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EDITORIAL.

Lord Lovat.

Our Chairman leaves us at the end of April to take up the appointment of Under-Secretary to the Dominions Office. We feel confident that every one connected with forestry will regret his going, but will wish him, at the same time, every success in his new work. State Forestry has been fortunate in having had but one Chairman of the Forestry Commission during its first 7½ years of existence; it has been doubly fortunate in having had Lord Lovat at the head of affairs. There have been some difficult corners to get round, but our Chairman has negotiated them all with coolness and skill.

Forest Policy.

The time has now come when British Forest Policy falls to be reviewed, and, if necessary, revised. The Forestry Act, 1919, provides for the payment of £3½ millions into the Forestry Fund by March 31st, 1929, and new legislation will be required at latest in 1928.

Recent debates in Parliament show that while there is very general satisfaction with the work of the Commission, there is also the feeling in certain quarters that operations should be on a much larger scale. Labour critics also object to the unusual constitution of the Commission and demand that there shall be a Minister of the Commission directly responsible to Parliament for the actions of the Commissioners.

The Forest Policy which the Commission is at present carrying out was drawn up in 1916–17 before the full effects of the War fellings had been felt. With the lapse of ten years, the experience gained in active operations during the life of the Commission, and in particular with the information provided by the Census of Woodlands, it is now possible to make a much more accurate assessment of the forestry position in Great Britain. All the facts point towards more vigorous State action.

Imperial Conference, 1926.

So engrossing are the claims of British forestry that we are rather apt to forget our responsibilities in connection with the forests of the Empire as a whole. From time to time the importance of the latter subject is, however, brought home to us and the latest occasion was the Imperial Conference held in London last November.

Not many years ago forestry would have been rejected as unworthy of the attention of the Prime Ministers of the Empire, with so many problems to deal with during a necessarily brief congress. That they should have decided at their opening meeting to appoint a sub-committee to consider this subject, and report upon it, is in itself evidence of the higher regard now being paid to forestry throughout the world. Under the chairmanship of Lord Lovat, the sub-committee set to work and produced a report and resolutions which were duly adopted by the Conference.

The proceedings have been published and are available to the curious in a Government blue book (Cmd. 2768/9). Only questions of Imperial interest could be dealt with on such an occasion. These included consideration of available timber supplies without and within the Empire; arrangements for the Empire Forestry Conference in 1928; the further development of forest products research; a review of the work of the Imperial Forestry Institute and the Empire Forestry Association. In connection with State forestry in relation to land settlement, attention was drawn to the procedure adopted by the Forestry Commissioners for the settling of forest workers on afforestation areas in Great Britain.

The approval by the Conference of the recommendations of the sub-committee should be of much assistance to the forestry movement.

Empire Forestry Conference, 1928.

Preparations are already being made for the Empire Forestry Conference which will be held in Australia and New Zealand in September and October, 1928. As in the case of the two previous Conferences, statements are to be provided by the various forest authorities bringing up to date all information on the position of forestry in the respective colonies. In order that these statements may be drawn up on uniform lines, a skeleton form has been devised which, if carefully followed, will add much to our knowledge of British forests overseas.

A number of subjects have been selected for discussion at the Conference, some of them bearing on local problems and others of importance from the Empire point of view. A great deal still remains to be done in making arrangements to ensure that specialists in the various subjects should be forthcoming and in possession of all the necessary data. The whole question of the personnel of the delegations and the detailed plans are being dealt with by the Standing Committee on Empire Forestry in collaboration with the Governments concerned.

Lord Lovat is Chairman of the Committee, which includes the Technical Commissioner, the Director of the Forest Research Board, the Director of the Imperial Forestry Institute, a member of the Empire Forestry Association, and representatives of the Government Departments chiefly concerned.

British Association.

Forestry is now occupying a more important place in the meetings of the British Association than was formerly the case. During the past two years a sub-section has devoted its attention exclusively to forestry questions. In August last this sub-section was presided over by Lord

Clinton and a large number of subjects were dealt with. The Forestry Institute provided an excellent place of meeting, and the Prince of Wales honoured it by his presence, spending about an hour in the building.

Among the papers which were read may be mentioned "The Water Content of Tree Seedlings," by Mr. E. V. Laing; "The Ecological Approach to Silviculture," by Dr. A. S. Watt; "The Parasitism of *Armilleria mellea*," by Mr. W. R. Day; "The Control of *Meria laricis*," by Dr. M. Wilson; "*Brunchorstia* Disease of Conifers," by Mr. J. L. Waldie; and "Estate Sawmills," by Colonel G. F. T. Leather.

The next meeting of the British Association will be held at Leeds from August 31st to September 7th, and a full programme of subjects is promised for the occasion. Opportunity will be given for discussion, and it is hoped that there will be a good attendance of technical foresters. Any who have papers to submit should communicate with the Honorary Secretary, Professor A. W. Borthwick, The University, Aberdeen.

Research Organisation and Personnel.

During the past year there have been several changes in the personnel of the Research Branch. Dr. Borthwick, Dr. Munro, and Dr. Anderson have resigned to take up duties outside the Commission, and Mr. Guillebaud has been appointed Chief Research Officer in place of Dr. Borthwick. The posts vacated by Dr. Munro and Dr. Anderson have not yet been filled.

The present organisation consists of the Chief Research Officer, stationed in London and responsible to the Technical Commissioner, the Research Officer for England and Wales, Dr. H. M. Steven, stationed at Oxford, and Mr. J. Macdonald, the officer in charge of sample plot work.

The subordinate full-time staff consists of 11 men allocated as follows: One Grade II Forester, Mr. W. G. Gray, and three workmen at Oxford. One Grade I Forester, Mr. J. A. B. Macdonald, and a Foreman at Inchnacardoch; and a Foreman-in-charge, Mr. H. A. Brookman, at Teindland. The Sample Plot Officer has a staff of four men of foreman rank selected from the Foresters' Schools. These men will be drafted into the field after a year or two spent on sample plot work.

Dr. Steven has charge of the work in England and Wales with a research nursery near Oxford, and two main experimental areas at Smales and Beddgelert respectively, besides various experiments scattered over the country. He is also closely associated with the Imperial Forestry Institute at Oxford giving lectures to the students on nursery practice and on research methods in forestry.

Experimental work in Scotland is at present being run from Headquarters, but Mr. J. A. Macdonald has local charge of the experimental work in the West of Scotland, and Mr. Brookman of field experiments in Morayshire.

Mr. E. V. Laing and Mr. G. K. Fraser at Aberdeen are part-time workers on research, dealing mainly with the peat problem.

Mycology has been dealt with by Dr. M. Wilson and Mr. J. S. L. Waldie at Edinburgh. Mr. Waldie has recently joined Dr. Steven at Oxford where he will investigate fungus diseases in nurseries in collaboration with Dr. Steven and under Dr. Wilson's supervision.

As regards Entomology, part of Dr. Munro's work is being carried on by Mr. R. N. Chrystal who is on the staff of the Imperial Forestry Institute.

Census of Woodlands.

The Census of Woodlands is practically complete, and all those who have been connected with its preparation are to be congratulated upon the results. The Commissioners realise how difficult it has been for Divisional and District Officers, already over-busy with their ordinary duties, to find time for a special enquiry such as this. There is satisfaction, however, in the thought that for the first time in our history we have secured reasonably accurate records of the area under woodland in each county and parish throughout Great Britain. The classification into categories of woodland and age classes, never hitherto attempted, has brought to light significant facts which are most interesting, especially from the point of view of forest policy.

The publication of the data has been postponed pending the checking of the figures, but it may be said that the area of productive forest is lamentably low, and that arguments previously advanced for afforestation in Britain are greatly strengthened by the statistics which, as soon as possible, will be published in an official report.

Census of Production.

Although it is less easy to draw definite conclusions from this census as compared with the Census of Woodlands, it furnishes much useful information, including the quantity and value of home-grown timber felled (by age-classes and types of material) and also the numbers employed in forestry operations.

It will be remembered that the compilation, now nearly complete, was instituted at the request of the Board of Trade as a necessary part of the general census of the industries of Great Britain. An enquiry of the same kind in 1908 cannot be regarded as satisfactory, and this renders any comparison of the present data with those previously obtained more or less futile, but it can at least be claimed that a beginning in the collection of statistics on proper lines has been made and that a basis has been established for comparison in future years.

Apart from the returns relating to Crown Woods, private land-owners or their agents supplied the data for this census. A number of land-owners were needlessly deterred from filling in the forms by the fear that the figures would be used against them in connection with taxation. These returns, of course, are strictly confidential, and will be used only for statistical purposes, but suspicion was not easily allayed, and in any case the forms proved somewhat troublesome to complete.

Both tact and patience had to be exerted on the part of the Assistant Commissioners and their office staffs in order to overcome many objections, and to induce voluntary but rather unwilling producers to give the necessary extracts from their estate books.

Divisional Changes in England and Wales.

The reorganisation of the Divisions in England and Wales has been completed since the last issue of the Journal, the Divisions mainly affected being the School, Nos. 1 and 5.

The reorganisation was necessary in order as far as possible to equalise the work of the Divisional Officers and provide better supervision of the various forests.

No. 1 *Division.*—The old School Division, which was comparatively unimportant, having Chopwell Wood, Thornthwaite and Rothbury forests, now comprises the counties of Northumberland, Cumberland, Westmorland, Durham, Yorkshire and Lancashire, with the additional forests of Allerston and Selby. The Divisional Office still remains at Chopwell Wood.

No. 2 *Division.*—This is practically unaltered, Derbyshire being added with one additional area, Hope Forest.

No. 3 *Division.*—No alteration.

No. 4 *Division.*—This was formerly No. 5 Division, but is now confined to the following counties :—Leicester, Warwick, Northampton, Huntingdon, Rutland, Buckingham, Bedford, Herts, Oxford, Berkshire, Middlesex, Essex, Kent, Surrey, Sussex and part of Hampshire.

No. 5 *Division.*—This Division comprises the counties of Nottingham, Lincoln, Norfolk, Suffolk and Cambridge, and although small territorially is important in forest area. The concentration should prove effective and economical inasmuch as the Divisional Headquarters is centred in Thetford Chase, with Swaffham and Rendlesham forests within easy reach.

New Forest and the Dean.—Mr. L. S. Osmaston has taken up his duties as Deputy Surveyor, New Forest, in place of Mr. V. F. Leese, and has been succeeded at the Dean by Mr. D. W. Young.

Forest Units in England and Wales.

In England and Wales there are now 65 units, nineteen of which are in Wales, of these, twelve are under 1,000 acres (plantable area), twenty-two from 1,000 to 2,000 acres, five from 2,000 to 3,000 acres, four from 3,000 to 4,000 acres, four from 4,000 to 5,000 acres, one from 10,000 to 11,000 acres, and of the Commission's area one of 25,000 acres or if we include New Forest and Dean we get with their component parts three of over 20,000 acres, while if we take the two counties of Norfolk and Suffolk we get an area of 35,000 acres, nearly 30,000 acres of which is practically in one block.

The planting programme by Divisions is approximately equal, and it is interesting to note that the Crown Woods play a comparatively small part. One noticeable feature is the steady growth of existing units ; with but two or three exceptions there is a steady accretion which more than balances the annual planting programme.

The total area of plantable land acquired is 173,000 acres.

Forest Units in Scotland.

These consist of fifty-one as at the date of publication. Eight lie in Ross, twelve in Inverness, eight in Argyll, five in Aberdeen, four in Elgin, three each in Fife and Kirkcudbright, and one each in the counties of Kincardine, Kinross, Forfar, Perth, Roxburgh, Dumfries, Peebles

and Sutherland. Six units comprise 4,000 or more acres of plantable land, seventeen contain between 2,000 and 4,000 acres, twelve are over 1,000 and under 2,000 acres, and the remainder are under 1,000 acres, but most of these form part of a combination of adjacent centres managed by one forester. Some of the largest units are composed of two, three or four individual acquisitions secured at periods subsequent to the original purchase and special attention continues to be given to increasing the area of every existing unit. Comprehensive blocks containing several forests have been created in Glenmhor in Inverness where within a distance of twenty-five miles with only two intervening breaks of about 5 miles there is a plantable extent of 14,500 acres; also around Glenbranter where four estates now bring the plantable extent up to about 10,500 acres. The Northern Division accounts for twenty-one, the South-Western for seventeen, and the North-Eastern for thirteen forests. The total area of plantable land acquired is 102,375 acres.

Damage by Gale.

The gale of January 28th last appears to have been the most destructive to woods in Scotland since the storm of March, 1905. The wind is said to have attained a velocity of 85 miles per hour, with the result that extensive damage has been done on many privately owned estates. Several of the Commission's sample plot areas were unfortunately among the woods which have suffered severely, some, indeed, have been entirely destroyed. The interesting stand of Sitka spruce at Durris is among the fallen, and plantations of Douglas fir on wet sites seem to have been badly damaged.

The Forestry Commissioners are associating themselves with the Royal Scottish Arboricultural Society in a systematic enquiry regarding the extent of the damage done, the principal species affected, the condition of the soil at the time of the gale, and other relevant matters. Such an enquiry cannot, of course, put the trees on their feet again, but the results may be of some assistance in putting us on our guard in the future.

Commission's Colours.

Following on a suggestion which was made in the last number of the Commission's Journal a special tie, consisting of broad stripes of brown and green, has been adopted after ascertaining the views of the Divisional and District Officers. The ties are obtainable (3*s.* 6*d.* each) from Messrs. A. Lawrie & Co., 89, Princes Street, Edinburgh.

Society of Foresters.

The Society of Foresters of Great Britain is gradually taking shape. The first number of its Journal, which is now in course of preparation, will contain a number of articles of unusual interest.

REVIEW OF PROGRESS IN RESEARCH AND EXPERIMENT.

By W. H. GUILLEBAUD.

As one who has, after two years' work in a Division, returned to the Research Branch, I think it may interest readers of the Journal to have a general account of the work of the Branch and also of the more important progress made in that period.

The research work carried out, or contributed towards, by the Commission falls under the following heads :—

Nursery and Planting experiments.
Research work on peat at Aberdeen.
Production, *i.e.* permanent sample plots.
Entomology.
Mycology.
Imperial Forestry Institute, Oxford.
Timber research.

As regards our own experiments, the underlying idea has been to improve existing practice and to express the improvement as far as possible in terms of cost. With this end in view, treatments are followed through the various stages from seed to seedlings and transplants and then into the forest, so that eventually we may be able to express in terms of the cost of establishing a plantation the saving effected by adopting, say, a given method of treatment in the seed bed.

NURSERY EXPERIMENTS.

Nursery experiments have now been in progress in both countries for seven years, and many different lines of investigation followed. In the last two years a very considerable advance has been made both in technique and in the nature of the results obtained. Without attempting to cover the whole field, the following outline will give a general idea of the scope of the work.

The work on seedlings has led to the recognition of the evils of dense sowing. Thus, the sowing of European larch (with a laboratory germination of 45 per cent.) at the rate of 1 lb. of seed to 144 square feet of seed bed produced 5,300 Grade I plants per lb., 6,800 Grade II and 5,200 Grade III, or culls. Total production, 17,300 plants per lb. Doubling the density, *i.e.* sowing at 1 lb. of seed to 72 square feet of seed bed, reduced the number of Grade I plants to 2,900. Grade II plants also diminished in number to 5,100, while with 5,400 per lb. there was a slight increase in the absolute number of culls. The total production of 13,400 plants was nearly 4,000 less than with the thinner sowing. Results with Douglas fir and Corsican pine are equally striking.

In the case of Corsican pine the work was followed up a further stage by lining out seedlings taken from thin and dense beds respectively, assessing the results when the plants were lifted. It was found that, while 60 per cent. of the plants taken from the thinly sown broadcast beds were available for planting (allowing for losses and culls), only 46 per cent. of the densely sown plants could be used. For

drill sowing, on the other hand, the percentage available was the same for both densities. It will be remembered that the densities used in general practice have already been standardised as a result of the earlier stages of this work, and the evidence now accumulating indicates that a further reduction may be advisable.

An important result of recent work on Season of Sowing has been the large plant percentages which can be obtained under special conditions. This opens up new prospects of improvement in seedling production if the methods employed can be translated into general nursery practice. As regards the seasonal side of the work, a great gain, both in number of seedlings produced and in their growth, is obtained by sowing Douglas fir early in the spring, *i.e.* mid-March. Sitka spruce, with its much smaller seed and consequent greater liability to damage caused by soil-caking, germinates best when sown later in the season—middle of April to about the middle of May. European larch appears to be less sensitive to weather conditions than Douglas or Sitka; it can be sown quite successfully in March in the South of England, and gives stronger seedlings than the later sowings.

