly all cases 90 per cent. of your men will be reasonably reliable, you will get your slackers, as every forester and foreman does. If you can, keep the least reliable apart from one another. If you let them work together, you may get more talk than work. This happens mostly with the younger men and you will have to keep an eye on them. You always have the opportunity to get rid of a man if he is not up to standard, but try to work him first, and don't sack him for the sake of doing so. Try and work him first and do all you can to get them interested in their job, as more interest in work, means more and often better work.

Be sure always to have no favourites, always treat one man the same as another. If you lean toward one man more than another, it will create ill feeling among them. Never give way to any man, once you do you will always be expected to. Never let men think you are dependent on them, if they get the idea into their heads that you are dependent on them, you may have trouble. Do not let them know how much of a certain job you intend to do. If they know you have, say, a large area to plant, they sometimes get a feeling that they cannot be done without, so do all you can to prevent this feeling, or they will try and demand higher prices for piece-work. With so many out of work at present, it should be no great difficulty to obtain men. On the other hand, if your operation is a long way from a village and the county rate of pay is low, you may experience a little difficulty in obtaining good men. This, by the way, is another reason why you should try and get them satisfied on piece-work, with the opportunity to earn a little higher wage than on day-work, and it will also give them more encouragement.

If your work is in a mountainous district and very exposed, you will most likely have to find the men a shelter ; if so, try and put it up as near the middle of the area as possible on which you are working. This will save a lot of walking time, as it will be easily accessible from all parts. The time saved by this will be more noticeable when the men are working day-work. When making your shelter, try and make a lock-up shelter, *i.e.*, if circumstances permit. Of course, rough shelters are all that are needed in most cases, but if you can make a lock-up shelter, you can always keep tools, etc., in it, and you will find it most useful for this purpose, and it can be locked up at nights and week-ends.

When you have a large gang engaged, say, on planting, it is always best to make them put their tools in the shelter each night ; they are always better to handle in the mornings, planting bags are kept dry

and it is better than putting them under fern or hiding them in a hedge, which does not help to prolong the life of the tools.

As a rule, carrying transplants costs a considerable amount when you have a large gang to supply. For instance, say you have had 50,000 transplants delivered by road lorry, and the nearest point to which it can take them is a quarter or half a mile from the planters, you will, I think, find it cheaper, to employ a horse and cart to pick them straight up and take them to your burries, than to let a man carry them in a bag or wheel them in a wheel-barrow all this distance. The plants will be moved more quickly, heeled-in more quickly, and there will be less danger from frost if it happens to be freezing at the time.

R. E. Pallett.

The Planting of Norway and Sitka Spruce at Kerry Forest (Montgomeryshire).

In the following article I propose to deal with the different methods of planting spruces, from a theoretical and economic point of view, in as concise terms as possible, which I may summarise under the following heads :—

(1) Mound and turf planting.
(2) Ordinary or mattock planting.

(1) *Mound and Turf Planting.*

This, of course, is carried out where the ordinary method of planting is a failure, viz., on areas having a general vegetation of *Molinia, Juncus squarrosus* and *J. conglomeratus*, cotton grass, which points in general to a clay subsoil with a layer of peat differing in thickness locally. Such conditions as these indicate a wet area. Where sites vary from damp to very wet, different methods of planting should be employed, for the former condition, turfs, and for the latter mounds.

When laying out areas for turf and mound planting the procedure is as follows :—The area is first drained, care being taken not to drain too heavily as a few extra drains can always be put in when and where wanted. In cutting out drains, turfs are cut 74 ins. by 14 ins. deep and spaced to the required distance, in the case of the Sitka spruce, generally 5×5, and Norway spruce $4\frac{1}{2} \times 4\frac{1}{2}$, the sub-soil from the bottom drain is also utilised for one row of plants, this should always be thrown 3 ins. from edge of drain, if less, when the front crumbles, it falls in and blocks the drain.

Immediately after draining operations are completed, the mounds and turfs should be lifted. The time of lifting is most important and should be completed in time to allow for turfs to settle before planting upon ; on the other hand, they should not be left too long to grow over and shrink.

When the operation of preparing turfs is in progress single turfs should not be dug out, but a line followed forming a small minor drain, which helps drainage and is also economic in the saving of further draining,

as this method costs no more than taking out the single turf, and, most important, minimises stagnant water.

The methods used in turf planting at Kerry Forest are as follows :— For turfs, one cut is made with a spade, the direction of the cut being with the junction at the radius of turf facing from the sun to minimise opening, the turf is then lifted with the hands from the ground and the plant inserted on ground level with a natural spread of root system, the cut being closed with toes.

The mounds are much thicker than the turfs, being from 14 ins. wide to 9 ins. in thickness. The L notch method is used here but the plant does not go to ground level as mounds are on wetter areas. With the object of giving the plant a start before reaching water level, a spade is again employed here, and we find that this is the most serviceable tool for the job.

With the areas mound and turf planted at Kerry it is found that the following advantages are apparent over the mattock planting :—

(1) The cost of weeding is lessened.

(2) Plants put on more growth (up to the present experimental stage).

(3) The number of failures usually found on wet soils when planted by the ordinary methods is eliminated.

It is early to give an opinion of the disadvantages, apart from the extra cost of planting per acre, compared with the ordinary methods of planting; this, however, is balanced somewhat by savings on the cost of weeding, which, in the type of vegetation where one would use mounds, would be very heavy. Below is an example of same :—

	£	*s.*	*d.*
Cost of planting 1 acre by ordinary method, without screefing, using Sitka spruce, 5 × 5, at 15*s.* per 1,000	1	0	4
Cost of weeding twice in one season, at 7*s.* per acre ..	0	14	0
Total ..	£1	14	4
Cost of planting 1 acre by mounds and turfs ..	1	6	2
Lifting and spacing turfs	1	11	0
Total ..	£2	17	2

This shows a loss on the mound planting in the first year, but it will still leave the area planted in the ordinary way to be weeded twice more (two years), whereas if plants on mounds keep up their growth as in early experimental stage, no weeding will be required, and, to come to the main point, there will be little difference between the cost when fully established, if mounding and turfing (taking an optimistic view) advances as in the experimental stage, and a saving when enhanced growth and reduction of beating-up are considered.

The Ordinary Method of Mattock Planting.

When planting drier areas by the ordinary method, it is found far more advantageous to eliminate screefing entirely. This has been done at Kerry Forest with good results and shows the following advantages over screefed areas :—

(1) More economical: Where planting with screefing costs (as at Kerry) 15*s*. per 1,000, it is done for 12*s*. without screefing.

(2) Plants do not check so long as otherwise as it does away with any water lodging in screef holes.

(3) Helps planting, in assisting planter to make a cleaner cut, thereby getting a better root spread, and the plant keeps firmer during gales after planting.

(The plantations of Sitka and Norway spruce at Kerry vary in elevation from 1,300 to 1,500 ft. above sea level, and generally check for two or more years.) C. R. WELLINGTON.

AN EXAMPLE OF BIRD LIFE AND ITS RELATION TO AFFORESTATION.

During the past season at Kerry Forest about 90,000 pine weevils have been collected, methods employed being (1) trapping with Scots pine billets laid on face of ground, covered with turf, and (2) hand picking.