Studies are also being made on the influence of tilth conditions on the germination and growth of different species. It has been found that there are important differences in this respect between the species, which explain some of the apparently discrepant results obtained in the seasonal sowing experiments. Sitka spruce in particular is very sensitive to tilth conditions.

The weed problem in seed beds has been tackled along two different lines—using a blow-lamp to burn off weeds before the tree seeds germinate, and the treatment of covering soil with 1 per cent. copper sulphate. First results with the blow-lamp appear promising, but special technique is required if this is to be applied on a large scale. The copper-sulphate treatment consisted in watering down a heap of soil with the solution a week before sowing was carried out and then sifting this soil over the seed for covering. The control plots, not treated as above, took 43 minutes to weed and produced 140 Sitka spruce seedlings per square foot, while the plots covered with treated soil took only 15 minutes to weed and produced 160 seedlings per square foot. A parallel series of plots treated with the blow-lamp took 37 minutes to weed and gave 151 plants per square foot. The improvement in germination with the copper-sulphate method may not be significant, but at least it is clear that the copper sulphate, applied in this way, has not been injurious. The application of a solution to heaps of soil for covering seed beds is not a very handy method in general practice, and the further experiment was tried of wetting down the seed bed with copper-sulphate solution before sowing. This entirely stopped weed growth, but upset the tilth and delayed germination. Eventually a stock of 129 Sitka seedlings per square foot was obtained. Damping off by *Fusarium* set in, however, in every one of the plots treated in this way, reducing the stock by the end of the season to only 30 plants per square foot.

Further attempts are being made to evolve a satisfactory method.

A great deal of work has been done on transplanting, and there is now a large amount of evidence as to the effect of such factors as spacing distance in the line and grading of seedlings upon losses in the nursery. In a few cases the final stage of putting the different classes of plants out in the field has been reached.

The spacing experiments have proved beyond doubt that for the principal species (Scots and Corsican pine, Norway and Sitka spruce, Douglas fir and European larch) losses in the lines are not appreciably increased when the spacing between the plants is reduced from 3 inches to 1 inch (spacing between the lines was 9 inches). Further, when the different batches of plants were put out into the field, losses were no heavier among those which had been spaced close in the lines. It must be emphasised, however, that the field trials will have to be carried out over several seasons before final conclusions can be drawn.

NOTE.—Norway and Sitka were not included in the field trial.

Grading experiments have brought out most clearly the heavy losses often resulting from lining out low-grade seedlings. For example, a batch of Corsican pine was graded and found to contain 23 per cent. of Grade III or culls. The losses on lining out were as follows : Grade I, 28 per cent. ; Grade II, 35 per cent. ; Grade III, 56 per cent. Similarly, a batch of Douglas fir contained 43 per cent. of Grade III seedlings. Losses were : Grade I, 2 per cent. ; Grade II, 2 per cent. ; Grade III, 15 per cent.

Where planted out into the forest results were as follows :—

Species.	Where planted.	Grade I.	Grade II.	Culls.
		Losses per cent. in the forest.		
Scots pine	Bramshill	4	4	12
Corsican pine ...	,, ...	16	18	28
European larch ...	Swalfham	8	19	54
Douglas fir	,, ...	24	26	40

Finally, a word about pests. Dr. Steven, working in collaboration with Dr. Munro, has been successful in keeping down several nursery pests, such as cockchafer, cut worm and chermes, which, in previous years, have interfered with our experiments. As regards cockchafer, summer hand-digging with collection of the larvæ, the previous year greatly reduced the stock of grubs. Those which remained were dealt with the following year by injections of carbon bisulphide on the first signs of attack.

PLANTING EXPERIMENTS.

I think it will be agreed that two of the most difficult problems we have to face in the field are, respectively, the establishment of plantations on peat, and the raising of oak and other hardwoods on heavy soils. During the past two years effort has been mainly concentrated on peat, and I think it is a fair claim to make that, as a result of all the work done, our knowledge has been definitely advanced.

The problem has been approached along three lines of attack; in the first place, by investigation of existing plantations on peat: Hafod Fawr, Inverliever, Corrour, Moorburnhead, etc. These studies have helped to determine the problems of most importance, and have indicated the lines on which the work should be tackled. Secondly, by means of extensive field experiments, and, lastly, by the more fundamental work being carried out at Aberdeen.

Perhaps the most important results have been the recognition (1) of the nature of the spruce root system, following prolonged investigations which began at Inverliever many years ago and have been followed up in detail by Dr. Steven, Dr. Anderson and the Research Staff generally. This has led to the elimination of screefing on peat, and to the development of turf planting. The cheapest form of the latter is the method of side notch planting on shallow turfs devised by Dr. Anderson at Inchnacardoch; (2) that with proper methods even deep peat under molinia may be plantable; (3) of the necessity, on heather peats, of mixing pines with spruce if prolonged spruce check is to be avoided.

The experiments on peat are being carried out at Inchnacardoch in the Caledonian Canal area, at Smales in the North Tyne Valley, and at Beddgelert in North Wales. The work in hand includes the following: different methods of turf planting, the use of manures, value of shelter, trial of different species and mixture, use of seedlings as compared with transplants, etc., etc. With regard to the last of these experiments a series of plots of Norway and Sitka spruce is now in its third year. Two-year and 3-year seedlings were planted on turfs alongside 2 + 1 and 2 + 2 transplants. Losses at the end of the second year were very small in all classes, especially in the Sitka, and there was actually a rather higher proportion of healthy looking plants in the seedlings than in the transplants.

Apart from the work on the deeper peat soils, there is an experimental area at Teindland Forest, near Elgin, dealing with another class of difficult land, namely, shallow scirpus-heather peat over leached moraine, with a pan a short distance below the surface. The principal experiments deal with direct sowing, ploughing, age and type of plant, choice of species, etc. The use of one-year Scots pine seedlings has so far been successful on a small scale.

Game birds are a great trouble in these northern experimental areas. Many of the experiments have been very badly damaged by black game, while grouse also are highly suspect. The few pines that were caged in at Inchnacardoch are now most promising, while those outside the cage were disbudded within a week of planting. Control of black game will be a serious problem in dealing with these areas on a large scale, especially if much pine has to be used.

Apart from work on difficult classes of land, many other experiments have been carried out throughout the country on such problems as spacing distance, age and type of plant, season of planting, etc. A trial of different methods of planting oak has now been carried out on a considerable scale in the Forest of Dean and at Alice Holt.

Interesting results have been obtained in a series of experiments on the seasonal planting of Corsican pine. This has now been repeated six times in all in four separate forests and covering the period P.23 to P.26. In four out of the six sets January planting gave the highest percentage of live plants. In one of the remaining sets the January result was within 1 per cent. of the best month and in the other within 5 per cent. In general, November to February appear to be fairly safe months, but either earlier or later planting is risky except in favourable seasons. In every case late spring planting (May) resulted in heavy losses.

Research Work on Peat at Aberdeen.

Mr. E. V. Laing has been working mainly on the root growth of young coniferous plants on peat. A good deal has also been learned about the storage of food-stuffs in the tissues, the presence of mycorrhiza in the roots, and on the mineral food requirements of Norway and Sitka spruce.

Mr. G. K. Fraser's work deals with the physical and chemical properties of different types of peat, classification of peats and their relation to surface vegetation. The effect of manures on peat is also under investigation. One conclusion arrived at is that phosphorus is the element of nutrient value most lacking in the poorer types of peat ; another, that it is little use applying any form of manure to peat unless the two are intimately mixed together. Thus, in practice, manure can only be effectively applied to the base of the plant when it can come in contact with the roots.

Both Messrs. Laing and Fraser are carrying out field experiments in connection with their research at Parkhill, near Aberdeen, and are kept in touch with our work at Inchnacardoch.

Production : Permanent Sample Plots.

During the past year 38 plots have been measured in England and Scotland and four new plots established. The recent measurements taken of two celebrated woods, the Taymount Douglas fir and the Durris Sitka spruce, have a somewhat melancholy interest in that both were wrecked in the great January gale. The data for these plots are as follows :—

——	Quality Class.	Age.	No. trees per acre.	Mean girth.	Height.	Volume per acre (true measure.)
				in.	ft.	c. ft.
Taymount Douglas fir ...	III	65	130	62	105	9,595
Durris Sitka spruce ...	—	44	500	30½	71	7,700

Other sample plots of interest were an *Abies grandis* plot at Novar with a periodic mean annual increment of nearly 600 cubic feet per

acre per annum (age 24 years), and a 28-year old Douglas fir plot at Vyrnwy with an increment of 400 cubic feet per acre per annum over the last five years.

Entomology.

The work on cockchafers has advanced an appreciable stage since P.25; the three species have been identified and a certain amount of work done on their life histories. Dr. Munro states that the two smaller chafers are more widespread and serious pests than the *Melolontha*, while the type of injury also is different. *Melolontha* gnaws the roots while *Rhizotrogus* and *Serica* girdle the plants. He gives the next flight years for *Melolontha* as 1930 and 1934, with minor flight years in 1927 and 1929. Heaviest losses occur in the second and third years after flight years, so special attention should be given to the collection of grubs in winter 1927 and spring 1928.

The most hopeful methods of control of *Melolontha* appear, at present, to be those adopted in the experimental nursery at Oxford, namely, green cropping followed by hand picking when the crop is dug in, and carbon bisulphide injections in the following year to deal with any grubs still remaining. Control of *Rhizotrogus* and *Serica* must await the full working out of their respective life histories.

Work on the pine weevil is concentrated in one area, Hawkhill Inclosure, in the New Forest, the object being to see whether by constant trapping in a large block the weevil population can be so far reduced that the pest will cease to be a serious menace to planting.

Mycology.

Infection experiments with *Phomopsis Pseudotsugæ* has proved that the fungus occurring on Japanese larch is identical with that on Douglas fir.

A disease occurring on European larch caused by a species of *Sclerophoma* is stated to be serious.

Following a visit to the Continent, Dr. Wilson reported on a serious disease of elm, attacking and killing trees of all ages in Holland, Belgium and France. As a result of his report an order was obtained from the Ministry of Agriculture prohibiting the import of elm plants into this country.

Pure cultures have been raised of *Fomes annosus* taken from various species of hardwoods and conifers. It is proposed to carry out infection experiments in the spring on a number of different species.

It was decided recently that Mr. Waldie should concentrate on fungus diseases in nurseries, and visits will be made to some of the nurseries during the coming year. It will help greatly in this work if foresters and foremen in charge of nurseries will report any cases of losses.

Imperial Forestry Institute.

The Commission is interested in the research work carried out by the staff and also contributes towards the maintenance of the Institute at Oxford. Much of the work is connected more with Colonial than

with Home Forestry, but Mr. W. R. Day, the Mycologist to the Institute, has recently published some very interesting work on *Armillaria mellea*, and is continuing his investigations.

At Christmas three of the students of the Institute spent some weeks at Alice Holt, taking measurements in a group of plots of different coniferous species, and at the present time we are getting assistance in working up some special data on the measurement of standing trees.

Timber Research.

A large scheme of research is being carried out by the Forest Products Research Board, partly at Farnborough, where mechanical tests and seasoning experiments are in progress, and partly at the Imperial Forestry Institute at Oxford, where timber structure is being studied. The material for a large part of the investigations is supplied by the Forestry Commission and the two Departments are working in close co-operation.

The importance of loose stacking of pit props has already been demonstrated.

An elaborate investigation into the utilisation of poor quality oak timber is now under way.

THE CULTIVATION OF WALNUT.

By H. M. Steven.

The cultivation of walnut for timber production has interested foresters from time to time, and the last period in Europe of this interest was just before the war. In America, increasing attention has been given in recent years to walnut species, both for timber and nut production. Our own War Office is interested in the subject because of the use of the better grades of timber for gun stocks, while the revival of the fashion for walnut furniture is also of interest. The time seems opportune, therefore, for a brief consideration of the silviculture of *Juglans* species.

Species.

In Europe only two species, namely *Juglans regia* and *J. nigra*, appear to have been used in forestry. *J. cinerea*, although it is a smaller tree, is worthy of trial in view of its more northerly distribution in America. According to Elwes and Henry (6)* the natural distribution of *J. regia* is Greece and Bosnia, eastwards through Caucasia and Afghanistan into Central Asia. It was spread westwards in Europe artificially from Roman times or earlier. *J. nigra* has a wide range in America from the Lakes southward to, but not into, the coastal fringe and Florida. Its westerly limit is Nebraska and Texas. The distribution of *J. cinerea* is similar, but it goes rather more northward and less southward. *J. nigra* has been tried on a small scale in Germany and France, while Sevnik (11) has written on its use in Yugoslavia.

Site Requirements.

It is clear that walnut is exacting, both as regards soil and climate. Rebmann (9) gives the latitude limits for the cultivation of *J. regia* as 44° and 52° N., with more northerly limits for *J. nigra* and *J. cinerea*. This would limit the use of walnut to the south of England. Schwappach (10) considers that *J. nigra* is one of the most exacting species which have been introduced into Germany. It requires both warmth and a long growing season, while it is liable to damage from early and late frosts. Lake (8) also stresses the danger from unseasonable frosts rather than winter cold.

Schwappach (10) considers that only the best oak soils are suitable for *J. nigra*. Rebmann (9) states that loose and calcareous soils are favourable. Brandstetter (4) advocates deep clay loams or moist alluvial soils with humus. Baker (1), in America, states that *J. nigra* only attains large dimensions on good soils. The presence of the Kentucky coffee tree is considered a good indicator. Batchelor (3) stresses the importance of a low water table for vigorous growth of *J. regia* in California. Sands and wet clays are unfavourable.

Walnuts usually occur in single stem mixture or in pure groups, but open pure stands of *J. nigra* occur in the Ohio River Basin.

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* *See* note of Literature at the end.

Origin of Seed.

There does not appear to be any data on this point, except that Thornber (12) states that French seed of *J. regia* was better than English in Arizona. As England is toward the northerly limit of both *J. regia* and *J. nigra*, it will, on general principles, be better to obtain seed from the northerly rather than the southerly range of the species.

Direct Sowing.

When mice and other seed-destroying pests are not a danger direct sowing is generally advocated. The reason of this is, of course, that the seedlings of both *J. regia* and *J. nigra* have strong tap roots and are difficult to transplant. According to Elwes and Henry (6), *J. cinerea* seedlings have busy roots. Different methods of sowing have been tried successfully. Brandstetter (4) recommends the sowing with husks when ripe, while Rebmann (9) advocates the stratification in moist sand and the sowing of pre-germinated nuts in May. Baker (1), in America, also recommends the latter method when rodents are to be feared, although he states that it is a bothersome method. Sowing is best in furrows or may be made in prepared patches with two nuts per patch with good seed of *J. nigra*. For *J. regia* a larger number, probably three to five, will be necessary except when pre-germinated nuts are used. When stratified the nuts which do not germinate may be held over in the sand. They may germinate the second year and be used for beating up.

Nursery Transplants.

When nursery stock is to be used the principal point is that the stock should go out as soon as possible because of the growth of the tap root. Autumn sowing or stratification of dry, mature nuts in moist sand is recommended, depending on the incidence of seed-destroying pests. Baltet (2) advocates the sowing of *J. nigra* in February and the deferring of the sowing of *J. regia* until May, so as to escape spring frosts, as this species germinates more readily. He recommends the use of germinated nuts with radicles broken. Sowing is usually done in wide-spaced drills, the depth of sowing recommended varies from $1\frac{1}{2}$ to 3 inches. As regards treatment of seedlings, Elwes and Henry (6) suggest undercutting to leave 6 inches root, or transplanting, both at one year, leaving the stock to attain 4 to 6 feet. Most other writers prefer the use of one-year stock for planting, the tap root of the seedlings, when lifted, being cut cleanly at about 12 inches.

Plantations.

Black walnut appears to give more promise as a forest tree than English walnut. Most of the data refers to the former species. Baker (1) recommends a spacing of 4 feet by 4 feet, with early thinnings. Schwappach (10) also recommends close spacing with beech or hornbeam as nurses. Some American writers also recommend the use of more shade-bearing species in mixture, *e.g. Catalpa*, such species being brought in later. The frost-tender nature of the species indicates

the desirability of nurses, but the light demanding characteristic of walnuts makes this difficult. This quality certainly suggests mixture later with shadebearers. Toumey (13) deprecates pure plantations. Partly owing to frost damage, excessive branching is to be feared, and authorities vary regarding the tolerance to pruning.

Production.

The only information found was that given by Baker (1). It does not appear that black walnut is a heavy timber producer.

Timber.

According to Brush (5), the particular qualities of the timber which render it suitable for gun stocks are: "It is liable only in a slight degree to warp and check, and shows only a small amount of shrinking and swelling after it has been properly seasoned; it is easy to work with tools to its final shape; itwill hold metal parts with little wear; it possesses a uniformity and slight coarseness of texture which render it easily gripped and held by the hand; it has a good degree of strength without excessive weight; it will stand considerable shock without injury; on account of its dark colour it is attractive in appearance and is not easily soiled." Black walnut timber appears to be as useful as English walnut. *J. cinerea* is considered less valuable, probably in part due to its poorer colour.

Insect and Fungal Damage.

Few references have been found. There is a tent caterpillar which does some damage to *J. nigra* in the U.S.A. Fawcett (7) has studied a fungus, *Dothiorella gregaria* Sacc., which causes canker on *J. regia* in California. It is believed to have come from *Salix lastolepis*.

Conclusions.

The principal difficulty in the culture of walnut in this country will be the obtaining of suitable sites. Really good soils are necessary, hence land usually acquired for afforestation will not be suitable. Walnut culture should be limited to the south of England. Of the different species, *J. nigra* is likely to prove most suitable, but until this is finally determined *J. regia* should be used also. *J. cinerea* is worthy of experimental trial. The question of nurses is difficult, but beech or other shadebearing hardwoods should be brought in later in view of the importance of soil conditions for the species. As regards establishment, the use of pre-germinated nuts sown in spring should be tried. If pests prove dangerous, successful establishment with one-year seedling should be possible with care. Different spacings and the question of pruning should be studied.

LITERATURE.

(1) Baker, *Black Walnut, Its Growth and Management.* Bulletin No. 933, U.S.A., Dept. of Agric., 1921.

(2) Baltet, *La pepinière.*

(3) BATCHELOR, *Walnut Culture in California.* Bulletin No. 379, College of Agric., Agric. Exp. Stn., Berkeley, California, 1924.

(4) BRANDSTETTER, *Zur kultur von Juglans nigra*, Oesterr. Forst und Jagd. Zeit. 31, 1913, pp. 10–11.

(5) BRUSH, *Utilisation of Black Walnut.* Bulletin No. 909, U.S.A., Dept. of Agric., 1921.

(6) ELWES and HENRY, *Trees of Great Britain and Ireland.*

(7) FAWCETT, *Melaxuma of the Walnut, "Juglans regia."* Bulletin No. 261, College of Agriculture, Agric. Exp. Stn., Berkeley, California, 1915.

(8) LAKE, *The Persian Walnut Industry of the United States.* Bull. No. 254, U.S.A. Dept. of Agric., Bureau of Plant Industry, 1913.

(9) REBMANN, *Neuere Erfahrung über die Anzucht einiger Juglandeen.* Allgem. Forst und Jagd Zeit. 88, 1912, pp. 257–272 and 401–403.

(10) SCHWAPPACH, *Ergebnisse Anbauversuche fremdlandischen Holzarten*, 37, 1901. (Quoted Elwes and Henry.)

(11) SEVNIK. *La culture de Juglans nigra en Yougoslavie.* Sumarski list: January, 1926. (This paper not yet available.)

(12) THORNBER, *Walnut Culture in Arizona.* Bull. No. 76, Univ. of Ariz., Agric. Exp. Stn., 1915.

(13) TOUMEY, *Seeding and Planting in the Practice of Forestry.*

THE FORESTER AS A NATURALIST.

By G. B. Ryle.

A forester is born and not made ; a naturalist is born and not made, and in most cases the factors which go to make the born forester also bring out in him the instincts and feelings of the born naturalist. In fact, the very life which he leads, with his unique opportunities for first-hand observation during all seasons of the year, cannot help but to inculcate in him a degree of insight into the ways of the wild which few others could obtain in a lifetime of book learning.

During the next few generations the face of Britain will be undergoing many important changes of a more or less man-made nature. On the one hand the march of industry is transforming a rural population into an urban one ; new towns are springing up and much wild country is becoming barren land in the eyes of the naturalist. Another great change, which one learns less about from the lay press, is due directly to the activities of ourselves—the Forestry Commission—and to a lesser extent to the landowning fraternity. But these activities are probably even more important from the point of view of the farmistic and floral changes which are following in their wake.

At the present time when large tracts of the country's wildest and most unspoiled ground are being converted into permanent forest land, foresters and naturalists will be losing valuable opportunities if they do not make a study of the changes they are causing to take place in both fauna and flora of their charges.

The Forestry Commission has already come in for a certain amount of criticism from certain of those ardent " sportsmen " who can see no farther than the pheasant, the partridge, the grouse, the stag and the fox, and it is admitted that extensive afforestation, especially with the dense foliaged conifers, will have a radical effect upon the wild life of the district. The majority of birds do not care for the densely stocked fir or pine forest, and there is no doubt that many species will be driven from their native haunts, and will be forced to take shelter in fresh fields and pastures new. The same, of course, applies to the other animal orders and above all to the vegetable kingdom.

There is no great fear that our activities will materially lead to the extinction of many species, though, doubtless, there will be cases where strictly local ones will be killed out or forced farther afield. The effect will be most marked in those cases where more or less unique types of country are being planted up. I have in mind, for example, the Breck district of Norfolk and Suffolk, known to us as Thetford Chase. This district supports a very peculiar fauna and flora, and the establishment of a huge pine forest there is bound to have a very marked effect on the local animal and plant life. The native species are lovers of brilliant light and dry parched soil : they will find no place under the shelter of a dense wood of Scots and Corsican pines, and their doom is sealed so far as that immediate vicinity is concerned. Similar changes will be taking place, in fact they have already begun, at every

forest centre, and to watch the gradual suppression of the native species and their replacement by new associations will give opportunities for much original observation and study.

These changes will not as a rule be sudden, though, as an exception, the killing out of the rabbit population from the forest area frequently results in a very rapid change in the local vegetation; they will normally come more or less gradually and there will be fierce, silent battles for survival. An insect normally feeding on a light-demanding plant will find its ordinary diet becoming suppressed, and it will either have to migrate or it will, in rare cases, change its food plant and begin to feed upon the new crop—the forest trees. Such a (temporary) change of diet has been noticed at Churt and at Clipstone in the case of the heather-eating *Strophosomus lateralis*. The weevil comes up from the soil in the spring, where it has been feeding as a larva on the heather roots. It finds the heather tops have been burned off and a crop of conifers has been planted. Being a sluggish insect it does not migrate to the nearest heather ground, but starts to feed on the young trees. (Result: up go your beating-up costs!) Other species will find that, year by year, their homes are becoming less habitable; birds and other active creatures will quit the area; plants will become suppressed and die out. It will be interesting to see how long the stone curlew and the ring plover, as examples, will continue to nest in the derelict brecks around Thetford as the trees grow up and cover the ground.

As one community dies out another one will assuredly succeed it, though in pure coniferous woods there will be in most cases a considerable decrease in number and variety of both animal and plant forms.

The "sportsman," referred to earlier on, holds out fears that these large forests will become the breeding haunts of countless birds and beasts of prey which will devastate his fast diminishing game preserves. We are doubtful whether his fears are based on sound foundations, for few of our raptorial birds or our beasts of prey are willingly denizens of the dense fir wood.

In some of the less accessible and wilder forests there may possibly be an increase in a few of the rarer species—the gamekeeper's "vermin"—but we will not be sorry if this is the case. If by accident the Forestry Commission is instrumental in saving from extinction such creatures as the wild cat, the pine-marten, the badger and others, every lover of Britain's small fauna will thank them.

Of course there are certain species which normally inhabit these dense forests and for that reason they are generally strictly limited in their distribution. Among the birds, the crossbill and the crested tit come into mind and these may both be expected to increase their range as the new forests grow up. But, generally speaking, the pure pine or fir wood is not a very good hunting ground for the naturalist.

Every forester knows his immediate forest foes and he may get rather tired of the continuous round of *Melolontha*, *Retinia*, *Myelophilus*, *Hylobius*, *Pissodes*, *Chermes*, and so on; but to the forester inclined that way there is a lifetime's study and interest to be had from the

beneficial creatures and from those creatures which appear to do no direct good or harm.

We are forming new forests and, all unwittingly, we are forming new fauna and flora in them. It would be a thousand pities if we were to lose all record of the old before the new have finally taken their place.

We cannot all hope to emulate Gilbert White or W. H. Hudson, but if we were to make a detailed study of the natural history of our forest charges and to put our observations on record, the results could be of untold interest and value to naturalists both of the present day and more particularly to those of future generations, who will walk in shady forests where we walked on barren heaths and moors.

CUPRESSUS MACROCARPA ON THE SOUTH DOWNS.

By W. H. Guillebaud.

The acquisition of Friston Forest on the South Downs, near Seaford in Sussex, presented the Commission with the immediate problem of dealing with an area of shallow soil over chalk within a couple of miles of the sea. An investigation of tree growth in the district was, naturally, an early step to be taken ; and, owing to the enterprise of Dr. Somerville, formerly President of the Royal English Arboricultural Society, material was available in the form of a number of most interesting plantations at Poverty Bottom, near Seaford, a farm previously owned by him. Permission to take measurements, and to fell sample trees, was kindly given by the present owner, Captain Masters. The plantations were investigated by Mr. Lovegrove, and the following notes summarise, and to some extent amplify, his report.

Poverty Bottom is a fair-sized farm situate north-east of Seaford within 3 miles of the sea. The lower slopes are partially sheltered from the direct force of the prevailing wind, but some of the higher plantations are in full view of the Channel. The soil is very variable in depth, ranging from 4 inches to over 2 feet of a brown clayey loam over chalk. It is generally shallow on the hill sides, but deep towards the bottom of the slopes.

Dr. Somerville planted five small blocks from 1 to 3½ acres in area, mostly approximately rectangular in shape, but one in the form of a long narrow strip running down the hillside.

The plantations are scattered over about 300 acres of down land on various aspects and at elevations ranging from 150 to 300 feet above sea level. The age varies from 14 to 17 years ; much beating up was apparently necessary, and some of the plantations are rather irregular in consequence. Local enquiries showed that most of the blocks were ploughed before planting.

The plantations are of especial interest in that Dr. Somerville tried a large number of different species, and sufficient time has elapsed to enable at least the most promising species to be picked out. The general procedure was much the same : an outer strip a yard or two in width was planted with Spanish Broom (*Spartium junceum*) and *Cupressus macrocarpa*, while inside came the other species, either in single rows or small groups. The planting distance was 3 feet.

It is clear that Dr. Somerville, quite correctly, placed high hopes in the broom and macrocarpa, as, besides using them for the outer protection belt, they were also largely planted inside in mixture with the other species—one plantation, indeed, now consists of almost pure macrocarpa. The macrocarpa were planted as one-year seedlings.

The following is a list of the species found in the plantations, approximately in order of numerical importance at the present time :—

Cupressus macrocarpa.
Scots pine.
Japanese larch.
Black Italian poplar.
Corsican pine.
Ash.
Norway spruce.
White spruce.
Austrian pine.
Thuya plicata.
Sycamore.
European larch.
Pinus insignis.
Willows.
Lawson cypress.
Cupressus sempervirens.
Cryptomeria japonica.
Deodar cedar.
Picea Morinda.
Sitka spruce.
Beech.
Birch.
Norway maple.

Many of the above species occurred only in one or two of the plantations.

Before discussing the growth of the plantations as a whole, it is necessary to stress the important influence of the broom-macrocarpa belts upon the development of the other trees within these belts. The broom grew vigorously, forming a dense bushy growth up to 10 feet in height and undoubtedly kept the wind out up to the limit of its effective height. The macrocarpa, however, has played the more important part owing to its much greater development. From inspection of the plantations it was obvious that most of the other species hung fire for a considerable time—until, in fact, the macrocarpa was sufficiently tall to afford them protection. The windward sides of all the plantations were severely blasted, and it is certain that the picture would have been very different if each species had been separately planted without any protective belt. In some of the plantations macrocarpa was liberally sprinkled throughout the block, and here the development of the other species has reached its maximum.

In one of the blocks macrocarpa was planted in alternate rows with Scots pine at 3 feet spacing. The latter have all been suppressed except in the centre where three or four part rows of Japanese larch and Scots pine form a little group among the pure macrocarpa. The usual outer fringe of Spanish broom 8 to 9 feet in height surrounds the plantation. Part of this plantation stands on a little over 12 inches of soil on chalk and part on a rather deeper soil at the foot of the slope. The growth differed considerably, and it was decided to measure a 1/10-acre plot in each area. Two mean sample trees were felled in each plot, the data being summarised below :—

	Age.	No. of trees per acre.	Girth.	Height.	Volume per acre (true measure).
			in.	ft. in.	cub. ft.
(1) Upper area ...	17	1,090	14	28 6	1,460
(2) Lower area ...	17	820	17½	34 6	2,215

The sample trees were cut into sections and ring counted. The age-height curves, when plotted alongside the curve for first quality European larch, show the general trend of the height growth to be fairly similar to that species. The trees in the upper plot were slightly below, and those in the lower plot slightly above the mean 80 feet class larch curve.

The volumes are remarkably high, especially as no account was taken of the subordinate species present (250 stems per acre of Scots pine, Japanese larch and poplar in the lower plot and 70 per acre in the upper plot).

For comparison the following table shows the volume per acre from the yield tables for European and Japanese larch and Douglas fir at 20 years of age :—

European larch ..	Quality I	1,870	cubic feet.
,, ,, ..	,, II	1,080	,,
Japanese larch ..	,, I	2,315	,,
,, ,, ..	,, II	1,445	,,
Douglas fir ..	,, II	2,435	,,
,, ,, ..	,, III	1,630	,,

Thus even on the shallower soil, macrocarpa has made a good showing under fairly unfavourable locality conditions. Analysing the height measurements taken in the five plantations, macrocarpa is seen to have grown faster than any of the other species planted. In every case there was a difference of from 3 to 6 feet in height between the *Cupressus* and the next tallest species (excluding one block in which were two *P. insignis* which were almost as tall as the macrocarpa). Next to macrocarpa comes Japanese larch, and then Scots pine and Black Italian poplar, the height of the two latter species averaging 6 feet below the macrocarpa. The respective mean heights of the macrocarpa in the five plantations were as follows :—

1. 24 feet.
2. $21\frac{1}{2}$ feet.
3. $28\frac{1}{2}$–$34\frac{1}{2}$ feet.
4. 15 feet.
5. 20 feet.

In addition to those already mentioned, the following is a list of species which have attained a mean height of 15 feet or over in one or other of the plantations :—

Thuya plicata.	Austrian pine.
European larch.	Birch.
Corsican pine.	Willows.

The spruces come at the bottom of the list with mean heights below 10 feet, except in one plantation, where Norway averaged 14 feet. Where they have not been suppressed both Sitka and Norway are now growing very fast after their slow start. A 3-feet leader was measured on one Norway. Beech occurred in one plantation only, but were growing fairly well in the shelter of the latter conifers. Corsican occurred in three out of the five plantations, in two of these it was

slightly slower growing, and in the third about 2 feet taller than Scots pine. The few *Pinus insignis* planted looked very promising. Ash and sycamore were about equal in growth to beech and had made rapid progress during the last four years.

To sum up the observations recorded at Poverty Bottom, it is clear that Spanish broom is a valuable shrub for use on shallow soils over chalk in exposed situations. Although the growth is relatively slow, it forms dense cover and is well worth a trial as an advance growth on some of the very exposed slopes at Friston. Of the trees, *Cupressus macrocarpa* is the outstanding species. The only drawback to its extensive use may be that so little is known as to the value of the timber. In this connection the writer was recently informed by Mr. A. C. Forbes that he has used the wood in Ireland for doors and window frames for a hut. The wood was not seasoned beforehand, but the results have been quite satisfactory. (Incidentally, the carpenter grumbled loudly over his task, as he found the wood hard and difficult to work.)

Dallimore and Jackson, in their book on Coniferæ, state that the wood grown in Britain is of good quality and durable and that good furniture could probably be produced from trees grown in close plantations. The branches are very persistent, but the trees in the one dense plantation at Poverty Bottom were beginning to clean themselves, and there is little doubt that under correct treatment clean timber can be produced. The tree is less affected by salt spray than probably any other species, and thus is particularly adapted for planting near the coast.

As regards the remaining species planted, *Pinus insignis*, Japanese larch, *Thuya*, and Scots and Corsican pine appear to have done the best of the conifers and poplar of the hard woods. Ash may yet be a profitable tree when it has got over its slow start. Birch, sycamore and beech were planted in only one out of the five plantations, and, though their growth was promising, the evidence is too scanty to say much about their merits. The very few European larch planted were not nearly so good as the Japanese.