The labour employed on this work has been three men, in addition to three to four school children on Saturdays and holidays (weather permitting in latter case).

The weevil occur over certain definite parts of the forest (previously wooded areas), and as these areas are scattered men have definite zones of responsibility. Weevils picked and trapped are kept for a check on quantities, and records kept of each area by P. numbers. By an early check upon these records it was revealed that P.27 areas were producing more weevil than P.28–29 areas ; allowing for acrege, labour and general conditions prevailing throughout the forest this seemed unusual, and upon investigation it appeared that traps on P.28–29 areas were being visited by carrion crows and pigeons, turfs having been pulled off traps and followed row for row. As the areas were occupied by day (customary working hours) only a few birds were seen, but it was found that flocks of the above species visited the area in the early morning and after the men had retired.

The most remarkable point was that the birds visited the P.28–29 areas only, and the explanation may be as follows :—

(1) That the area was freshly felled and was the last habitat of the birds.

(2) That the crows were attracted by a few rabbits which are near the area, and the pigeons follow their flocks. This theory may be weak, however, and I will leave it for the readers of the Journal who are more versed in ornithology to judge.

Some of the following notes may also be of interest regarding weevil attack and local habits :—

(1) Plantations at Kerry contain Norway spruce, Sitka spruce and Douglas fir. The Sitka suffered most from attack, but shows the best

recuperative powers by healing quickly and sending up new leaders, where a high percentage of Norway spruce and Douglas fir dies.

(2) Dense bracken areas seem most immune from weevils.

(3) The most difficult areas to deal with when the pest is well established are those where a good percentage of heather is found : the weevils seem to live on and among the stems, and quite naturally are not found in numbers on the traps.

(4) Weevils show a distinct liking for the Scots pine billet in preference to other species, or bark.

C. R. W.

Rainfall at Glenbranter.

The west coast of Scotland is well known to most people for its wet climate. To those who have never visited this part of the country the following details of the rainfall for 1928, recorded at Glenbranter, may give them some idea of the conditions.

During the three years or so in which rainfall records have been kept, last year (1928) was by far the wettest year. The total rainfall for the twelve months—1st January to 31st December, inclusive—was 117·77 ins. Rain fell on 253 days, *i.e.*, days on which the measurement was 0·1 in. and over (measurements below 0·1 in. are not recorded). The corresponding figures for 1927 were 97·64 ins. and 254 days. The wettest month in 1928 was January, the rainfall being 22·56 ins., and the driest month was May, with 1·37 ins. January's rainfall came pretty near the yearly average for many districts in eastern Scotland ; for instance, the rainfall for 1928 recorded at Dirleton was 24·24 ins.

The following table shows the records for the years 1926, 1927 and 1928 :—

Month.	Year 1926.	Highest on single day.	Date.	Year 1927.	Highest on single day.	Date.	Year 1928.	Highest on single day.	Date.
January ...	15·62	1·62	7th	16·01	1·83	12th	22·56	1·47	9th
February ...	9·49	0·98	15th	6·68	1·48	3rd	9·15	1·06	4th
March	11·27	2·98	7th	9·06	0·96	23rd	9·27	2·37	20th
April	3·78	1·38	14th	6·81	1·77	13th	5·26	0·84	8th
May	5·03	0·83	27th	5·02	0·89	20th	1·37	0·52	26th
June	6·47	2·26	11th	6·16	0·78	16th	6·76	0·99	9th
July	6·83	2·79	22nd	4·90	0·93	3rd	7·28	1·27	10th
August	8·66	1·76	20th	8·11	1·32	8th	6·69	1·30	13th
September ...	8·26	1·75	14th	9·70	1·78	28th	7·53	1·10	7th
October ...	12·27	2·60	24th	10·81	1·51	22nd	14·86	2·25	19th
November ...	12·97	1·33	5th	12·00	2·04	1st	15·30	2·11	23rd
December ...	8·37	1·04	8th	2·38	0·71	22nd	11·74	1·67	25th
Totals ...	109·02			97·64			117·77		

During the month of January, 1928, rainfall was recorded on 30 days, and during May on 9 days.

R. T. Anderson.

Glenmhor Society of Foresters.

A movement which originated with the forestry staff at Inchnacardoch, Inverness-shire, has resulted in the formation of the Glenmhor Foresters' Society, Glenmhor being the "Great Glen," of which Fort Augustus forms the centre. The Society does not intend to devote itself exclusively to forestry subjects, but has a wider outlook, more in the nature of a mutual improvement or literary society, and, while forestry subjects will naturally hold an important place in the syllabus, subjects of more general interest will also be discussed.

The syllabus of the first session includes lectures by the Assistant Commissioner for Scotland, the Divisional Officer (Mr. Scott) and Dr. Anderson, and the magic lantern, and possibly the cinema, will be used on occasion. Membership is open to all men and boys engaged in forestry in the district, whether on the Commission's forests or on private estates, and persons not employed in forestry are also eligible for election and are represented on the Committee.

The meetings so far have been held in the dining room of the men's bothy at Inchnacardoch, and have been confined to the male sex, but some of the meetings will take the form of public meetings or functions, and will be held in a public hall and be open to the general public, including ladies. During the summer it is hoped to have excursions to forests or estates in the neighbourhood.

J. W. Mackay.

A Memorial Grove.

During a short holiday in Germany in the autumn of 1928, I had the pleasure of renewing my acquaintance with Tharandt, near Dresden, the home of the Royal Saxon Forest Academy, which has recently been raised to the status of "Hochschule."

My stay in Tharandt synchronised with the meetings of the Deutscher Forstverein which were being held in Dresden and neighbourhood, and I was privileged in being allowed to take part in their excursion to the Tharandt and Spechtshausen Forests. In the course of the afternoon we visited the grave of Heinrich Cotta, the founder of the Academy, which lies in the middle of a grove of oak trees on the high plateau above the valley of the Wilder Weisseritz, near the Arboretum and forest nursery.

This grove was planted to celebrate the eightieth anniversary of the birthday of Heinrich Cotta, who, by the way, died in the following year, and consists of eighty oak trees, planted by as many foresters, whose names are preserved in the archives of the forestry department of the state of Saxony. The grove is in the form of an oblong, with a gravelled space in the centre, more or less of a uniform shape, with a broad gravel avenue leading to it from the middle of one side.

The bole of one of the trees on the exposed edge of the grove had been broken by a storm in the winter of 1927–28, and our visit was made the

occasion of the planting of a strong young tree in its place. This was done with all due ceremony, orations were made at the grave, and wreaths were laid in the names of the Deutscher Forstverein and the Oesterreicher Forstverein.

J. W. M.

Pine Weevil Trapping.

In June, 1926, in the plantations on Craig Phadrig, an outbreak of pine weevil (*Hylobius abietis*) was observed, and as this did not seem to be one likely to develop into a serious menace it was decided to adopt the slab and sawdust method of trapping. Though so comparatively late in the season the few traps prepared did considerable execution, and when proceedings ceased at the end of July a fair collection indeed had been made. In 1927, again, a minor outbreak was dealt with in a similar manner with satisfactory results.