The main conclusions which the writer is disposed to draw from the plantations at Poverty Bottom are that in *Cupressus macrocarpa* we have a very useful, if not indispensable, species for planting on the chalk Downs, and that other species, notably sycamore and ash, might be grown on the lower slopes, in mixture, possibly, with Japanese larch and/or beech, provided there is not only a wide protective belt of macrocarpa to windward, but also a criss-cross system of internal belts which would divide up the land into small blocks $\frac{1}{2}$ to 1 acre in area.

Spanish broom is worth planting outside the *macrocarpa*, as at Poverty Bottom, and perhaps also inside among the hardwoods as an additional break to the wind.

Pinus insignis is worth a trial behind macrocarpa belts on the upper, shallower and more exposed slopes; it may ultimately stand longer and grow into a bigger tree than the macrocarpa itself, where the chalk is very near the surface.

SITKA SPRUCE IN DENMARK.

(From DOUGLAS—OG SITKAGRAN, by O. FABRICIUS, 1926. Abstracted by J. M. MURRAY.)

The Sitka spruce was discovered by Menzies in 1792 near Puget Sound, and introduced to Europe in 1831 by David Douglas. Greater quantities of the seed came in about 1850, and it was between that time and 1854 that the tree was first grown in Denmark. These early specimens are all dead, and possibly the oldest and largest of the species in the country is an isolated tree in Frijsenborg Park. This is said to have been planted about 1860, and in June, 1923, the height was 24·8 m., and the girth at 1·3 m. about 4 m.

It appears that the first real tests of the tree started in 1873 and 1880 with single trees and groups. Commencing about 1890, small plantations were made, and in the last 25 years the areas cultivated with Sitka spruce have increased annually. The largest extent of plantations occurs on the west coast of Jutland, and especially on the downs of Thisted county. The approximate area stocked with Sitka spruce in 1922 was 2,800 acres.

Very little is known of the origin of the earlier Sitka spruce seed imported to Denmark, but the later importations prior to 1921 mainly came from the coasts of Oregon and Washington. According to Rafn, seed was brought from Queen Charlotte Island in 1921, and plants from this source are said to be more hardy and just as quick-growing as those from Washington and Oregon.

Various forms of Sitka spruce have been distinguished. Visart and Bommer (Belgium) name two of them—*Picea sitchensis*, with more or less hanging branches and long needles, and *P. Menziesii*, with straight branches and straight prickly needles. *P. sitchensis* is a native of the more humid parts and, according to Beissner, is faster-growing than *P. Menziesii*, which is a native of the drier regions. The latter is regarded as a form that ought not to be used.

Hansen in 1892 mentioned that some introduced plants appeared to be hybrids between *Picea sitchensis* and *P. alba*. Sørensen reported that plants produced from seed collected in Høllund Søgaard plantation were not damaged by frost, while those growing alongside from American seed were.

After a few years this difference disappeared, but the Danish plants were very variable in appearance; some plants were like the Sitka spruce and some like white spruce.

In another case the plants produced from Danish seed had cones like Sitka spruce and needles like white spruce, and vice versa. The growth of these hybrid forms is being followed, since it is possible they may be found useful on exposed and frosty sites. Artificial crossing has been tried also.

In regard to climate, when it is considered that, while the geographical range north and south is great, its range inland is limited more by the access of moist sea air than by the soil in North America (Mayr), there is nothing remarkable in that Sitka spruce fails to grow in parts

of the interior of Europe. Even in Denmark differences in air humidity bring about differences in development.

Except where a shelter is suddenly removed older plants of Sitka spruce seldom suffer severely from frost. Although "frost-drying" by frost, sun and blast causes occasional defoliation it is reported not to be so prevalent as with Norway spruce. On the downs early frosts do damage for several years after planting. Spring frosts on the downs are of little consequence, however, but on flat areas such as heath plains, and in hollows at a distance from the coast, the danger is great. A tight covering of grass increases the risk.

In Denmark the Sitka spruce is said to be more frost-tender than Norway spruce or silver fir, and owing to the almost simultaneous bursting of the top and side buds in spring the damage done may be greater. The frost damage produces irregularity in heights, but this may occur without this agency.

It is considered, in Denmark, that Scots pine and Norway spruce appear, in their relations to climate, to be diametrically opposite to Sitka spruce, but this does not exclude the possibility of all three thriving in the same place.

It has been observed that where rainfall, humidity and soil moisture are low the Sitka spruce does not thrive and that where one of these factors is insufficient the demands on soil quality become higher. Dry years have a definite reducing effect on height growth, not only in the year of drought, but also in the following year. In this connection Munch, in Germany, found that in a series of drought-resisting tests, Sitka spruce suffered most, and there followed in order Norway spruce, Weymouth pine, silver fir, Douglas fir.

Drying cracks several metres long occurring in the upper part of the stem were recorded in one plantation. All the trees affected were above the average diameter and volume of the plantation, and the cracks indicated spiral growth. The plantation from which this trouble was recorded grew on a hard moor soil resting in most cases on a bleached sand of variable thickness on pan, or panlike red earth, at a distance of about 97 cm. from the surface. The rainfall records for the year when the cracks occurred show that during the vegetation period when demands for water were high the precipitation was abnormally low.

Similar drying cracks were recorded for Norway spruce during the same year. (In Britain drying cracks of a similar character are common in *Abies grandis* and *Abies nobilis*.)

In regard to wind-resistance, it is said that in Denmark Austrian pine, mountain pine, white spruce and Sitka spruce may be grouped as most resistant.

The Sitka spruce is said to be storm-firm, but it does suffer, on exposed places, damage by the breaking of the main shoot. (Similar damage occurs in Britain.) The effect is not persistent.

In regard to soil, it is said the best development occurs on friable, sandy loam. But, if the air and soil moisture are sufficient, growth is good even on poor sand and the demands on soil quality are only little greater than with white spruce or Norway spruce. On the

poorest soils the needles remain short. Bohn-Jespersen relates that the Sitka spruce favours soil containing lime and it is said that it reacted to applications of marl. It appears, however, to make lower demands on lime than does silver fir.

On peat (tørv) the Sitka spruce does better than any other species of tree. Where the peat is not well-decomposed it is often slow, often not better than birch. On "dog's-flesh" the Sitka spruce does not thrive. A necessity for reasonably successful development is thorough draining. On beech moor and burned areas Sitka spruce thrives better than most other species.

According to Mayr, the Sitka spruce occurs in the southern limits of its growing region only on the moistest localities, in cooler districts on normal soil, and preferably on southern slopes, the further north it goes (Smitt). In Denmark, on declivities having a sandy soil with a strong movement of water the growth is always good. Where the soil is clay the growth is not uniformly good.

Sitka spruce does not thrive where the water is stagnant and the water-table high, and certain observations made on Tvorup Down plantation illustrate this. This area was planted with Sitka spruce and mountain pine in mixture. It was divided into four "localities" and height measurements were taken on July 15th, 1922, and July 15th, 1924. Soil tests were made, pits were dug and the depths of the water-table below surface were measured on July 15th, 1922, and about the 15th of each alternate month thereafter.

The following table shows the results of these observations :—

Locality.	Mean depth of water-table below surface.	Sitka spruce. Heights in centimetres.			Mountain pine. Heights in centimetres.		
		1922.	1924.	Annual increment.	1922.	1924.	Annual increment.
	cm.						
I ...	90·15	210	250	20	220	240	10
II ...	82·3	115	165	25	200	220	10
III ...	62·3	60	85	12·5	180	190	5
IV ...	55·6	—	—	—	145	170	12·5

The figures indicate that mountain pine will withstand the evils of a high water-table better than Sitka spruce.

On heaths it is an advantage if there is a layer of wet soil not deeper than can be reached by the roots.

The nursery experience with Sitka spruce in Denmark has some interest. In treating the cones of Sitka spruce for seed extraction, it has been found that exposure to a temperature of 30° C. for a length of time destroys germinating power. A bushel of cones yields about 0·7 lb. of seed.

It has been found that poor nursery soils produce poor plants subject to early frost damage. An application of phosphatic manure during summer (August) assists ripening and reduces this danger.

The seed is sown usually at the rate of 1 lb. to 248/344 square feet, but Paludan—a nurseryman—states that with irrigation the area may be increased to 587/734 square feet.

After sowing in wet weather certain foresters cover with sand and afterwards with ling mixed with moss and lichen. The ling-moss-lichen covering is removed after the plants come up. Paludan covers with coarse sand. Generally the seed beds are covered with bushes which are thinned out and removed gradually after the seedlings are through. A layer of sand one-fifth to two-fifths of an inch deep and a covering of moss and lichen is said to prevent drought damage. Sand is also given as a suitable covering to prevent damping-off, frost-throw and weed-growth.

In the earlier part of the summer covering with mats is recommended, but later on as much sunshine as possible ought to be admitted to assist ripening. Winter covering is also applied.

Lining-out is usually done with 2-year-old stock, but lining-out of 1-year seedlings is practised also with success in sheltered and highly cultivated nurseries. Lining-out in September is said to give good results. The spacing is either 6 inches by 6 inches, or 9 inches by 4 inches.

The number of plants raised from 1 lb. of seed was 12,200 2-year seedlings and 6,700 transplants 2 by 2. Paludan states that 36/45,500 seedlings 2-year old were got per pound of seed.

When planting in the forest a spacing of 4 feet is usually adopted with a view to early cleaning. The time of planting is generally spring, and it is said that autumn planting has been a failure.

When there is danger from frost a foreculture of birch is found useful, and nurses of mountain pine are also used under such circumstances. A mixture of mountain pine and Sitka spruce is used on poor heaths. Such a culture may require considerable attention to prevent the spruce from being damaged.

The value of pruning so that only one stem is maintained was ascertained by measurements. Two-stem trees showed 81·76 and three-stem trees 64 per cent. of the mean diameter of single-stem trees.

In Denmark the Sitka spruce has been used successfully for hedges. Its power of producing adventitious shoots is of great assistance in this work.

Measurements of various sample plots were given which indicate that the growth of Sitka spruce in Denmark is good. The volume production of the main crop after thinning in Mejlgaard Overskov was at 22 years 2,610 cubic feet, and at 34 years 5,984 cubic feet per acre. At Gludsted, where the trees were subject to frost damage and grew on a soil consisting of 3–4 cm. moor peat, about 30 cm. mixed bleisand and old ling layer in which the roots were mainly found, 40–50 cm. streaky coarse sand with harder and looser parts, and under this coarse and fine slightly loamy sand ; the volume at 36 years was per acre 2,070 cubic feet in one plot and 1,466 cubic feet in another.

Of diseases occurring only a few need be mentioned. *Fomes annosus* appears to be a serious enemy, as is also *Armillaria mellea* after beech. *Lophodermium abietis* also causes some damage. *Dasyscypha calycina* is recorded as being prevalent in one plantation. *Moniliopsis Alderholdii* and perhaps *Fusarium blasticola* cause damping-off in seedlings. *Phycis abietella* and *Aphis abietella* are recorded among the dangerous insect pests along with *Tetranychus ununguis*.

The article concludes by saying that Sitka spruce in Denmark makes low demands on the soil ; is a good wind-resister ; has a high poduction of good timber. The experience of the tree's growth is limited, however, and it is not recommended for very extensive planting as yet.

Silvicultural Circular No 1.

NORWAY AND SITKA SPRUCE PLANTING: WITH SPECIAL REFERENCE TO DIFFICULT SITES.

MEMORANDUM ISSUED TO FIELD OFFICERS, NOVEMBER, 1926.

1. I have been particularly struck during recent inspections with the satisfactory results obtained by various methods of mound-planting Norway spruce and Sitka spruce. The systematic experiments being carried out by the Research Officers and the successes and failures obtained in routine planting operations all point to the desirability of modifying the prevailing methods of planting these species.

I would be glad, therefore, if Divisional Officers would take careful note of the suggestions below and carry out large scale experiments (in blocks up to say 5 acres apiece) designed to test methods of mound-planting. I am particularly anxious that the "side-notch" method, which is new, should be tried not only on deep peat, where heavy draining provides all the turfs required, but also on better sites where it may be necessary to cut turfs specially for the purpose.

GROWTH OF SPRUCE ROOTS.

2. Careful dissection and study of the roots of large numbers of spruces has shown that when a spruce is planted deeply (*e.g.* by vertical notching) the lower part of the nursery root system invariably dies. This may result in the death of the plant, but more frequently it remains in a state of "check" until it has formed a new root system. This new root system either develops from the upper remnants of the original nursery root system or new roots are put out at the collar of the plant. The new root system is thus essentially a shallow one developing in the aerated soil or vegetation layers. It is frequently marked by long "pioneer" roots with here and there bunches of mycorrhiza roots in decaying vegetation such as molinia. Apparently the plant feeds through the mycorrhiza rootlets. As the new root system develops, the checked plant regains its normal green colour and proceeds to grow.

On poor peaty sites spruces may remain in check for 15 to 20 years and yet ultimately come away.

3. Owing to this habit of checking, the establishment of spruce plantations is often a very costly business. The first planting is cheap enough but costs accumulate for the following reasons:—

(*a*) Excessive deaths.

(*b*) Beating up plants which look sickly but are merely in check. Much money is often wasted in this way. The rule should be never to beat up a spruce which is alive.

(*c*) Prolonged weeding.

(*d*) Check increases the length of the rotation.

Obviously also a plant which remains in check has not the same power of ultimate growth as a plant which uses its youth in a more profitable manner.

Application to Side-Notch Method.

4. From the above considerations it appeared probable that the main problem in spruce planting (assuming the site to be otherwise suitable) was to secure adequate root aeration. If the original nursery root system could be kept alive and made to function the check period should be reduced to a minimum.

The Research Officers have accordingly developed a method known as the side-notch method, which has given very promising results. The method is described in the attached note. Briefly, the advantages so far secured by using this method are :—

(*a*) Seedlings (*e.g.*, top sizes of 2- and 3-year seedlings) can be used.

(*b*) The losses are low (4 per cent. with seedlings on a very bad peat site at Inchnacardoch).

(*c*) No weeding is necessary.

(*d*) At the end of two years the plants have an excellent colour.

If these claims are sustained in routine planting it is clear that not only will the total cost of establishing spruce plantations be greatly reduced but also that, in spite of the extra cost of preparing turfs, the cost to the end of the first year may not appreciably exceed present costs.

Note.—It is not claimed that the side-notch method is going to deal with the whole problem of planting poor sites and dispense with proper drainage and so on. It does, however, appear to be a most promising method of establishing spruce on " Spruce ground."

General Observations.

5. I have two further observations to make on spruce planting. The practice on wet sites of planting a row of spruce on the turfs thrown out of drains should become universal.

Some of our worst failures have been on molinia ground where the spruce have been placed in screefed holes. This procedure is obviously contrary to the whole argument set out above.

R. L. Robinson.

Turf Methods of Planting.

6. The principles involved have been outlined in paragraph 2 above. The practical implications of these principles have been recognised for a long time, for example, by Manteuffel about the middle of last century and in the development of the turf and drain system, which was designed in Prussia and applied extensively on peat and clay in the Belgian Ardennes since 1878. Two methods are described below, namely, the Belgian System (for full description see Report on " Peat Reclamation in Belgium, 1924 "*) and the " side-notch " method carried out at Inchnacardoch, Inverness-shire, in 1925. This followed on from an experiment carried out in 1924 to test the conclusions of the Inverliever Report* in 1923, as regards shallow turf planting.

* Available from the Library (22, Grosvenor Gardens, London) for consultation.

Belgian System.

7. The principle of this system is the laying out of parallel drains of such dimensions, and spaced at such distances apart, that each turf taken from the drain and placed inverted between the drains, provides a site for plants at the planting distance desired.

The operations are as follows. The herbage is burned or cut. Drains are marked out diagonally across the slope with a gradient of about $1\frac{1}{2}$ per cent. The present practice is to space the parallel drains 18 feet apart, centre to centre. The drains are 18 inches wide at top, 9 inches at bottom and 9 inches deep. The turfs cut are thus 18 inches by 18 inches by 9 inches and are placed upside-down in three rows between each pair of drains. Two rows are each 3 feet from the centre of the drains and the third row is mid-way between. The turfs are spaced 4 feet 6 inches apart in the rows. All the turfs taken out of the drain are thus utilised.

The best type of tool for cutting the sides of the drains is a small type of sheep or rutter spade. The underside can be cut with a turf-lifting spade and the turfs lifted out with a peat hack. The practice is to carry out these operations two years before planting.