Towards the end of April, 1928, there was a heavy outbreak of weevil which extended over an area of approximately 20 acres. In order to cope with this a more effective and rapid method of trapping had to be devised, so from the adjoining plantations of Scots pine, 20 years old, large quantities of twigs 5 ins. to 8 ins. in length were obtained from the growing points of the lateral branches. These were inserted in the earth, simulating, as it were, growing plants; also through the entire area small bunches of these twigs were laid on the ground. Every day these and the vertical twigs were inspected and the weevils carefully collected. They were replaced with fresh twigs at intervals. A count was kept of the collection obtained from day to day. The bundles, as a rule, provided 5 to 15 individual weevils each, and the isolated twigs invariably carried 2 to 3 weevils each.

Though in 1928 thousands of weevils were collected, the area affected suffered seriously, but it was considered that the damage done was much less than would otherwise have been the case. A peculiarlty of the place where the outbreak was heaviest was that the soil was friable in nature with much rock outcrop. Three years previously, in 1925, a fire passed over the surface. Later in season 1928, as in former years, it may be interesting to note, this area carried a remarkably heavy crop of *Digitalis purpurea*, the foxglove. The experience of the writer is that having the land screefed previous to planting is also a good method, one whereby this, perhaps the most deadly pest affecting the conifers, can be more easily observed.

A comparison of the different weevil-trapping methods shows that the one adopted at Craig Phadrig was definitely superior to others in efficiency and economy (*i.e.*, for an area where the source of the weevil attack is inside the plantation itself). It should be successful as a measure of protection to a plantation against weevil invasion from adjoining areas. The operation of setting out the twigs, either in bundles or singly, is extremely simple, and collection of the weevils is also quite easy. Renewal of the traps with fresh shoots should be fairly frequent, particularly in hot weather.

P. Stewart.

Effect of clear Fellings on wet Areas.

War-time fellings of some hundred acres have been replanted with Sitka spruce, Norway spruce and Douglas fir. Shelter belts of about two chains breadth (Scots pine and oak) have been left at intervals. While heeling in plants in these belts, it was noticed that the soil contained no more than an average amount of moisture, and this condition extended into the plantation for a distance of approximately the height of the trees. Up to this point, the plantation is thriving, and the soil covering is a mixture of brambles, grass and fern. Beyond this, the soil covering reverts to a wiry grass, and the soil is waterlogged, so much so that turf planting has been resorted to in some cases.

Draining does not altogether solve the problem as it appears that the rain cannot penetrate the first few inches of soil. Driving a bar in beside the plant has proved useful. It therefore seems that on wet areas one may, with advantage, leave belts of standing timber closer together than would be necessary for protection against wind, to aid natural drainage in addition to their original purpose.

B. Gale.

Questions regarding Oak.

During recent felling of mature oak it was noticed that not only did the length and girth of the trees vary according to the depth of good friable soil, but also the quality of the timber varied in proportion of heartwood to sapwood and in the amount of fungoid disease present.

(1) The best trees were on an old nursery site, and it may be assumed that they had been allowed to grow undisturbed from their seed-beds or lines.

(2) Next in quality came the trees immediately adjoining, on a deep soil, fairly heavy but in which an 18 ins. bar could be sent to its depth with little trouble.

Taking a stump of 12 ins. diameter, of these two classes, it would show from 9–10 ins. of heartwood and these trees were singularly free from disease.

(3) The worst trees were on a site having a heavy sub-soil of gravelly clay, 6–8 ins. below the surface, hard to penetrate. Whether these were planted to their correct depth or whether the tap roots were unable to penetrate is hard to say. The fact remains that the tap root did not develop normally, and a 12 ins. stump only shows from 6–8 ins. of heartwood. Fungoid diseases were the rule in varying degrees.

In considering the production of good timber, the following questions warrant investigation :—

(1) The relation (if any) between the growth of the tap root and the production of heartwood.

(2) Whether a tree minus a tap root gets the full benefit of 3–4 ft. of good soil, and, if so, at what age ? as the tap root gets to the lower layers much quicker than the side roots.

(3) How much (if any) may be cut off the tap root without adversely affecting the tree.

There is a saying among foresters of the old school that "a tree grown from an acorn produces harder timber than a transplant." This may or may not be true, but again it points to an unchecked tap root and much heartwood, and the old brigade, if a trifle dogmatic, often stumbled on to the effect while we fumble over the cause.

B. GALE.

BRACKEN.

Investigations have been proceeding for three years under the supervision of Dr. A. C. Smith, of the Edinburgh and East of Scotland College of Agriculture, and the results and observations given below may be of service to Divisional and District Officers. Attention is specially directed to paragraph 4.

JOHN D. SUTHERLAND.

1. Bracken is limited to certain soil types, and does not extend easily into very dry or wet soils.

2. Bracken cut for three years is not completely eradicated, but becomes open enough to permit access of stock.

3. Bracken fronds are produced in succession throughout the summer, hence switching in May only removes a portion of the fronds, and would involve a second cutting later.

4. Cutting when the fronds are about eight weeks old (about July 1st in Boghall Glen) has proved the more economical of labour, because after that the new growth is relatively small.

5. Cutting for three years impoverishes the underground parts and leads to death of considerable portions, but does not destroy growth in future.

6. Insect larvae have been observed to damage the underground parts, but there is no evidence that this limits the extension of bracken.

7. Top-dressing the young growth with salt in May encourages grazing and treading by sheep, and in this way about half the year's crop of bracken has been destroyed in the first year.

8. Irrigation with spring water for two years encourages growth of grass below bracken, and thus increases grazing, but no direct effect has been observed on the bracken.

ENTOMOLOGY.

During the past year Mr. G. C. Brooks was appointed Assistant to Mr. R. N. Chrystal at the Imperial Forestry Institute, Oxford. Mr. Brooks will devote his whole time to the study of the Commission's entomological problems. These, as is well known, are many and varied, and it has been decided to concentrate as far as possible on the following pests:—Pine tortrix, Heather beetle and *Chermes cooleyi*. Attention is also being given to the chafer larvae, Pine weevil and *Tortrix viburniana*.

Reports on visits to certain of the Commission's forests during the summer are summarized in the following paragraphs :—

(1) Pine tortrix or Pine shoot moth, *Evetria buoliana*. This pest has been the subject of the principal investigation during the latter part of the summer. Mr. Brooks spent a considerable time at Swaffham and Thetford, and has obtained much useful information, both as to the incidence of the larvae and the degree of parasitism. He found that in a P.21 plantation of Scots pine at Swaffham there were nearly 10,000 larvae per acre established in the buds, and of these over 85 per cent. were parasitised (unfortunately, not before the mischief to the trees was done). In other areas recently attacked it was estimated that from 78 per cent. to 90 per cent. of the plants were damaged by the tortrix larvae. The damage to Corsican pine in the Thetford area was only 20 per cent. of that on Scots pine. The work has not been in progress sufficiently long to enable any practical methods of control to be suggested.

One other point of interest in connection with the tortrix work which may be mentioned is that large quantities of infested shoots were collected at Thetford and Swaffham for the Imperial Bureau of Entomology. Thousands of parasites were raised from the larvae and despatched to Canada, where severe damage to pine wood from tortrix has been reported.