The planting on the turfs is done with a semi-circular spade. The core removed with the spade can be replaced in part with earth or with a mixture of earth and basic slag. The mixture consists of 7 parts of mineral soil and 1 part of basic slag. Two handfuls of the mixture are given to each plant. Successes have been achieved both with the soil-basic slag mixture (*e.g.*, by Sir John Stirling-Maxwell at Corrour) and with the plain turfs (*e.g.*, at Halwill).

Side-Notch Method.

8. As with the Belgian System the turf (which in this case should be 15 inches by 15 inches by 6 inches to 8 inches thick) is inverted, but in planting there is the essential difference that the roots of the spruce are spread out horizontally on the natural surface of the vegetation, and the turf rests on them.

In order to get the spruce into position the turf is slit vertically from one side to the centre with a spade. The turf is then raised up by the outside ends of the slit, which at the same time opens the slit, the plant is pushed in the slit to the centre of the turf, its roots are spread horizontally below the turf, which is then dropped back into position and firmed. Care should be taken to make the notch on the lee side of the turf, on the side sheltered from the sun.

It seems reasonable to conclude that the turfs should be prepared well in advance of planting in order that the natural vegetation should be killed and that weathering by winter frost, etc., should take place.

THE ANNUAL REPORT.

By C. O. Hanson.

I have been specially asked to write an account of my method of preparing the Annual Report, but feel rather diffident in doing so. It is hoped that the following remarks will not be taken as laying down the law in any way; I give my method of collecting facts during the year in the hope that it may prove of some little help to others, and that improvements may be thought out so as to reduce to a minimum the burden of writing up the report.

When the first report was written I found that a considerable amount of search amongst the files was necessary, and a good deal of information had to be asked for from the foresters. In order to avoid this in future years a system has been gradually evolved which enables me to write the report fairly rapidly and with the minimum of work on the part of the foresters and office staff; it is based on the necessity of collecting and recording facts throughout the year instead of leaving the work till the time of writing the report.

1. *Facts for the Body of the Report.*—A copy of last year's report remains on my table throughout the year, and every now and then I jot down in pencil in the margin of the appropriate head any facts for report next year. A great deal of trouble is eventually saved by doing this, and it only takes a minute or two to enter up interesting facts as they occur.

At the present moment (December 19th) I find I have jotted down as above:—(1) dates of transfers of various officers, and changes of staff which have occurred up to date; (2) names and areas of new acquisitions; (3) buildings begun since October 1st; (4) short notes on the weather of October, November and December, with effect on cultural operations; (5) note on sales of pitwood; (6) notes on forest workers' holdings begun; (7) advisory work done.

With notes as above already made, when the time comes to write up the report one's memory is greatly assisted, and searching of files is almost eliminated.

2. *Statistical Information.*—In June various statements are sent up recording the results of the planting season, including "Plants used for planting and beating up," "Seed sown," "Plants lined out," and at this time also I prepare the statement of "Plants lifted."

To obtain the necessary figures I use three forms, known as Plant Record Forms A, B and C. These have been used for three or four years, and have proved exceedingly useful. Forms A and B are typed out before the planting season begins, and a copy is sent to each forester, and as work proceeds the forester enters the figures. It takes a little time, but if done as and when the plants are lifted or received and used or sent away, it gives but little trouble, and the information is exceedingly useful in many ways (*e.g.*, the forms help the forester

to estimate beating-up requirements next year). Form C is sent out later in the season. It is an abstract of A and B in which all the items are classified and totalled by species. Forms A and C only are returned to the Divisional Office at the end of the lining-out season, and are used for preparing the report. B is retained by the forester, and A can be returned to him. (It is called for simply because it gives particulars of liftings more conveniently than Form C.)

The following are the headings of the forms, but the heads are along the top of the form and not as here set out. Instructions are typed on the back of the form.

Form A.

Plants from Home Nurseries.

1	Liftings ...	Species.	
2		Age.	
3		Thousands.	
4		Dates	from
5			to
6	Used for Planting	Compt. No.	
7		Thousands.	
8	Used for B.U.	P. No.	
9		Thousands.	
10	Used for L.O.	Nursery.	
11		Thousands.	
12	Exported ...	To (Forest).	
13		Thousands.	
14		D.N. No.	
15		A.N. No.	
16	Destroyed	Thousands.	

(B 34/4007)Q

B 3

Form B.

Plants from other Forests.

1	Receipts ...	Species.	
2		Age.	
3		D.N. No.	
4		A.N. No.	
5		Recd. from (Forest).	
6		Thousands.	
7		Remarks (Shortages and Excesses).	
8	Disposals ...	Used for Planting	Cpt. No.
9			Thousands.
10		Used for B.U.	P. No.
11			Thousands.
12		Used for L.O.	Nursery
13			Thousands.
14		Destroyed—Thousands.	
15		Re-exported	To Forest.
16			Thousands.
17			A.N. No.

Form C.

Final Record of all Plant Movements.

1	Plants Lifted and Received	Species.	
2		Age.	
3		D.N. No.	
4		A.N. No.	
5		Recd. from (Forest).	
6		Thousands.	
7	Method of Disposal	Used for Planting	Cpt. No.
8			Thousands.
9		Used for B.U.	P. No.
10			Thousands.
11		Used for L.O.	Nursery.
12			Thousands.
13		Exported	To (Forest).
14			A.N. No.
15			Thousands.
16	Destroyed	Thousands.	

During the season *all* receipted advice notes pass through the office, and one copy of each is retained and filed. When plant record forms are received, early in May, I check figures on Form C with the corresponding advice notes. This serves to verify the forester's figures, and also to make sure that no advice note has gone astray. After checking the Form C of any forest I enter the figures on the various Annual Report statements. I find from my diary that I began this work in 1926, on May 26th, and completed these particular forms on June 11th, doing the work at odd times for two or three hours at a time. The office staff was not troubled with them except for typing, but the same forms are used by the accountant in preparing his transfer invoices at a later date.

3. *Details of Work done.*—To obtain figures for certain columns in "Analysis of Cultural Operations" statement, and also for permanent record, I call for a special annual progress report from each forester early in October. If all weekly progress reports have been correctly prepared, the totals should show the work done during the year, but often errors are made and the preparation of this special progress report enables the forester to correct his figures, and to insert any work he may have omitted to enter. He also enters "Area affected" under the drainage and fencing colums. These special progress reports are filed with the Annual Report.

As a result of the above methods, I find that I have to make very few special enquiries at the time of writing the report, as the figures on record, assisted by one's memory, provide almost all that is necessary. In 1926 I commenced the report, on September 29th, and finished it on October 7th, except for a few details afterwards filled in. There then remained only the typing, and the report was dispatched on the correct date.

SOME REFLECTIONS ON FOREST CLOTHES.

By C. O. HANSON.

Every forester, using the term in its widest sense, is interested in the matter of clothing suitable for forest work, and wonders whether he is using the most suitable apparel. He is for ever getting wet, and wonders whether he could wear something which will keep him dry.

It strikes me that officers must have tried almost all kinds of material, and possibly by ventilating the subject in the Journal a really good waterproof method of clothing oneself may be discovered. I therefore give my own experience which, however, only goes to prove that I have not yet evolved anything warranted to keep one dry. Boots, leg-covering, knickers, raincoat, and hat are the most important items.

Boots.—Many people prefer shoes, and these are all right for summer work, but I prefer boots in wet weather. I have tried them both heavy and light, and find almost every kind ceases to be waterproof after a winter's use, however much one pays for them. I now use medium weight Lotus boots, which I find really waterproof for one winter, and they can be used out in summer when they have ceased to be really waterproof. They are expensive, and it would be a boon to hear of any cheaper make which is reliable.

I find the following treatment is excellent, and improves the waterproofness, while making the boots softer. On buying a new pair I pour half a small bottle of salad oil into each boot, roll it round till all parts are wet, and then set aside for two or three days to soak in. When first worn, put on an old pair of socks or stockings, as they get very oily, but this soon rights itself. Do not put in more than this or one will ooze out oil for days ! In very wet places I have used rubber high boots. They are excellent for in-and-out work when making short inspections from a car, but I find I cannot walk far in them.

Leg-covering.—For many years I used leather gaiters, and believe these are the best leg-covering for general use, but, not being so young as I was, I find the weight is a burden, and have recently worn stockings and canvas anklets. These are excellent in dry weather, but the stockings, of course, get soaked on wet days.

Knickers.—Although a certain officer, known to all, invariably wears trousers, I cannot believe that many foresters will follow his example, except in summer, when a pair of flannel " bags " are cool and comfortable. Most people prefer knickers of sorts, either of the plus-four or tight-knee variety. I have tried all sorts, and have not yet found anything which will keep the knees dry. Is there such a pair on the market ? I have tried Burberry pull-ons which cover the knees, but they are hot, tend to drag at the knee, and after an hour or two in rain the wet comes through. Anyone who can produce a well-ventilated knicker which will keep the knees dry will receive the thanks of the whole Department. Perhaps some Headquarters officer could take the matter up with some enterprising firm.

Raincoat.—I have always used a Burberry, and they are thoroughly good on the whole, but expensive. The Technical Commissioner and Assistant Commissioner (England and Wales) use blue raincoats, which they say are excellent. Can more of these be obtained, and if so, from what firm ? I understand they are much less expensive than a Burberry.

Hat.—I find a cap gets horrible to wear when wet, and use a Homburg of sorts. Recently I have used a cheap waterproof Homburg known as the "Bramble-Falcon" make. It costs only 7*s.* 6*d.*, is quite respectable to look at, and is waterproof. It is heavy, and therefore useful only in winter. Unfortunately, it shrinks, and one should get a size larger than is usually worn, padding it till it has shrunk after getting wet.

This question of clothes seems to me to be well worth inquiring into, and it ought not to be impossible to find really good waterproof garments. Undoubtedly one's health is affected by continuous soaking, and at present one's only safeguard is to carry a complete change to the nearest possible point—taking, at any rate, a change of boots and stockings with one when travelling by train or car.

I have written more from the point of view of the inspecting officer than from the forester's, but the question is of equal importance to all grades.

UNIFORMS FOR FORESTERS IN SCOTLAND.

By F. C. HANDFORD.

For some years the question of clothing foresters has been under review. From the purely official point of view the system of having woodmen in uniform is of value in protecting plantations from damage by trespassers. Normally, the forester would wear out his old clothes while pursuing his daily occupation, but clothes chosen for social use are by no means the best for rough work in the open. It may therefore be concluded that a specially made suit or uniform is desirable.

Discussion with the foresters indicated that a hard-wearing uniform would be welcomed and that they would be prepared to contribute towards the cost. In September, 1925, official sanction was obtained to an arrangement by which foresters might obtain a uniform, the ordering and payment for which should be carried out through the Department, who would contribute 30*s.* towards the cost. By this arrangement it was possible to place one contract for the whole supply, thus assuring uniformity of design and making possible a "cut" price.

Following inquiries, an offer was accepted and is in operation by which a uniform (made to measure) consisting of a khaki serge jacket (lined, four patch pockets), with roll and step collar, together with strong Bedford cord breeches, is supplied for 61*s.*, less 30*s.* paid by the Department, making a net cost of 31*s.* By taking ready-made breeches, which are available in various sizes said to fit practically any man, the net cost to the forester is brought down to 25*s.* 11*d.* per uniform. The Departmental allowance of 30*s.* may be repeated after the lapse of two years.

The scheme has given much satisfaction, and 28 uniforms have already been supplied.

A difficulty has always existed in regard to headgear for forest work. Estimates were obtained for caps to be used with the uniform, and of a shape to give shade and keep rain-water from passing down the neck. Helmet-shaped caps of waterproof material and ventilated were quoted wholesale at 11*s.* 6*d.* by one firm and 9*s.* by another, but were considered too expensive.

TIMBER MARKETS AND PRICES.

By W. S. Fletcher.

The marketing of forest products has of late years grown more difficult, owing principally to the competition of imported woods. In many cases the greater suitability for immediate or early manufacture and the kindness of the texture are sufficient reasons for giving imported timber preference, independent of first cost.

The present high price of imported oak of prime quality is a factor in our favour. Some users of native oak readily say that it is cheaper and also more suitable. These users are chiefly furniture manufacturers and their reference is to suitable squares. These squares well cut, properly selected and looked after command a good price fresh cut and a very much better price when seasoned.

It might also be made to apply to boards and small dimension planks, given proper care in converting and suitable arrangements for seasoning.

There are still a few trades which insist on our native hardwoods. Railway wagon builders and repairers absorb a particularly large quantity of good quality oak. Home-grown ash has no rival for certain parts of vehicles, aeroplanes, and beyond all, sports equipment.

It is suggested that with the assistance of full investigation and enquiry, much better conditions regarding sales may be secured than those at present obtaining in a number of cases.

Grading is a suggested practice that may be found of considerable use in the future. In the case of ash it is a necessity, and as regards oak, improvement may be made by a somewhat similar measure.

In marketing there are certain factors that dominate value—the cost of extraction and railway transport and the fact that inferior timber, bone and offal, costs as much for these services as the merchantable timber. It is often found that cost of extraction is excessive, owing to there being little or no competition amongst hauliers; frequently, only one haulier is capable of undertaking the work.

It seems almost impossible to get railway rates reduced, but the companies are always willing to consider any proposal affecting special traffic of sufficient volume. For goods which can be railed in box wagons, reductions will be allowed from fixed rates on special occasions.

This matter of haulage and rail is worthy of careful consideration as a means of broadening the area of sales, and possibly increasing prices.

Good felling, careful trimming of knots, and cutting back the long straggling top are useful. It frequently happens that by cutting off a few feet cube of top, the value of the butt is increased out of proportion to the loss in measure.

Values in general can scarcely be given. The economic value, after all, is the value in the timber yards. Oak, our largest product at present, varies very much. The lower grades, *i.e.*, smaller sizes of from 8 to 12 inches q.g., are the most difficult to sell and average

about 1*s.* 6*d.* per foot cube in the yards. For oak of 12 to 14 inches q.g. the price is better by 3*d.* or 4*d.* per foot, and trade in this size is likely to improve. For the sizes 14 inches and up there is, as a rule, a fair demand, and at prices that will range from 2*s.* 3*d.* to 3*s.* in users' yards. Quality is the great factor which controls price.

Ash with variations in quality has a wide range in price, but girth is not a great factor, from 7 inches upwards being favoured. For special butts suitable for sports work the price may be 7*s.* 6*d.* per foot and for whole parcels of good class, anything from 3*s.* per foot cube f.o.r. Poorer qualities range from 1*s.* 6*d.* to 2*s.*, and the very poor have scarcely any market, unless it is a local one.

Beech is not always easy to sell, except in favoured districts. The users are furniture manufacturers, the stick trade, and the finer quality piano factories. Good class logs fetch about 1*s.* 9*d.* in the yards, although there is a special market at a figure of 5*d.* to 6*d.* per foot above that. For small rough beech and the large ungainly butts there is no demand. Beech must be felled between the beginning of November and the end of February ; this applies also to ash to get it in its perfection.

Elm is always in good demand at from 1*s.* 3*d.* to 1*s.* 6*d.* in the yard. Poplar has little sale except near the Midlands, and the value is about the same as for elm. Lime is a valuable wood and in sizes above 12 inches q.g. will, if well grown and not too far from the West Country, fetch from 2*s.* 3*d.* to 2*s.* 6*d.* f.o.r.

Sturdy hardwood coppice, suitable for pitwood, has its value according to the cost of transport by rail to the nearest coalfield, the favoured areas getting a price of from 24*s.* to 27*s.* per ton.

Birch poles for turnery and various uses, taken all round, have a value of 26*s.* to 28*s.* per ton in the yard. The sizes which can be sold at better prices being 3 inches to 4 inches diameter, but the waste prevents this being sound policy unless there is sale for the waste.

Of conifers, larch is the favourite, and when fresh felled has a ready market at anything over 1*s.* per foot cube in the wood, according to locality, the Midland coalfield being the greatest users. Scots pine and Corsican pine in pitwood sizes fetch from 5¼*d.* to 6½*d.* per foot. Spruce is difficult to sell as pitwood but in some cases will be taken. Convertible Scots pine is a poor market and only local markets are suitable. The price may be anything from 6*d.* to 8*d.* per foot, although in many districts there seems no demand.

Thinnings from plantations have a fairly ready sale and each district gets a rate at per dozen or per hundred. It is suggested that with care and full enquiry something may be done to improve this valuable source of revenue in the future.