(2) The effect of the attack of *Chermes cooleyi* on Douglas fir was studied by Mr. Chrystal in the Forest of Dean, Ringwood and Eggesford. In the Forest of Dean small-scale spraying experiments had been carried out on the spraying of infested blocks of young trees, using 5 per cent. Lysol. The spray was put on after the young shoots had formed, and though some of these had been severely scorched, the leaders were in nearly all cases unharmed. The spray had killed most but not all of the Chermes. A weaker spray, 3 per cent. Lysol, is now recommended, the spray to be applied before the young shoots develop and repeated in a few weeks. It is hoped to carry out spraying experiments on a larger scale this year. Mr. Chrystal strongly urges, however, that all Douglas fir plants should be dipped in an insecticide before they leave the nursery : this is a precaution which might well be taken and might obviate attack in many cases.

Other plantations in the Dean were inspected, especially the 15–20 ft. Douglas fir in Lining Wood which has now been under observation for some years. It is satisfactory to note that although the attack here was so severe that on previous visits all growth appeared to be at a standstill, the trees are now beginning to shoot up once more and are overcoming the attack. Younger plantations, still heavily infested and more or less completely checked in growth, were also visited. At Ringwood and Eggesford the attack was far less general than in the Dean, individual trees here and there showed the typical curling of the shoots, accompanied by the almost complete cessation of height growth which are such characteristic features of severe chermes attack.

In general, Mr. Chrystal adheres to his previously expressed views that *Chermes cooleyi* will never be a serious menace to Douglas fir grown

under fully suitable locality conditions. Where conditions are not wholly favourable the insect can inflict a severe check on the height growth of the trees in their early years, though even in this case there is reason to believe that the trees can in time grow out of the disease.

Chermes nüsslini. Some small groups of *Abies pectinata* were observed at Eggesford, mixed with groups of larch and hardwoods of various kinds. Although *Chermes nüsslini* was found on many of the silver firs, the trees were growing very well and their future progress will be worth watching.

Strophosomus lateralis. An outbreak of the Heather beetle in a P.26 plantation of Corsican pine at Ringwood was investigated. Considerable damage had been done to the plants and it was found that this was worst in recently burned areas, or on ground where molinia had replaced the heather, the attack virtually ceasing where the plants were surrounded by heather. It begins to look as if it may be necessary to reintroduce heather, by planting, on ground off which old heather has to be burnt, heather and tree plants being inserted at the same time. Trapping has been tried at Clipstone where Heather beetle is also a nuisance, but so far without much success.

W. H. GUILLEBAUD.

CHRONOLOGICAL AND GEOGRAPHICAL UNITS.

Returns for accounting purposes as required by the Treasury always refer to a particular forest year. If any fencing, draining, planting, weeding or beating up is at any time carried out, the cost of the operation must be debited to the year in which the main planting operation was effected on the particular area concerned. The object of this is, of course, to arrive at the cost of establishing the crop initiated in each individual year.

This practice has one rather curious effect. It has resulted in giving, in the minds of foresters and others dealing with the accounts, a geographical significance to what is really a chronological unit.

A forester will report rabbit damage. He is asked, where. In nine cases out of ten he will reply, " In P.23 or P.25," as the case may be. Now the whole area planted in a forest in the forest year 1922–23 or 1924–25 is, as a rule, far too large a geographical unit to be of any use for reference purposes. It is most improbable that the whole of a year's plantations will be felled in any one year. It is absolutely certain that they will not all be thinned in one year. The only proper geographical reference is the compartment number, and on a reasonably accurate map the compartment has a fairly exact geographical meaning.

This wrong choice of unit will in time correct itself. When a change of foresters occurs the new man will tend to learn his whereabouts by reference to the compartment numbers. " P.26 " will begin to have the merest academic interest. " Compartment 5 " will have the greatest practical significance, as being that compartment where there is a specially fine group of Scots pine or where the honey fungus is appearing.

It is suggested that if the compartment numbers were regularly used in conversation and correspondence, and particularly in progress reports and costing returns between the various grades interested in any particular forest, a far more exact geographical definition would be maintained, and compartment records could be more easily compiled. Of course, as soon as possible after a forest has been acquired it must be surveyed, and compartment boundaries and numbers must be more or less immutably fixed.

In years to come, when an Inspecting Officer is walking through a forest, he will be guided entirely by the compartment map. If he desires to know the date of a plantation he can always obtain it from the record map (which shows in green the boundaries of each year's plantations) and the compartment record.

L. A. NEWTON.

DEAN FOREST PRODUCE AND PRICES.

Perusal of last year's Journal gives some interesting comparisons of prices and produce in three of the Commission's Divisions, and it is thought that some comparable figures for the Dean Forest, which is actually the largest revenue-producing possession of the Commission, may also be of interest. In the Dean Forest and its outliers almost every type of hardwood can be found, varying from pure oak to almost pure coppice, with a few large oak standards.

Before giving actual figures of comparable areas showing the yields and expenditure, a general note of the main type of forest sales may be of use. The main outlet for oak timber up to 200,000 cubic feet per annum is a sale by contract to a single firm which has three mills, two of which are temporary and portable, in the southern portion of the forest. There have of late been comparatively few extensive fellings of mature timber in the northern part of the forest. The reason for this is the premature deaths in the younger 60–80 age class, which have caused a large area to be cleared 60 years before it is mature, and also the closing down of the only two sawmills in the north of the forest.

The local collieries absorb the small oak as pitwood, and roughly another 150,000 cubic feet of large produce is sold by tender. The pitwood market generally, which has been up to the present a fairly constant one for Dean Forest produce, has been badly upset by local coalfield conditions, under which many pits are only working two days a week even in the winter, and also by the wholesale fellings of large oak coppice areas situated within easy haulage distance of the coalfield.

The Dean Forest produces annually some 5,000 cords of cordwood, of which at least 3,000 have been consumed by a local distillation factory on a contract basis. The disposal of the remainder is rather an acute problem, as only a small quantity is taken up by local firewood sales, the chief reason being that most of the inhabitants of the district are colliers who obtain their fuel at a much reduced price from the collieries at which they work.

The yield from thinnings has steadily increased during the last four and five years, and still the demand exceeds the supply. In this connection some measure of co-ordination amongst the Commission's forests, with the object of obtaining both uniformity of classification and prices and proper distribution, would seem to be essential. With such a co-ordination there is every indication that the rustic pole market will absorb much larger quantities than has been thought possible. The classes in which poles are sold in the Dean Forest are, per 100 f.o.r. :—

	2nd class.	3rd class.
Larch	65*s.*	30*s.*
Douglas fir	55*s.*	25*s.*
Spruce	—	18*s.*

2nd class—3½–4½ ins. butt, minimum length, 12 ft.
3rd ,, 2–3½ ins. ,, ,, ,, 10 ft.

The figures appended below give a comparison between the costs and yields of three very different types of forest fellings :—

(*a*) 13·5 acres oak, aged 120 years, with old and almost useless hazel coppice : 37 standards per acre.

(*b*) 3 acres pure chestnut coppice, 26 years old, sold felled by measure, and cleft by the purchaser in the wood.

(*c*) 9 acres mixed coppice, 35 years old, with standards of oak and chestnut about 60–80 years. The coppice is mixed ash. birch, chestnut, wych elm, alder and sallow, with some cherry.

The whole yield from (*c*) cut, with the exception of the cordwood and pitwood, was taken by a firm of turnery merchants whose works are about one and a half miles distant.

The prices given are those obtained in the wood.

(*a*) Pure Oak, 13½ Acres.

	Cost of Preparation.	Price obtained.
Oak timber ...	... 9*s.* per 100 cu. ft.	... 9*d.*–1*s.* per cu. ft.
Chestnut ...	... 9*s.* per 100 cu. ft.	... 5*d.* per cu. ft.
Beech ...	... 9*s.* per 100 cu. ft.	... 4*d.* per cu. ft.
Pitwood ...	... 5*s.* 6*d.* per cord ...	... 26*s.* per cord.
Cordwood ...	... 6*s.* 6*d.* per cord ...	... 7*s.* per cord.
	Total amount obtained	... £686
	Less cost of preparation	... 146
Net return	Total	... £540
	Per acre	... 40

(*b*) Pure Chestnut Coppice, 3 Acres.

	Cost of Preparation.	Price obtained.
Chestnut ...	... 9*s.* per 100 cu. ft.	... 64*s.* per 100 cu. ft., T.O.B.
Oak	... 9*s.* per 100 cu. ft.	... 1*s.* 3*d.* per cu. ft.
Pitwood ...	... 6*s.* 6*d.* per cord ...	... 30*s.* per cord.
	Total amount obtained	... £257
	Less cost of preparation	... 36
Net return	Total	... £221
	Per acre	... 74

(*c*) COPPICE WITH STANDARDS, 9 ACRES.

	Cost of Preparation.	Price obtained.
Oak, 1st class	10*s.* per 100 cu. ft.	10*d.* per cu. ft.
,, 2nd class	10*s.* per 100 cu. ft.	6*d.* per cu. ft.
Ash	10*s.* per 100 cu. ft.	2*s.* 6*d.* per cu. ft.
Chestnut	10*s.* per 100 cu. ft.	8*d.* per cu. ft.
Wych elm	10*s.* per 100 cu. ft.	8*d.* per cu. ft.
Princes	8*d.* per cu. ft.	38*s.* per ton.
Poles	1*s.* 4*d.* per dozen	22*s.* per ton.
Dozen stuff	5*d.* per dozen	26*s.* per ton.
Rake stails	4*d.* per dozen	1*s.* 10*d.* per dozen.
Stock stakes	6*d.* per dozen	1*s.* 4*d.* per dozen.
Hedge stakes	3½*d.* per score	1*s.* per score.
Bean sticks	4*d.* per bundle	10*d.* per bundle.
Pea sticks	1½*d.* per bundle	5*d.* per bundle.
Cordwood	3*s.* 6*d.* per country cord	5*s.* per cord.
Pitwood	5*s.* 4*d.* per cord	28*s.* per cord.
Total amount obtained		£520
Less cost of preparation and haulage		203
Net return — Total		£317
Net return — Per acre		35

A. H. POPERT and T. W. MORRIS.

LIST OF TECHNICAL OFFICERS.

Headquarters.

At 22, Grosvenor Gardens, London.
Story, Fraser, Education and Publications Officer.
Guillebaud, W. H., Chief Research Officer.

At Imperial Forestry Institute, Oxford.
Steven, H. M., Research Officer, England and Wales.
Batters, G. J. L., Probationer District Officer.

Travelling Officer.
Macdonald, James, District Officer (Sample Plots).

England and Wales.

Assistant Commissioner's Office (1, *Whitehall, London*).
Taylor, W. L., Acquisition Officer (acting).
Jones, E. W., Assistant Acquisition Officer.
Fletcher, W. S., Utilisation Officer (temporary).
Maurice, E. C., Estate Management Officer (temporary).

New Forest (*The King's House, Lyndhurst, Hants*).
Osmaston, L. S., Deputy Surveyor.
MacIver, L. E., District Officer.
Lowe, G., District Officer.
Roberts, J. F. A., Assistant to Deputy Surveyor.
Yarr, W. J., Assistant to Deputy Surveyor.

Dean Forest (*Whitemead Park, Parkend, Lydney, Glos.*).
Young, D. W., Deputy Surveyor.
Forster Brown, W., Deputy Gaveller (Mines).
Popert, A. H., District Officer (Part-time Dean School).
Roper, J., Survey Clerk.

Division 1 (*Chopwellwood House, Rowlands Gill, Co. Durham*).
Hopkinson, A. D., Divisional Officer.
Ross, A. H. H., District Officer.

Division 2 (*Castle Chambers, Shrewsbury*).
Sangar, O. J., Divisional Officer.
Fairchild, C. E. L., District Officer.
De Uphaugh, F. E. B., District Officer.
Best, F. C., Probationer District Officer.
Smith, R. H., Probationer District Officer.

Division 3 (6, *Bedford Circus, Exeter*).
Hanson, C. O., Divisional Officer.
Ryle, G. B., District Officer.
Russell, W. D., District Officer.

Division 4 (64, *Goldsworth Road, Woking, Surrey*).
Felton, A. L., Divisional Officer.
Forbes, R. G., District Officer.
Whyte, J. P. M., District Officer.

Division 5 (*Bridge House, Santon Downham, Brandon, Suffolk*).
Long, A. P., Divisional Officer.
Ryder, D. C. D., District Officer.
Muir, W. A., Probationer District Officer.

Schools for Forest Apprentices.
Broadwood, R. G., District Officer (Instructor).—Parkend, Lydney, Glos.
Watson, H., District Officer (Instructor).—Beaufort, Inverness.

SCOTLAND.

Assistant Commissioner's Office (25, *Drumsheugh Gardens, Edinburgh*).
Cameron, J., Estate Officer.
Newton, L. A., District Officer (Acquisitions).
Anderson, M. L., Research Officer, Scotland.

Northern Division (35, *Queensgate, Inverness*).
Scott, F., Divisional Officer.
Mackay, J. W., District Officer.
Meldrum, J. A. K., District Officer.
Oliver, F. W. A., Assistant to Divisional Officer.

North-Eastern Division (12, *North Silver Street, Aberdeen*).
Annand, J. F., Divisional Officer.
Bird, D. H., District Officer.
Cowell-Smith, R., District Officer.

South-Eastern and Western Division (25, *Drumsheugh Gardens, Edinburgh*).
Murray, J. M., Divisional Officer.
Fraser, J., District Officer.
Whellens, W. H., District Officer.
Home, G., District Officer.
Gosling, A. H., District Officer.
Webster, J., District Officer.

FORESTERS.

Name and Address.	*Grade.*	*Forest.*
England and Wales.		
Division 1.		
Price, A.; Low Dalby House, Lockton, Pickering, Yorks.	II ..	Allerston.
Bewick, W. J.; Thrunton, Whittingham, Northumberland.	II ..	Rothbury.
Laney, H.; Foresters' Lodge, Beck Wythop, Thornthwaite, Keswick, Cumberland.	II ..	Thornthwaite.