Taking all things into consideration the fact of being able to put on rail economically and with all speed, subject to weather, seems of great importance and worthy of careful consideration of its possibilities.

SOME IMPRESSIONS ON LAND ACQUISITION.

By E. W. Jones.

Taking the long view, and who is he amongst us who dares to take any other, we plan and scheme as to what the future holds ; will the Commission's work soon be multiplied, and without much warning ? If it be so, it needs no hard thinking on the part of the already overstrung acquisition staff to know the cry that will go up : " We want more land ! " Will the supply equal demand and, if not, how is it to be made to do so ?

To find an answer to these questions it is necessary, unless existing legislation be severely altered, to study the landowners' point of view.

In the first place, landowners, both large and small, are likely to be wishful of parting with areas which are suitable for afforestation on account of :—

(*a*) Heavy taxation (imperial and/or local).
(*b*) Economic reasons.
(*c*) Patriotism.
(*d*) Interest in forestry.

It would appear that the supply of land arising out of the first two reasons, *i.e.*, (*a*) and (*b*), is not likely to increase appreciably at any very striking rate, although indirectly, or even because of some unseen factor such as a form of capital levy or a heavy slump in sheep values, either may have a marked inducement in the right direction. Hardly also does it appear possible to look for offers of land on account of (*c*), *i.e.* patriotism, to any great extent, unless economic conditions first bring weight to bear upon the owner.

It is therefore to the landowner's interest in forestry that we must turn with hopeful eyes, and certainly with more ease of mind. It is probably a fair supposition that the awakening of the landowner's interest is in true proportion to the expanding work of the Forestry Commission, and if acquisitions to date are a true guide, this would appear to be a most hopeful sign of the good things to come.

The landowner may say that he is slandered—that both he and his forbears have always maintained an interest in forestry—but is any other answer necessary than the statistics published after the recent Survey of Woodlands ? Surely by " interest in forestry " is meant a true perspective of the Commission's operations and of the advantages which will accrue both to the owner and the State.

The question then arises for the future : how is the owner's interest to be quickened ? Through three channels : by the press, by contact with other landowners or their agents who are already enlightened, or by direct contact with the Commission's officers. The results to be obtained through the first two channels are to all intents and purposes an unknown quantity ; the least that can be said of them is that both may lead to the third channel, which in the opinion of the writer, formed by obvious shortcomings, but at any rate by personal contact, is by far the most important of all three. Empty prejudice may

not infrequently be eliminated, new ideas inculcated, and by such personal contact the attitude of an owner or his agent can be grasped and countered as by no other means.

Where a landowner possesses a valuable sporting property, and particularly if it be a property which requires re-afforesting, the idea of a lease to the Forestry Commission may or may not have occurred to him. Possibly it has, and he has turned it down out of hand, being convinced that his shoot would be quite ruined and not having the initiative to probe a little further. It is here that a little discussion on the question of sporting rights may often prove helpful, and a few germs of thought can not infrequently be introduced by process of suggestion. It may, for example, be pointed out that belts of existing high forest round the fringe of a large woodland area, or at good " flushing " points, can be excluded from negotiations ; or, tentatively, it can be suggested that a main ride of exceptional width be left unplanted in order to secure a good shooting break.

It is, of course, always easy to promise too much, but, at the same time, it is just these small points which give to an owner that little impetus which may make him turn the whole question over in his mind and realise that the advantages of a lease may well outweigh his former prejudice. Few owners are aware that the Commissioners are usually ready to consult with him as to the lay-out of the plantations-to-be.

The type of owner most frequently encountered is the one who has an area to dispose of and who has very definite ideas as to its value—ideas which more often than not are rosily optimistic ; he is the one with whom it is most difficult to deal. We will suppose that he has a block of six sheep farms to offer : probably he does not want to put them on the market, or to advertise a sale, and he is thus debarred from testing their value. An expert valuation he considers unnecessary expense, and, further, to complicate the issue, he may have recently disposed of one or two adjacent farms at figures which he proudly indicates yielded so many years' purchase of the gross rents. In such cases both tact and patience are required ; a firm offer may be made based upon a fair valuation, and later on, perhaps, it may be slightly increased. The owner eventually either will accept the offer—in which case he is afterwards under the impression that once again he has been " done by the Government," and does not hesitate to tell his friends so—or he may turn down the offer and spoil the area from an afforestation point of view by selling off parts of it to individuals.

Even the type of owner whom we have just considered is not so case-hardened as the man who wilfully circulates the fact that the Forestry Commission are interested in order to bring a third party up to scratch ; in the eyes of a land acquisition officer nothing is too bad for him.

Under existing procedure it does not always appear possible for a definite decision to be arrived at as to whether an area is entirely suited to the Commissioners' requirements or not, prior to negotiations for the acquisition being all but concluded. When terms supposedly satisfactory to both parties have been agreed, and where an owner

has been to considerable trouble in computing areas, and perhaps re-lotting (and more especially is it important where an agent or auctioneer is concerned), it is not to be expected that he will be over-enthusiastic as to the outcome of his wasted labours. It is certainly a mistake to be avoided, especially if there be a prospect of more suitable land from the same source at any future date.

Land acquisition being, to the practised eye, so closely inter-related with land agency, the day may not be far off when the two may marry, and the ultimate result of such a union could hardly prove anything but beneficial in helping to increase the regular flow of land required for extended operations. One of the results would be that the officer concerned would be able to keep a more watchful eye upon possible acquisitions within his field of operations, and at the same time to get in touch with a larger proportion of owners and agents as the natural outcome of his varied duties and restricted area. Also, it is whispered that Divisional offices would hoot with joy at the thought that no longer would they toil at leases or agreements, plans or specifications, rates or taxes, and humdrum arguments with abusive tenants. So why not ?

USE OF PAPER MULCH IN NURSERY LINES.

By J. M. Murray.

The term " paper mulch " is applied to a covering of specially-prepared paper placed on the soil for the purpose of modifying soil temperatures, decreasing losses of soil moisture, and preventing the growth of weeds. The method was invented and patented by Mr. C. F. Eckart, and it has been used extensively in the cultivation of pine-apples, and to a less extent, on sugar cane and certain vegetables in the Hawaiian Islands. It is being tried in California on vegetable plots.

In some of the Commission's nurseries experimental trials of the material have been made, and recently a modification has been attempted by substituting canvas with a bitumen coating for paper.

The method entails large initial costs, and it appears probable that a considerable amount of experimental work and certain investigations will require to be carried out before it can be pronounced a sufficiently useful method for more extensive application. It is possible that there may be produced different results under different conditions of soil and climate, and that, for instance, on heavy soils or in wet districts results may be obtained which are not referable to modifications of temperature or to any decrease of soil moisture losses. The effect of shading by the larger transplants may be a factor also having some influence. Further, the effect on the soil flora and fauna may be worthy of attention.

Meanwhile, the literature on the subject is not large. A certain amount has been written in Hawaiian and American papers and the reducing effect on weed-growth is said to be satisfactory. Unpublished results of experiments carried out by the Hawaiian Sugar Growers' Experiment Station indicate a material increase of temperature and a considerable reduction in the loss of soil moisture where a paper mulch is used.

The results of experiments undertaken with vegetable crops in California are given in a recent issue of Hilgardia. The crops were potatoes, milo and beans. The experiments covered the period between May 17th and August 25th. The results indicated that as regards soil temperatures, as shown by thermograph bulbs placed 3 inches below the surface of the ground, the covered plots were warmer 62·5 per cent. of the time and the bare plots warmer 28·3 per cent. of the time. On the average the covering hastened the time of warming, retarded the rate of cooling, and gave a more uniform temperature condition. The average daily range in temperature was 8·58° for the covered plot, 11·07° for the bare plot, and 31·03° for the air. For any one day the extremes ranged from 3° to 13·5° for the covered plot, from 1° to 19·5° for the bare plot, and from 14° to 61° for the air thermometer. The maximum temperature reached under the cover was lower for each day's record than that on bare ground.

In the bare plot the maximum was reached about 6.45 p.m.; the actual times ranged between 6 p.m. and 8 p.m. The average for the

covered plot was 4.30 p.m.; the actual time ranged between 4 p.m. and 6 p.m. The bare plot reached its minimum temperature about 8.50 a.m.; the covered plot reached its minimum about 7.30 a.m. In both plots the soil was warmer during the night than during the day.

The moisture experiments appear to have been influenced by accidental factors, but they indicated a decrease in water losses in the upper 18 inches of soil in the covered plot as compared with the bare plot. The differences amounted to from 4 to 20 per cent. of the total moisture present.

In the final crop only beans were considered. It then appeared that the yield was better from the bare than from the covered plot.

So far as they go these obsevations indicate that the method is likely to produce the best results on soils that suffer from drought and under climatic conditions in which there are great fluctuations in the air temperature.

PROTECTION AGAINST WEEDS IN NURSERIES.

Use of Chemically-treated Flax.

This material, laid in strips between the transplant lines, has not been altogether satisfactory in Scotland. Unless very securely fixed there is risk of the removal of it by wind in exposed nurseries. In some places we find that it does not sufficiently suppress weeds in the spaces between the plants and immediately alongside of them. This, however, is not the universal experience, and possibly more careful treatment when laying down the strips would lessen the cause for this complaint. More durable material, waterproofed, has given satisfactory results, and on the whole the plants protected by strip covering have appeared to be in better condition than those treated in the ordinary way by open cultivation. The expense of all surface coverings so far discovered appears to be prohibitive.

USE OF FABRIC MATERIAL AT GWYDYR.

By J. L. Shaw.

In 1926 an experiment was conducted in two beds (of 588 and 550 square yards) of 2-year old Sitka spruce seedlings at Diosgydd Nursery, by laying specially treated fabric between the lines to check weed-growth. Wire hoops were used every 10 feet, but on one bed (rather exposed) a plain wire every 10 yards had to be stretched across the whole area to hold the fabric in position.

An examination under the felt showed a poor smothered weed growth, but in the rows of plants and between the two edges of felt, there was evidently a forcing effect on both trees and weeds. Weeds were forced to such an extent that, to avoid them seeding, they had to be weeded on both flats at a total cost of £1 17*s.* 10*d.*

On Bed 36, which is more sheltered, the felt lay in position very well, and its effect on the trees seemed to make them more drawn and lanky, 90 per cent. of them being 9 inches and 10 inches high at the end of the growing season.

On Bed 30, rather exposed, and continually being disturbed by wind, the effect on the young trees was undoubtedly injurious to growth, owing to the continual rubbing of the felt and walking of the men in replacing it.

The felt was removed at the end of September, and is quite fit for use again, apart from the fact that the sticky nature of the material when new is now worn off.

On hilly or exposed nurseries the use of felt cannot be recommended, owing to the difficulty of keeping in position, but on level ground it might be beneficial if pegged down every 8 feet by hoops. The hoop

tends to throw rain-water sideways, otherwise the felt drops into a channel and drains all rain-water off the bed.

Details of expenditure are given below :—

	£	s.	d.
Treated beds—			
Laying felt on 1,138 square yards ..	1	17	7
Relaying felt on 550 square yards ..	1	9	4
Weeding between felt strips ..	1	17	10
	£5	4	9
Removing and storing felt ..	£0	12	0
Control beds—			
Bed 36—Three times weeded } 1,138 square yards	1	17	9
Bed 30—Twice weeded .. } 1,138 square yards	1	10	3
	£3	8	0

THINNING.

By J. H. MACKAY.

To those who have followed closely the numerous articles that have appeared in our Forestry Societies' journals upon this most important silvicultural practice of thinning, this article may seem most superfluous. They say: "Has not the subject of thinning been exhausted? Every grade and method has been classified! If you want to make a grade D thinning in the Borrgrieve's method you remove such and such trees from this and that crown class, and there you are!" It is precisely for these "profundi" that the article is written.

Let us consider for a moment the objects to be obtained by thinning and the dangers which it eliminates. The major object in all cases is to reduce the struggle for the survival of the fittest to such an extent that the trees remaining on the ground may develop to their best advantage. If a plantation of normal stocking was allowed to grow untended for, say, 50 years, on good soil, we would find the following state of affairs. A dense crop of trees all more or less of the same height; the individual trees have spindly stems and small crowns, and, if we are fortunate, the crop will still be standing up. We are immediately struck by the small crown, and agree that more space should be given to these to develop, since the growth of the stem depends upon the size of the crown and roots up to a certain degree, which will be mentioned later. If the crop has been neglected so long that the stem is now no longer able to bear the weight of the crown without the additional support offered by the surrounding trees, then thinning is useless, clear felling being the only cure; or, again, if the crop has reached that stage where the trees fail to respond to the extra crown and root space owing to too keen and prolonged competition, then clear felling is again the only remedy. Or, again, even if the stems are strong enough to just bear the weight of the crowns, and the trees can respond to the increased space, then a thinning is carried out; the trees are more exposed to the influence of the wind, and since the stem is so constructed as to give the maximum strength using the minimum of material, the tree will either break, or in a supreme effort to reduce the wind pressure will lower the centre of gravity of their crowns by becoming stagheaded.

Thus one sees briefly the dangers which systematic thinning eliminates, and the objects that make thinning of such paramount importance in silviculture.

I mentioned above that the growth of the stem depends upon the size of the crown and the root system up to a certain extent; the reservation becomes obvious when one considers a tree growing in the open. It is observed that the lower branches are considerably longer than the upper ones to allow the foliage to receive light, and a point is reached when the assimilative products produced by the foliage are entirely required for lengthening and strengthening the branch bearing it. The same applies to the root system. When this point is reached,

the tree is obtaining too much crown and root space for economic growth. Dr. Metzzer, a German physicist, has determined that the volume of the branches from the top downwards increases in a geometric progression, while their production of building material increases only in arithmetic progression. By plotting the curve and straight line represented by these progressions, one obtains, from the point of intersection, the maximum quantity of branches which is beneficial for the growth of the stem.

But there is also the question of quality, which must be taken in conjunction with that of maximum volume growth, and should the latter result in branched and hence knotty wood, it will be necessary to grow the trees closer to increase the natural pruning and thus increase the quality. The problem to be solved resolves itself into, what is the minimum of ground space which a tree demands for fast growth? This can be determined only by examining the trees in each plantation and noting what proportion of the stem is taken up by the crown; and the length of the annual shoot. Empirical figures obtained from other plantations are only guides and cannot be applied with any accuracy, because the complex of factors, climatic, edaphic and biotic, which affect growth, vary not only in each district but in each forest and each plantation.

Thinning in Theory.

After a crop has formed a close canopy it begins a new existence, in which there is a competition for light between the crowns of the trees. As time goes on there is a differentiation between the crowns of the trees, which resolve themselves into what are known as the crown classes. Thus trees having an advantage either from early establishment, better soil conditions, or an inherited character for rapid growth, will have their crowns above the general level of the forest canopy and form the dominant or predominant classes. Those trees which have not grown so quickly for reasons the converse of the above, form the co-dominant classes, and form the general forest canopy, while those that have been so checked for hereditary or other reasons that they have fallen considerably behind, form the dominated class. Finally, there is generally added a class of suppressed and dead trees which does not enter the crown classes, or may merely penetrate the bottom of the crowns of dominated trees.

The trees forming these crown classes have been themselves classified according to their appearance, *e.g.*, vigorous, healthy trees, diseased trees, deformed trees, and so on, so that we have every tree in the wood as carefully classified and labelled as would please the heart of the most categorical German.

With these crown classes it was possible, on paper, to evolve three main types of thinning, which some foresters (and by "foresters" I include all those who participate in the art and science of forestry) fondly delude themselves into believing they can and do apply in practice.

These three types have been called, "thinning from below," "thinning from above," and "Borrgrieve's method." The first two

are obvious, while Borrgrieve's method is the removal of dominant trees and dominated trees, leaving the co-dominants to form the final crop.

Detailed instructions have been carefully compiled showing exactly the crown classes and the tree types in these classes to be removed in making a thinning of any type or degree. Thus, when a District Officer receives instructions to make a "D" grade thinning of the "thinning from above type," he has only to go through the wood and mark those trees described in the instructions under that head.

I have been a District Officer for only two years, but have never been asked to do such a foolish thing, although there do exist many foresters who are blinded by the brilliance of the minds which produced such plausible theories. So much is this the case that there are few text-books upon thinning in this country (and fewer still in America) which do not expound at great length these unnatural creeds; and if our text-books, written by so-called experts, bolster up these theories, how can we say they are wrong?

If I might digress a moment I would say, as a general rule, that text-books destroy the stimulus towards independent thought, and have been elevated to a far too high plane. Views which are not expressed in text-books are considered unorthodox and generally fallacious, and an indication of lunacy. There is appearing, fortunately, a movement away from so-called home truths in forestry, and a wider, more flexible, outlook is being tolerated, which indicates a great advance.

Thinning in Practice.

To return again to the subject under discussion, I mentioned previously that the essence of thinning was the freeing of trees to allow development of the crowns and root systems. It is therefore a first essential of thinning that trees whose crowns are in actual competition must be the trees which a thinning affects. The removal of the dominated and suppressed crown classes, so called, does not constitute a thinning, but is merely a cleaning. This elimination leaves us with the dominant and co-dominant classes.

It once fell to my lot to thin a plantation, and at the same time classify the trees into their crown classes. Although four of us worked hard and conscientiously there was, with few exceptions, a division of opinion as to whether a tree was dominant or co-dominant, which shows that the crown classes, though obvious on paper, are considerably the reverse in the forest, which brings us to the conclusion that the dominant and co-dominant trees are as near as anything one class, and in practice must be treated as one class. The result is that the thinning from above, thinning from below, and Borrgrieve's method all become one and the same thing.

Or, again, supposing that the plantation we thinned was exceptional in not showing properly differentiated crown classes, let us consider briefly the steps taken in making a thinning. First, it is purely academical to question the advisability of leaving the large, well-grown trees which show every indication of being in good health and no

tendency towards a growth of heavy side branches. On the other hand, a wolf tree with large side branches should be removed where it is prejudicing the growth of several trees belonging to the dominated classes, trees which have good leaders and sufficient crown to be able to respond to the light and space.

Space prohibits an exhaustive catalogue of the possible problems in thinning, but the two extreme cases taken prove many things. They show that thinning from below is not a thinning but a cleaning, and that if it be allowed as a thinning, then thinning from below and above may occur in the same wood or even in adjacent groups of trees. Nor can this be described as Borrgrieve's method, since no good rule of thinning the largest and smallest trees is in force. It proves, or rather indicates, the conclusion that there are no definite types of thinning in spite of what the text-books say.

Another point of great importance which will be noted is that the thinning is made in respect of the position of the crowns and not the stems of the trees. This is a point which should never be lost sight of while thinning, for the temptations are many to remove a good tree close to another good tree to liberate a poor tree. Trees, we know, have a variable factor of growth which is heritable, and unless a tree has been obviously suppressed its relative poor growth should be taken as an indication of inherent slow growth, and hence the tree should not be favoured at the expense of a fast-growing tree.

My object in writing was to try and impress upon foresters that each wood must be thinned according to its special requirements, and no standardisation is possible. If I have not been successful in this, I hope I have given some a stimulus to independent thought on forestry matters.

THE WORK AND DUTIES OF A DISTRICT OFFICER.

By F. E. B. DE UPHAUGH.

This article is an attempt to give the impressions of a Forest Officer on Probation whose views were at first entirely theoretical, and in general mostly wrong, and which gradually have changed to a more definite standpoint, acquired by his short experience of running a district.

I shall only deal with the work connected with actual planting and maintenance, and not with the sundry other duties of a District Officer, such as sales of produce, acquisitions, grant schemes, and inspection of repairs to forest workers' holdings, etc.

My first idea of running the forests under my charge was to hurry round as often as possible to see that the forester was carrying out the work which I had instructed him to do, or more precisely, that the Divisional Officer had instructed me to get done. In fact, I was not much more than a postman or inspector under the Divisional Officer. However, it was not long before I discovered that a District Officer should be able to take complete charge of all the forests in his district—in fact, never to forget that he is acting for the Divisional Officer, and that he is therefore solely responsible for all the work carried out in his district. In the ordinary working of his area, he must show complete self-reliance, only referring to the Divisional Officer on the more important decisions, and reporting what actions he has taken or is about to take. It is no less important for a District Officer to have definite views of his own than it is for him to keep the Divisional Officer in continual touch with the work he is doing.

I have found it advisable to stay several days, say 3 or 4, at each forest, as otherwise it is impossible thoroughly to inspect the work done since last visit, the work actually in hand, and to formulate detailed plans for that which has to be accomplished during the interval before the next visit. Personally, I have found it expedient not to let more than a month go by without an inspection, or one loses touch with the work in progress; but, on the contrary, too frequent visits show lack of confidence in the forester, and by these visits one is merely doing the forester's job.

A first idea soon to be corrected was that a general inspection was sufficient. I shortly discovered the importance of a detailed inspection of everything; to give an example—seeing that fencing posts are firm enough, that the wires are set the right distance apart; in fact, that the men in charge not only know their work but are applying their knowledge. This is especially the case when watching a planting gang at work. I found it was no good watching the gang in general, but that it was better to examine each man's work in turn, finding out his weak points and correcting him, and also helping him to see where he was at fault by taking him up his previous lines, also finding out why these faults had not been noticed and corrected by the forester.

At first I generally took the forester on my rounds partly to find out the areas. Now, as far as possible, I always go round on my own.

It is certain that one does not keep one's eyes open whilst walking along and talking to the forester, and his time is likely to be wasted, at least in part; any necessary instructions can always be issued subsequently and (so far as possible) confirmed in writing.

I prefer to vary my routes when going from point to point, so as to gain a gradual knowledge of all the areas under my charge. The District Officer should know his forests as well as the foresters themselves, and this knowledge must mean not only where beating-up and weeding want doing, but also that he should be able to picture exactly how the work is progressing, and to what point it has reached. In this way he can find out not only whether the staff is too large or too small to get the work done in the scheduled time, but also he can judge when his next visit is necessary, in consequence of which he is able at any time to instruct the forester what to do next without making a special visit to the forest. I take it that the duty of the District Officer is to tell the forester what has to be done, and not to have to ask him for information as to what wants doing.

In like manner, my ignorance of the nursery stocks has been a great handicap to me this year. A stock that is unsuited for one forest may be admirably suited for another; when stocktaking, a forester generally described any transplants he considers unsuited to his own use as either "Nils" or "Optionals." He naturally does not want to run the risk of having them allocated to his own forest. In consequence of this, if the District Officer does not find it out, suitable stocks are left unallocated.

Lastly, if possible, it is a good plan to spend whole days with the working gangs, not only to inspect the men at work, but in order to be able to pick out likely gangers or men for forest workers' holdings.

Note by Divisional Officer, No. 2 Division.—The above officer is in charge of six forests aggregating over 16,000 acres plantable, distant up to 45 miles from his station, and with P. 27, aggregating nearly 1,600 acres, earlier plantation totalling about 5,700 acres, and 66 acres of nurseries. There are considerable sales of produce from three of the forests.

O. J. S.

MOUNTAIN MOORLAND AFFORESTATION.

By G. W. Hollis.

Ploughing is generally impracticable for use in afforestation, but where large areas consist of peaty moors comparatively free from large stones and roots, and where the gradient permits, ploughing can be done.

The question of whether ploughing is an advantage may be raised, and personally I doubt there being any advantage on a soil where there is neither lack nor superfluity of moisture. But, in dealing with the peaty moorlands that are saturated in winter and dry in summer, I am convinced that ploughing is beneficial to the young trees, besides other minor advantages such as the assistance a furrow gives when following the rows to fill up blanks. On the Margam area we have approximately 500 acres of peaty, moorland type, mountain flats, at an altitude of 1,000 feet and slightly over. During the seasons P. 21 to P. 24 Norway spruce were planted in the ordinary way, the surface first being screefed and the plants inserted after notching by either the mattock or the Schlich spade. These areas have been, if not a complete failure, an utter disappointment to all the foresters concerned. The plants mostly originals are of a sickly yellow colour, and scarcely an inch of growth has been added in the period of three to five years. Whether these plants, which are an eyesore to everyone, will eventually get away remains to be seen.

During the planting season 1924–25 on similar types of land, with the same altitude and exposure, ploughing was introduced, first with an ordinary agricultural share, which proved useless in the tough *Molinia* turf, and then with a patent share brought out by a resident farmer. The ploughing consisted of furrows, cut flat at the base, 7 inches wide and 2½ inches deep; these were ploughed 4 feet 6 inches apart, with sufficient gradient to drain off the surplus rainfall. So wet was the ground at this time that as the plough forced out the turf, water flowed along the furrow. Shallow drains were afterwards cut at intervals of approximately 60 yards to prevent water lying in the hollows, and also to check the rush of water in the furrows after rainfall. The area was then planted with Norway spruce and Sitka spruce in the wettest places. Of the former species rather large plants were used, and in this case I think a smaller size would have given better results, as they would have been afforded some shelter by the furrows. Where small plants occurred they are quite healthy-looking and sturdy to-day, whereas the larger plants transpired too freely and finally lost their needles, and many never recovered.

With these results one cannot claim ploughing to be a complete success as regards establishing Norway spruce plantations, but since ploughing, the area itself has improved wonderfully; rainfall now percolates into the lower regions instead of running off along the furrows, and there is a remarkable difference in the types of grasses. Where *Molinia* and *Scirpus* reigned supreme, there is now a fair mixture of dry land grasses of the *Aira* family.

This area has just been beaten-up with good hardy plants, small enough to gain protection for a year or two from the furrow. So we shall now, I hope, be able to prove the ploughing to be a success. It may be interesting to note that the ploughing and planting were done at the same cost as for screefing and planting.

Sitka spruce planted in the furrows the same season have done very satisfactorily. During P. 26 we ploughed 200 acres, of which 15 acres were left unplanted for one year as an experiment, to see the effect of the year's draining and aeration before planting.

Unfortunately we have now lost the use of this patent share, until some implement manufacturing firm will purchase the patent and make them in quantity.

SITKA SPRUCE TRANSPLANTS OF DIFFERENT ORIGINS: SUSCEPTIBILITY TO FROST.

By J. A. B. MACDONALD.

That Sitka spruce plants grown from different seed-lots may vary greatly in their susceptibility to damage from early frosts, is clearly illustrated in the Commission's nursery at Inchnacardoch.

In Section No. 37, lined out in April, 1926, there are three different lots of Sitka. They are as follows :—

(1) 26,500 (30 lines), now 3 year-1 year. The seedlings were ex Craibstone Nursery, and the Identification No. is 22/20.

(2) 21,000 (27 lines), now 2 year-1 year. The seedlings were ex Inchnacardoch Nursery; the Identification No. is 23/37.

(3) 66,000 (96 lines), now 2 year-1 year. These were ex Beaufort Nursery, and their Identification No. is again 22/20.

Lots (1) and (3) have a healthy blue-green colour, while Lot (2) appears in general to have a reddish tinge, due to the large number of frosted tips. The green of this lot is very much yellower, and the difference in colour is so marked that it can be seen from the hill above the nursery. The frosting occurs evenly over the whole of this lot (2).

In order to obtain some definite data regarding the amount of frost damage among the 23/37 plants, compared with the 22/20 lots, a grading of 200 plants in the last two lines of (1) and of 200 in the first two lines of (2) adjoining, was made. 200 plants in the last two lines of (2), and 200 in the adjoining first two lines of (3) were similarly graded. Percentage results are as follows :—

Lot.	Id. No.	Grade I.	Grade II.	Total Plantable.	Frost Damaged.	Other Culls.	Dead.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
(1)	22/20	56·5	24·0	80·5	0·0	15·0	4·5
(2)	23/37	19·25	12·75	32·0	49·5	14·0	4·5
(3)	22/20	59·5	14·5	74·0	2·0	21·5	2·5

The plants in these three lots are very much alike in size, those of Grade I being about 9 inches high.

The section has a very slight slope to the north. The soil is a fine dark loamy-sand. The humus content is high, and as far as can be judged the section is of even quality throughout.

In this nursery there are other sections lined out with the 23/37 Sitka, and in every case the plants have been similarly damaged. No frosting has occurred in other sections lined out with 22/20 plants, and some Sitka plants reared from 24/15 seed are also free from frost damage. Some Douglas fir have suffered from early frost.

Both 22/20 and 24/15 seed-lots came from Queen Charlotte Islands, British Columbia. The 23/37 seed-lot was presented by the American Forestry Association, U.S.A., and possibly came from a locality where the growing season is long, and the climate mild.

It will be interesting to learn if this frosting among 23/37 Sitka transplants is general.

This investigation was carried out at the request of Mr. Frank Scott.

CURRENT LITERATURE: REVIEWS AND ABSTRACTS.

THE FINANCIAL RETURNS FROM THE CULTIVATION OF SCOTS AND CORSICAN PINES.

By W. E. Hiley, M.A.

(Oxford Forestry Memoirs, No. 6.)

If x is greater than or less than y, find the comparative values of x and y. Such, at the outset, appears to be the problem which Mr. Hiley sets himself to solve. It is admitted at the beginning that data of present conditions are of the scantiest, and also that in attempting to make any forecast as to future values one may be guilty of overstepping the borders of discretion. But at the same time, though we may not know with precision either present conditions or future values, we can tell with a fair degree of certainty the probable maxima and minima of all the relevant factors. Thus the results achieved are approximate figures only, and their whole value depends upon the correctness or otherwise of these maximum and minimum figures—or the range of probability for each variable. For example, the range of probability for average values of timber in the future is taken to lie between the chance of values remaining steady and the chance of values doubling every 40 years, that is a rise in value of about 1·5 per cent. per annum. Again, the prices obtained for Scots pine timber are fairly well known, but home-grown Corsican pine is almost non-existent in the timber yards. It is doubtful whether it will ever be as valuable bulk for bulk as Scots: it may only fetch half the price. The range of probability is thus fixed as (1) Corsican and Scots will be of equal value, or (2) Corsican will be only half the value of Scots. Similarly, with the costs of establishment of the plantations, Corsican is probably rather at a disadvantage. In this respect it is unfortunate that no reliable figures showing the comparative costs could be obtained.

It is stated that on the basis of "sample plots in six districts in England the quality class of Corsican pine corresponds closely with the quality class of Scots pine on the same soil." This statement may be true for many districts, but we know of a very large region across the Eastern midlands of England where Corsican pine reaches first quality, while Scots pine is in the bottom of quality 2, or even in quality 3. This is perhaps not solely on account of soil conditions, and it is undoubtedly a fact that in smoky districts Corsican has the advantage over Scots. Generally, soils producing first quality Scots might produce first quality Corsican in the southern parts of the country, but the reverse will not at all invariably hold good.

In comparing the timber production of the two species another difficulty is faced: we have complete yield tables for Scots and the Commission's yield tables are used by the author throughout; but for Corsican the preliminary yield tables are not sufficiently detailed, in that no intermediate yields are tabulated. The Commission's sample plot data have been drawn upon to get over this difficulty, though the results taken over such a short period of time and in such a limited number of plots should be used with great caution.

The cost of planting is (probably correctly) considered as a recurrent expense, and the question of natural regeneration of second and subsequent crops is ignored. We know little about the possibilities of natural regeneration of Corsican in Britain, whereas Scots is certain to be reproduced naturally in the majority of our State forests in future rotations.

Using Mr. Hiley's "ranges of probability" of income and expenditure, first quality Scots pine yields an interest of 2·4 per cent. to 4·3 per cent., while first quality Corsican would yield 4·2 per cent. to 6·6 per cent. if the timber was of equal value, or 2·2 per cent. to 4·7 per cent. if the timber was half the value of Scots timber.

Given the cost of establishment of Corsican is £1 per acre more than that of Scots, equal returns might be expected from the two species if Corsican is only 59 per cent. of the value of Scots timber (quality 1).

The author further goes on to discuss the financial desirability of land improvement to render the ground fit for the production of more remunerative crops than the pines, and he gives some rather astonishing figures. Under fairly average conditions, with land costing £2 an acre, quality 1 Scots would give an interest of 2·6 per cent. Calculations with quality 1 larch show that land costing £42 an acre might also produce 2·6 per cent., so that at first sight it would appear worth while to spend £40 an acre to convert first quality Scots soil into first quality larch soil. But an investment yielding 2·6 per cent. is not a very sound proposition, and it would be a policy of doubtful wisdom for the State or for the private planter to sink such a large sum for the sake of producing a slightly more valuable tree. The figures are admittedly of academic interest only, and with our present limited knowledge of the means of soil amelioration they are of little practical applicability.

In view of the very high proportion of Scots and Corsican pines which are being planted annually by the Commission, such calculations as these, even though based on rather scanty data, are of especial interest. Mr. Hiley might be criticised for even attempting to solve a problem of this kind in the face of such a scantiness of data, but a policy of "wait and see" is no forester's policy. The very incompleteness of the data shows that there is a problem not fully solved, and one we must set out to solve in order that our sons may not find a crop of tares where we thought we had sown wheat.

G. B. Ryle.

EMPIRE FORESTRY JOURNAL.