Name and Address.	*Grade.*	*Forest.*
England and Wales.		
Anderson, J. T.; Craig Villa, Falstone, North Tyne, Northumberland.	II ..	North Tyne Valley.
Reid, D.; The Haven, Coldyhill Road, Newby, Scarborough, Yorks.	II	Allerston.
Phelps, S. E.; Gillerthwaite, Ennerdale, Frizington, Cumberland.	II ..	Ennerdale.
McNab, C.; Middle Redford, Hamsterley, Witton-le-Wear, Co. Durham.	II ..	Hamsterley.
Gough, W. R.; c/o Mrs. Hunter, Wrench Green, Hackness, Scarborough, Yorks.	II ..	Allerston.
Hodgson, W.; Chopwellwood, Rowlands Gill, Co. Durham.	II ..	Chopwell.
Division 2.		
Edwards, J.; c/o P. M. Harrison.	Head.	Mortimer.
Harrison, P. M.; Castle View, Wigmore, Kingsland, Leominster, Herefordshire.	I ..	Mortimer.
Williams, Jack; Pandy Glasdir, Llanfachreth, Dolgelley, Merioneth.	I ..	Vaughan.
Jones, G. W.; Linmere, Delamere, Northwich, Cheshire.	I ..	Delamere.
Squires, C. V.; Brookbatch, Acton, Bishops Castle, Shropshire.	II ..	Walcot.
Shaw, J. L.; Diosgydd Isaf, Bettws-y-Coed, Carnarvonshire.	I	Gwydyr.
Anderson, J. W.; Alwyn Cottage, Tynycefn, Corwen, Merioneth.	II ..	Cynwyd.
Harris, W. A.; Chamberlayne Lodge, Arley, Bewdley, Worcestershire.	II	Wyre.
Fraser, R.; Aberangell Lodge, Cemmaes Road, Mont.	II ..	Dovey.
Harrison, Percy; Cwm Mawr, No. 1, near Cascob, Presteigne, Radnorshire.	II	Radnor.
Brown, G. H.; Hafod Ruffyd Ganol, Beddgelert, Carnarvonshire.	II	Beddgelert.
Cowe, J. F.; 139, Stafford Road, Huntingdon, Stafford.	II ..	Cannock Chase.
Inglis, A.; Haughwood Cottage, Mordiford, Hereford.	II	Haugh.
Lomas, J.; Pant Perthog Farm, Pant Perthog, Mont.	II ..	Corris Valley.

Name and Address.	*Grade.*	*Forest.*
	England and Wales.	
Division 3.		
Lewis, T.; Parkhill Lodge, Park-end, Lydney, Glos.	II	Tintern and Chepstow.
Butter, R.; Underdown, Haldon, Exeter.	I	Haldon.
Wallington, A. W.; Parish's Lodge, Overstowey, Bridgwater, Somerset	II	Quantocks.
Williams, D. N.; Broadwood, Dunster, Taunton, Somerset.	II	Exmoor.
Dyer, H. C.; Botany Bay, Tintern, Chepstow, Mon.	I	Tintern.
Hollis, G. W.; The Colony, Pembrey, Carmarthenshire.	II	Pembrey.
Wallington, H. J.; Harefield Lodge, Plumley, Ringwood, Hants.	II	Ringwood.
Colwill, S.W.; Foresters' Lodge, Cold Harbour, Wareham, Dorset.	II	Wareham.
Pritchard, R.; Brawbridge Bungalow, Halfway, nr. Liskeard, Cornwall.	II	Bodmin.
Jones, A. H.; Upper Porthgwyn, Llanddew, Brecon.	II	Brecon.
Weir, A.; Forester's Lodge, Alltwallis Road, Carmarthen.	II	Glangwili.
Pallett, R. E.; Forestry Commission, Trecastle, Brecon.	II	Glasfynydd.
Wild, P.; Graig Wen Cottage, Abercarn, Newport, Mon.	II	Llanover.
Harrison, P.; Tidvil House, Rugby Road, Resolven, Neath, Glam.	II	Rheola.
Division 4.		
Simpson, A.; Forest Lodge, Alice Holt, Farnham, Surrey.	—	Alice Holt and Woolmer.
Richards, G. H.; Clapper Oak Cottage, Minley, Farnborough, Hants.	II	Bramshill.
Butler, R.; Jewsley Cottage, High Street Green, Chiddingfold, Godalming, Surrey.	II	Chiddingfold.
Jones, T.; Piddington Lodge, Piddington, Northampton.	I	Salcey.
Nelmes, F.; Whitelimes, Cranbrook, Kent.	I	Bedgebury.
Johnson, A. E.; Park Villa, Stelling, Canterbury, Kent.	II	Lyminge.

Name and Address.	*Grade.*	*Forest.*
	England and Wales.	
Cottenham, W.; c/o Mrs. Fox, Woodnewton, Peterborough, Northants.	II ..	Rockingham.
Gulliver, G. H.; Forest Lodge, Syresham, Brackley, Northants.	II	Hazelborough and Brackley.
Aston, T.; Thatch Cottage, West Dean, Seaford, Sussex.	II ..	Friston.
Division 5.		
Hankins, C.; Tangham Farm, Capel St. Andrew, Woodbridge, Suffolk.	Head	Rendlesham.
Anderson, T. E.; Preston Lodge, Edwinstowe, Mansfield, Notts.	I	Clipstone.
Argent, C. D.; Forest Lodge, Brandon Road, Swaffham, Norfolk.	I	Swaffham.
McGlashan, J.; The Nursery, Lynford, Brandon, Suffolk.	II	Thetford.
Tribe, W.; Laughton Lodge, Gainsborough, Lincs.	II	Laughton.
Hendrie, T.; Broom House, Brandon, Suffolk.	II ..	Thetford.
Clark, J. S.; Santon Downham, Brandon, Suffolk.	II ..	Thetford.
Kidd, J.; Brookview Cottage, Bourne, Lincs.	II ..	Bourne.
Bewick, R.; Tithe Farm Cottages, Calverton, Notts.	II ..	Sherwood.
Johnson, H.; Forest Lodge, Weeting, Brandon, Suffolk.	II ..	Thetford.
New Forest Division.		
Forgan, W.; Denny Lodge, Lyndhurst, Hants.	I ..	New Forest.
Aston, O. R. T.; Signal House, Parkhurst Forest, Newport, I. of W.	I ..	Parkhurst and Brightstone.
Aston, S.; Wood End Cottage, near Wickham, Hants.	— ..	Bere.
Dean Forest Division.		
Smith, Frank; Worcester Lodge, Coleford, Glos.	Head	Dean.
Walker, A. E.; Crown Lodge, Oxenhall, Newent, Glos.	— ..	Dymock.
Humphries, W. J.; Marians Lodge, Coleford, Glos.	I ..	Dean.

Name and Address.	*Grade.*	*Forest.*
	England and Wales.	
Christie, W.; Reddings Lodge, Coleford, Glos.	II ..	Dean.
Taylor, G.; Russells Lodge, Parkend, Lydney, Glos.	II	Dean.
Aston, C.; Sutton Lodge, Littledean, Newnham, Glos.	II	Dean.
Adams, I.; Brandricks Green, Parkend, Lydney, Glos.	II ..	Dean.
Lees, G.; Serridge Lodge, Lydbrook, Ross, Herefordshire.	II ..	Dean.
Watson, F.; Perch Lodge, Coleford, Glos.	II ..	Dean.
Morgan, T.; Crabtree Hill Lodge, Cinderford, Glos.	II ..	Dean.
	Scotland.	
N. Division.		
Cameron, J.; Auchterawe, Fort Augustus, Inverness-shire.	Head ..	Inchnacardoch, Portclair and Creagnaneun.
Anderson, W.; Polloch House, Glenfinnan, Inverness-shire.	I ..	Glenhurich.
Mason, W.; Nevis Farm, Fort William, Inverness-shire.	II ..	Nevis.
McEwan, J.; Portclair, Invermoriston, Inverness.	I ..	Portclair.
McClymont, W.; Aultsigh Cottage, Invermoriston, Inverness-shire.	II	Creagnaneun, Balmacaan.
Mackay, K.; Hilton Embo, Dornoch, Sutherland.	II ..	Dornoch.
MacAlpine, J. A.; Ratagan, Glenshiel, Kyle, Ross-shire.	I	Ratagan, Glenshiel, Inverinate and Eilanreach.
Murray, W.; Leckanashie, Lochcarron, Ross-shire.	II ..	North Strome and South Strome.
Macintosh, W.; Easter Buntait, Glenurquhart, Inverness-shire.	II	Glenurquhart.
Gunn, J.; Auchterawe, Fort Augustus, Inverness-shire.	II ..	Inchnacardoch.
Rose, A.; Smithton, Culloden, Inverness.	II ..	Culloden.
Kennedy, J.; Inchree, Onich, Inverness-shire.	II ..	Glenrigh.

Name and Address.	*Grade.*	*Forest.*
	Scotland.	
Cameron, R.; South Laggan, Invergarry, Inverness-shire.	II ..	South Laggan, Glengarry.
Donald, R. R.; Beaufort School, Kiltarlity, Beauly, Inverness-shire.	II	Beaufort.
Macdonald, D.; Craig Cottage, Achnashellach, Ross-shire.	II	Achnashellach.
Stewart, P.; Station House, Clachnaharry, Inverness.	II ..	Craig Phadrig, Kessock and Findon.
Mackenzie, G.; Slattadale, Achnasheen, Ross-shire.	II	Slattadale.
N.E. Division.		
Warren, A.; Teindland Cottage, Orton, Morayshire.	I ..	Teindland, Altonside and Ordiequish.
Sinclair, W.; Craibstone Nursery, Bucksburn, Aberdeenshire.	I ..	Craibstone Nursery.
Shaw, R.; Fetterdale, Tayport, Fife.	I ..	Tentsmuir.
Lamb, J. A.; Seaton Nursery, Tillydrone Road, Woodside, Aberdeen.	I ..	Seaton Nursery.
Mitchell, F. M.; c/o Kennedy, Kintessack, By Forres, Morayshire.	II ..	Culbin.
Robbie, J. D.; c/o Davidson, The Crook, Alves, By Forres, Morayshire.	II ..	Monaughty.
McConnell, J.; Brechin Road, Friockheim, By Arbroath, Forfarshire.	II ..	Montreathmont.
Corbett, J.; "Finella View," Drumtochty, Auchenblae, Fordoun, Kincardineshire.	II ..	Drumtochty.
Clark, F. J.; Ordbrae, Huntly, Aberdeenshire.	II ..	Bin.
Allan, J.; Kemhill, Kemnay, Aberdeenshire.	II	Kemnay.
Kennedy, J. M.; Badaguish, Glenmore, Aviemore, Inverness.	II ..	Glenmore.
Ross, A.; West Lodge, Pitfour, Aberdeenshire.	II	Deer.

Name and Address.	*Grade.*	*Forest.*
	Scotland.	
S.E. and W. Division.		
Cameron, Hugh; Inverliever, Ford, Argyleshire.	II ..	Inverliever.
Macintyre, J.; 1, Langholm Street, Newcastleton, Roxburghshire.	II ..	Newcastleton.
Spraggan, D.; Guithas Cottage, Ardgarten, Arrochar, Glasgow.	I ..	Ardgarten.
Reid, J. M.; Auchendarroch, Duror, Oban, Argyll.	II	Glenduror.
Paterson, S. H. A.; Glensalloch House, Barcaldine, Ledaig, Oban, Argyll.	II ..	Barcaldine.
Simpson, A. N.; Tulliallan Nursery, Kincardine, Fife.	I ..	Tulliallan Nursery.
Anderson, R. T.; Glenbranter, Strachur, Argyll.	II ..	Glenbranter.
Fraser, A. M.; Glencorse, Parkgate, Dumfries.	II ..	Closeburn.
Graham, A.; Eshiels Cottage, Peebles.	II ..	Glentress.
Kennedy, J. A. M.; 38, Maxwell Street, Dalbeattie, Kirkcudbrightshire.	II ..	Dalbeattie and Bennan.
Cameron, Alistair; Kinloch Street, Ladybank, Fife.	II ..	Edensmuir.
Macmillan, H.; Drynairn Cottage, Ardentinny, Argyll.	II ..	Glenfinart.
Ross, W. L.; Comrie Keltneyburn, Aberfeldy, Perthshire.	II ..	Drummond Hill.
MacRae, M.; c/o Taylor, Black Road, Kelty, Fife.	II ..	Blairadam.
Grant, A.; Letters Place, Kilmun, Argyll.	II	Benmore.
	Research and Experiment.	
Macdonald, J. A. B.; Strathoich, Fort Augustus, Inverness-shire.	I ..	—
Gray, W. G.; c/o Godfrey, New Cottages, Kennington Lane, Oxford.	II ..	—
Grant, A.; 1, Lovat Terrace, Fort Augustus, Inverness-shire.	II ..	—
Brookman, H. A.; Altonside, Lhanbryde, By Elgin, Morayshire.	II	—

28/57 441 lbs.; *Larix leptolepis*; 1925; Japan; Shinano Shubyou Co., Ltd.; 98·2; 37 + 2.

28/58 337 lbs.; *Pinus sylvestris*; 1927; England (East); own collection; 97·9; 91 + 1.

28/59 3 lbs.; *Pinus sylvestris*; 1927; England (North); own collection.

28/60 2 lbs.; *Pinus Laricio*; 1927; England (West); own collection.

28/61 4 lbs.; *Pinus Laricio*; 1927; England (East); own collection.

28/62 2½ lbs.; *Cupressus macrocarpa*; 1927; England (West); own collection.

28/63 3 lbs.; *Nothofagus fusca*; 1927; New Zealand (Lake Wakatipu, Southland); gift from New Zealand State Forest Service.

28/64 10 lbs.; *Pinus Laricio*; 1927; Cyprus (Troodos); Cyprus Government.

28/65 333 lbs.; *Larix europaea*; 1926; Scotland (East); own collection, extracted at Tulliallan.

28/66 90 lbs.; *Larix europaea*; 1927; Scotland (East); own collection, extracted at Tulliallan.

28/67 104 lbs.; *Larix europaea*; 1927; Scotland (East); own collection, extracted at Seaton.

28/68 2½ lbs.; *Thuya plicata*; 1927; Scotland (West); own collection, extracted at Tulliallan.

28/69 13 lbs.; *Pinus sylvestris*; 1926; Scotland (East); own collection, extracted at Tulliallan.

28/70 351 lbs.; *Pinus sylvestris*; 1927; Scotland (East); own collection, extracted at Seaton.

28/71 137 lbs.; *Pinus sylvestris*; 1927; Scotland (East); own collection, extracted at Tulliallan.

28/72 60 lbs.; *Pinus sylvestris*; 1927; Scotland (East); E. S. Grant.

28/73 102,500 transplants (2 + 1); *Larix leptolepis*; crop year unknown; origin unknown; S. Bide & Sons, Ltd., Farnham.

28/74 2,000 transplants (2 + 2 + 1); *Larix leptolepis*; crop year unknown; origin unknown; Royal Engineers, Dreghorn.

28/75 1.000 transplants (2 + 2); *Larix leptolepis*; crop year unknown; origin unknown; Howden & Co., Inverness.

28/76 1,500 transplants (2 + 2 + 1); *Larix europaea*; crop year unknown; origin unknown; Royal Engineers, Dreghorn.

28/77 100,000 seedlings (2 years); *Pinus sylvestris*; crop year unknown; origin unknown; Arran Estate.

28/78 3,000 seedlings (2 years); *Picea alba*; crop year unknown; origin unknown; B. Reid & Co., Aberdeen.

28/79 3,000 seedlings (2 years); *Quercus sessiliflora*; crop year unknown; origin unknown; Paludan's Nurseries, Denmark.

28/80 6 lbs.; *Larix eurolepis*; crop year unknown; Scotland (East); Glamis Estate.

28/81 9 lbs.; *Larix leptolepis*; 1926; Scotland (East); E. S. Grant.

28/82 2½ lbs.; *Cupressus macrocarpa*; 1926; Scotland (East); E. S. Grant.

28/83 1½ lbs.; *Cupressus nootkatensis*; 1926; Scotland (East); E. S. Grant.

28/84 44 lbs.; *Quercus sessiliflora*; crop year unknown; origin unknown; J. Rafn.

28/85 1,104 lbs.; *Quercus sessiliflora*; 1927; England (West); own collection.

28/86 2,475 lbs.; *Quercus sessiliflora*; 1927; England (East); own collection.

28/87 110 lbs.; *Quercus pedunculata*; 1927; England (West); own collection.

28/88 66,537 lbs.; *Quercus pedunculata*; 1927; England (East); own collection.

28/89 1,176 lbs.; *Quercus Robur*; 1927; England (West); own collection.

28/90 12 lbs.; *Quercus* (? *sessiliflora*); 1927; England (West); own collection.

28/91 40 lbs.; *Acer Pseudoplatanus*; 1927; England (East); Watts Naval School, Elmham.

28/92 3 lbs.; *Acer Pseudoplatanus*; 1927; England (East); own collection.

28/93 200 lbs.; *Acer Pseudoplatanus*; 1927; England (North); own collection.

28/94 295 lbs.; *Acer Pseudoplatanus*; 1927; England (West); own collection.

28/95 4,455 lbs.; *Castanea vesca*; 1927; origin unknown (foreign); Turner, Mansfield.
28/96 200 lbs.; *Castanea vesca*; 1927; England (East); own collection.
28/97 2,418 lbs.; *Fraxinus excelsior*; 1927; England (East); own collection.
28/98 1,000 lbs.; *Fraxinus excelsior*; 1927; England (North); own collection.
28/99 749 lbs.; *Fraxinus excelsior*; 1927; England (West); own collection.
28/100 135 lbs.; *Juglans regia*; 1927; England (West); own collection.
28/101 100 lbs.; *Juglans regia*; 1927; origin unknown; Southampton fruiterer.
28/102 1,051,700 natural seedlings; *Acer Pseudoplatanus*; crop year unknown; England (East); own collection.
28/103 52,000 seedlings (1 year); *Acer Pseudoplatanus*; 1927; England (West); own collection.
28/104 10,000 transplants; *Castanea vesca*; crop year unknown; origin unknown; J. O. Boring, Tring.
28/105 11,800 transplants; *Castanea vesca*; crop year unknown; origin unknown; W. Treseder, Cardiff.
28/106 50,000 seedlings (1 year); *Fagus sylvatica*; crop year unknown; origin unknown; English Forestry Association.
28/107 10,000 seedlings (1 year); *Fagus sylvatica*; crop year unknown; origin unknown; Country Gentlemen's Association.
28/108 20,000 seedlings (2 years); *Fagus sylvativa*; crop year unknown; origin unknown; Slocock.
28/109 25,000 seedlings (2 years); *Fagus sylvatica*; crop year unknown; origin unknown; S. Bide & Sons, Farnham.
28/110 34,000 transplants (2 + 2); *Fagus sylvatica*; 1923; origin unknown; D. Stewart & Son, Ferndown.
28/111 97,000 transplants (2 + 1 and 2 + 1 + 1); *Fagus sylvatica*; crop year unknown; origin unknown; J. O. Boving, Tring.
28/112 141,800 transplants (1 + 2, 1 + 3 and 2 + 2); *Fagus sylvatica*; crop year unknown; origin unknown; Commissioners of Crown Lands.
28/113 47,000 transplants; *Fagus sylvatica*; crop year unknown; origin unknown; Earl Shaftesbury.
28/114 45,000 transplants; *Fagus sylvatica*; crop year unknown; origin unknown; Liverpool Corporation.
28/115 86,000 transplants; *Fagus sylvatica*; crop year unknown; origin unknown; Stewart & Son.
28/116 150,000 transplants; *Fagus sylvatica*; crop year unknown; origin unknown; English Forestry Association.
28/117 5,200 transplants (1 + 1); *Larix leptolepis*; crop year unknown; origin unknown; Landowners' Co-operative Forestry Society, Edinburgh.
28/118 10,000 transplants; *Larix leptolepis*; crop year unknown; origin unknown; English Forestry Association.
28/119 20,000 transplants; *Larix leptolepis*; crop year unknown; origin unknown; S. Bide & Sons, Farnham.
28/120 300 transplants (2 + 2); *Pinus Jeffreyi*; crop year unknown; origin unknown; English Forestry Association.
28/121 40,000 seedlings (2 years); *Pinus Laricio*; crop year unknown; origin unknown; Roberts.
28/122 8,000 transplants (2 + 2); *Pinus Laricio*; crop year unknown; England (East); Country Gentlemen's Association.
28/123 3,000 transplants (2 + 2); *Pinus sylvestris*; crop year unknown; Scotland (North); T. & W. Christie, Forres.
28/124 46,000 transplants (2 + 1 and 2 + 2); *Pinus sylvestris*; crop year unknown; origin unknown; Commissioners of Crown Lands.
28/125 100,000 transplants (2 + 2); *Pinus sylvestris*; crop year unknown; origin unknown; English Forestry Association.
28/126 500 seedlings (2 years); *Sequoia sempervirens*; crop year unknown; origin unknown; English Forestry Association.

(12/890)Q Wt. P2851/518 300 5/29 H. & S. Ltd. **Gp. 12.**