Forestry activities at home and abroad during the past year are commented upon in the editorial notes. An account is given of the World's Forestry Congress, and the report of the Forestry sub-committee appointed to make recommendations to the recent Imperial Conference in London is published in full. Protection forests in Nyasaland is the subject of an excellent article by Mr. J. B. Clements; it furnishes convincing evidence of the important relationship between

forests and water supply. Reafforestation in Mauritius is dealt with by the local Conservator of Forests, and there are informative papers on forestry research in the United States, the wood-pulp industry of Sweden, and the railway-sleeper problem in India. Among miscellaneous items are brief notes on standard names for timbers, the position of the forest service in Cyprus, and the effects of deforestation in the tropics.

The Journal has become a useful medium for the circulation of information on current forestry literature ; in the present number about fifty books and periodicals are reviewed.

ZEITSCHRIFT FÜR FORST UND JADGWESEN, FEBRUARY, 1926.

What Influence has the Age of the Mother Scots Pine upon its Offspring ?

A summary of Dr. Busse's earlier conclusions from his experiments, started in 1915, on age of the mother trees of Scots pine was given on page 35 of the April, 1925, number of this Journal. The experiments have been recently reassessed and somewhat different conclusions arrived at.

Probably owing to the last few seasons having been exceptionally dry a difference in growth between the different plots is now apparent. The plants grown from seed collected from young trees are appreciably taller than those grown from seed of old trees, so that the differences which were very marked during the first few years after planting and then almost disappeared, have again shown themselves.

Some of the trees have now, after 12 years' growth, begun to bear cones, and it is interesting to note that the plots of trees from seed taken off under 16-year old parents have much the largest number of cone bearers, and at the same time these trees are among the tallest and most vigorous in the whole experiment. It looks as if early cone bearing may be an inherited character and also that it may be an indication of special vigour and not of weakness as is more generally held.

The Durability of Beech Railway Sleepers.

In this article Professor Schilling describes the results of an investigation started in 1897 in co-operation with the Railway Administration.

The trees were felled part in summer and part in winter. All the sleepers were impregnated with a tarry oil (? creosote), some immediately after felling and some after seasoning. It was soon found that impregnation immediately after felling was a hopeless method as the sleepers warped and cracked so badly as to be useless after a very few years. Excluding these sleepers, a total of 455 were tested. Of these only eight required renewal at the end of 26 years, while the remainder are still doing good service. Summer felling is not a good practice unless the leaf is left on the tree for some time after felling. Red heart, as long as there is not too much of it, is unimportant.

W. H. Guillebaud.

ZEITSCHRIFT FÜR FORST UND JADGWESEN, MARCH, 1926.

Contribution to our Knowledge of the Root System of Scots Pine.

In this long and important article Dr. Liese describes his elaborate investigations into the root system of Scots pine. The following is a summary of some of his main conclusions.

The root tip of Scots pine can attain a thickness of 0–2 inches in mineral soils but is always very thin in humus.

The number of xylem strands (usually three to four) in the main root is already determined in the seed. These reduce to two, in the lower part of the main root or more or less rapidly according to weather and locality conditions.

The rooting of one year Scots pine is very dependent upon soil conditions. Loose soils produce not only a deeper development but also a greater number of side roots. Of the side roots put out in the first year, only a few of those in the first 3 inches of the tap root develop into main lateral roots. The remainder grow slowly at first, but later can expand and become important for the development of the plant.

The main lateral roots are all derived from branchings of xylem, strands of the main root taking place in the first year of the plant's life. Poorly developed lateral roots on old root stocks can also always be traced back directly to the main axis of the tap root or of a side root. Their adventitious formation, such as occurs in spruce and Douglas fir, was never observed under normal conditions.

Occasionally, following mechanical injury or as a result of biotic agencies, root initials were observed in the resulting callus growth.

The number of xylem strands in the lateral roots is two, adventitious roots produced by injury may have more (3 to 4 strands) but these are reduced to two in their subsequent development. The diarch xylem plate of the lateral roots is always vertical at the point of departure from the main root ; but becomes more horizontal in the course of growth. In the case of triarch structure following injury one of the apices of the resulting triangle points vertically downwards.

The root architecture is dependent to a high degree upon the number and position of the xylem strands. These materially affect the divergence of the lateral roots, the frequency of occurrence of "sinkers," etc. The growth in length of the main lateral roots depends on the growth energy of the plant, the soil conditions, and above all, on the age. In general, growth in length is complete within the first 20 years of the tree's life. As the rate of growth of main laterals diminishes, the less developed deeper roots (especially in consolidated sand soils) begin to grow more strongly.

Liese draws some important practical conclusions from his observations.

(1) In studies on races of Scots pine the root systems should be investigated. Since all old main lateral roots are derived from those formed in the 1-year seedling and new root formation is of very

infrequent occurrence, it is an important point to know if a plant can put out roots in two or in four directions. The more xylem strands there are in the main root the better will be the distribution of the laterals. Liese's observations showed that those plants with four xylem strands were always the best developed. It is believed that some races may have normally four xylem strands in the tap root, others three and others two.

(2) Those plants will do best which can develop a well branched deep root system during the first few years. The depth at which diarchy of the xylem strands begins in the main root is of great importance, and observations showed that moisture conditions during the first spring were the main determining factor. In unfavourable seasons diarchy might start within 3·15 inches of ground level.

(3) Humus is an important factor in promoting the development of laterals.

(4) Subsequent poor growth may often be traced back to bad planting methods. The roots should be inserted vertically and not at an acute angle, but deep planting is extremely harmful.

Root pruning is recommended before planting.

(*Reviewer's Note.*—Liese's article throws light on some of the failures experienced in this country in raising Scots pine in nurseries, especially on old, worked out and often consolidated arable land. Bad rooting on such areas is notorious. The remedy is to get humus into the soil, to dig deeply and above all to avoid consolidation in seed beds.)

W. H. G.

ZEITSCHRIFT FÜR FORST UND JADGWESEN, APRIL, 1926.

Extraction of Coniferous Seed.

The article contains a description of seed extraction methods by Von Pentz, but does not add much, except by way of confirmation, to what various writers in the *Zeitschrift* have already recommended.

Early cone collection is strongly condemned. Green cones readily become mildewed and heated when stored in bulk, they are difficult to extract, and the seed quickly loses in germinative capacity. Cones should not be stored in large bulk for several weeks or months before extraction if there is lack of proper storage space. Extraction should commence as soon as the first main consignments arrive and so avoid excessive accumulations.

The author again stresses the importance of de-winging the seed dry by machine, and describes a new but simple type of machine which is an improvement on previous patterns.

It is interesting to observe the extreme care which is considered necessary in handling the seed after extraction. Von Pentz advocates not merely storing the seed in glass vessels, but the use of vessels or water-tight boxes for dispatching seed from the extraction station to the forest nurseries. He points out that a loss of only 2 per cent. in the germination of the seed between the kiln and the nursery involves a loss in value of over three times the cost of the containing vessel. In practice, it is probable that much greater losses are often experienced.

W. H. G.

ZEITSCHRIFT FÜR FORST UND JADGWESEN, OCTOBER, 1926.

The Die-off of Oak in Westphalia.

Forstmeister Hey refers in a short communication to the ravages of the oak tortrix in Westphalia. It appears that since 1910–1911 caterpillar attacks have occurred in unbroken succession, defoliating stands of all age classes and causing great destruction. This year, for the first time, the sequence was broken following a frost which occurred in the night of June 15/16th. This frost appears to have killed out the caterpillars, but the trees rapidly recovered, the crowns throwing out fresh foliage. Oak mildew followed the frost in abundance, but attacked mainly epicormic branches, so that, for once, its appearance was welcomed.

It remains to be seen what will happen next year.

W. H. G.

ZEITSCHRIFT FÜR FORST JADGWESEN, MAY, JUNE AND DECEMBER, 1926.

Various Aspects of the Dauerwald Problem.

By Dr. Wiedemann.

In these three critical studies on various aspects of the Dauerwald Problem in relation to Scots pine, Wiedemann continues on his iconoclastic way, demolishing the ground work of supporters of the Dauerwald theories.

In the first article, he discusses the natural regeneration of Scots pine in the neighbourhood of Bärenthoren and proves conclusively that the remarkably free regeneration in that forest is due mainly to soil factors and can be related quite readily to the distribution of certain types of soil in the district. It is not, as Möller contended, a consequence of the special methods of treatment applied at Bärenthoren, and on which the Dauerwald theories have been so largely built up. Wiedemann found that Scots pine regenerates just as readily in forests adjoining Bärenthoren as in that celebrated area itself, provided similar soils are selected for comparison, while nothing could be more different than the respective silvicultural treatments—in Bärenthoren, heavy, though gradual, thinning extending over a long period, with intensive manuring with twigs and branches from the thinnings, and no clear felling; outside Bärenthoren, light thinning, clear felling and no twig manuring.

Wiedemann then deals with the supposed virtue of the so-called half-shade Scots pine, which Wiebecke, Möller and other protagonists of the Dauerwald theory have so strongly upheld. By exact measurements, Wiedemann demonstrates that the effect of partially shading Scots pine by regeneration under old trees is a great reduction in increment although, on the other hand, the young trees are definitely more

slenderly branched and cleaner. Freeing the young trees by removing the mother stems quickly changes the habit of the former, which develop normally into full light trees. Wiedemann's sample trees show that while the height of full light Scots pine (*i.e.*, grown in the open) corresponded to quality II, the half-shade pines were quality IV and the full shade pine quality V. In diameter growth, the shade pines were still further behind. By close planting or sowing, it is possible to raise pine which are just as fine branched as the shade pine, but, growing in full light, have a far higher increment. In addition to the poor increments put on by the half-shade pines, felling and extraction damages involved in the removal of the mother trees must be considered. Wiedemann assesses this damage as very heavy though no figures are given.

Wiedemann's article in the May number of the *Zeitschrift* deals with the width of strip or group fellings in stands of Scots pine. There are many of the Dauerwald School who, though not disposed to adopt a selection or long-term shade regeneration system for Scots pine, yet are strongly opposed to extensive clear fellings and advocate instead regeneration by means of small groups or narrow strips. Wiedemann took measurements in 50 strips, and groups in Saxony and Eastern Prussia, and found that in not a single case was there evidence of improved growth having been produced by the lateral shade. On the contrary, the effect was harmful in almost all cases. As a rule, the young crop failed completely throughout a strip which varied in width from 19 to 25 feet from the old trees, while the injurious effect could often be traced for 50 feet from the standing crop. The damage was worse on fresh, grassy soils than on dry sandy sites, but its extent depended largely on the felling direction. Strips with a north-south or north east-south west felling direction, *i.e.*, those strips in which the sun was shut out, were most affected. Losses were due to drought, smothering by weeds and *Lophodermium*.

Wiedemann points out that in this respect Scots pine behaves in exactly contrary manner to Norway spruce for the climatic region covered by the enquiry, the reason being the very different requirements and response to environmental conditions of the two species. He emphasises the need for a better knowledge of tree physiology.

The edge effect is apparent not only on the shade side of the strip, but also on the open side ; thus, in a 60-foot strip, there may be two backward edges extending together nearly to the middle of the strip, leaving only a narrow central band of normal vigorous growth. In Saxony, strips are usually from 60 to 90 feet wide, with a 4- to 5-year felling period, and Wiedemann's careful measurements show convincingly that such a system has many dangers for Scots pine, and that much increment is lost. The author does not suggest a return to large block clear fellings, but recommends strips not less than 130 to 230 feet in width, with intensive soil cultivation on the lines followed by such men as von Keudell, Spitzenberg and von Schulenburg.

In his third article, in the December number of the *Zeitschrift*, Wiedemann proceeds to demolish an elaborate piece of statistical work by Forstmeister Krutzsch on the current annual increment in

Bärenthoren from 1913 to 1924. One has rarely read a more devastating piece of criticism.

Möller, the founder of the Dauerwald idea, built largely upon the supposed improvement in the increment in the Forest of Bärenthoren, which he held to be the result of the silvicultural methods adopted by the owner. The data for arriving at the increment were obtained from working plan assessments made at different periods in the past. Each assessment was made by a different forest officer, and each time the basis of the work varied considerably. Increment studies on large blocks of woodland are very ticklish matters at the best of times, and Möller's conclusions have been largely discredited as based on faulty data.

Krutzsch recently went over the whole ground again, and added to the material a large number of measurements of existing stands at Bärenthoren from which the volume now on the ground can be fairly accurately determined. To arrive at the increment, however, required an accurate analysis of the data collected in previous revisions, and it is here that Krutzsch appears to have come down. Krutzsch employed for the purpose Schwappach's yield table for Scots pine from 1896, and Wiedemann shows that this yield table was not applicable to the stands at Bärenthoren, and further that the former's method of applying the tables was incorrect in many important respects.

Wiedemann concludes as follows on the basis of the very limited and faulty data available :—" Bärenthoren, with its smaller number of stems per acre and, in part, unaveraged stands, has approximately the same volume increment as a normal Scots pine forest (regenerated by clear felling) of the same quality, and a corresponding distribution of age classes." Such a conclusion, assuming it is correct, certainly does not justify the attempts now being made by German Dauerwald enthusiasts to convert even-aged Scots pine forests into uneven aged crops of the Bärenthoren type.

W. H. G.

THARANDTER FORSTLICHES JAHRBUCH, 1926.

Frost Damage to Spruce.

The most important article contained in last year's publications (now produced monthly) is a very thorough research into the frost danger of spruce in Saxony by Dr. Münch. Although apparently carried out with great care, the investigation does not appear to have produced results of any great practical importance. Frost damage in Saxony is chiefly caused by late frosts occurring in the latter part of May and early in June, and is chiefly confined to " frost holes." These may consist of depressions in comparatively flat land or of the bottoms of very narrow valleys, more particularly in the latter case, where the flow of cold air down the valley is impeded by constrictions. In some areas late frost damage was found to occur so regularly year after year that it has been found almost impossible to raise a crop of pure spruce on clear felled areas.

A very considerable difference was found in the dates on which plants burst their buds. The younger the plant, the sooner it came in leaf, and from this observation it is recommended to plant as old trees as possible in frosty areas. Furthermore, regardless of age, great differences were also found in individual plants, due partly to origin and partly to the individuality of the plants. It is suggested that while plants are still in the nursery they should be observed, and the "late" plants marked so that they may be utilised for frost holes.

The best remedy, however, would appear to lie in never clear-cutting frost holes until the next crop has got a good start in life.

Forestry in Finland.

Dr. Rebel's article on this subject is of great interest. It would appear that since this country became a self-contained state great progress has been made by the forestry department under the direction of Dr. Cajander.

In view of the opinions expressed by certain Members of Parliament in a recent debate which took place in the House of Commons, Dr. Rebel's remarks on the politics of forestry in Finland are worth noting. The Department of Forestry in that country is independent from political interference, and is to a large extent self-contained, having its own funds, its own engineers, architects, exploitation and saw-milling experts and its own research station. The Members of Parliament do not interfere, and their unpractical and idealistic schemes are not allowed to over-rule the sane judgment of those in charge of the Department.

Such a state of affairs Dr. Rebel would like to see in his own country of Bavaria, and to it he ascribes a considerable measure of Finland's successful start in the management of its most valuable national asset—its forests.

The outstanding feature of Finnish forestry from a technical point of view, apart from the well-known and highly valuable facilities for water transport, appears to be the ease with which natural regeneration is obtained, and the author of this article gives special attention to the causes of this state of affairs. In the first place, he ascribes it to suitable geological conditions—the soil being derived largely from old formations, such as granite, gneiss, etc. Further causes are good nitrification, as shown by general presence of such a plant as willow-herb, the youth, geologically speaking, of the glacial deposits, the absence of unsuitable ground vegetation, and the short period of active growth.

The last is worthy of further remark. Dr. Rebel is of opinion that the sudden change from winter to summer favourably affects natural regeneration, as the seedlings when they germinate grow quickly, and get their roots down to the mineral soil, thus avoiding the dangerous spring period which kills so many natural seedlings in Central Europe when the roots are only still in the humus layer.

The question of heather is also of importance. Apparently only 8 per cent. of the country is covered with this plant, and its growth is patchy—occurring in little clumps, and not as a a regular and dense

mass over large areas. This is considered by Dr. Rebel to reduce very much the so-called "Heidekrankeit," with which we are not unfamiliar in this country.

With regard to species, Scots pine, spruce, birch and grey alder are the chief trees found in Finland. Growth does not appear to be rapid, but the pine are free from snowbreak, and are of the northern type, with narrow deep crowns. Spruce also develop crowns of greater depth than would be considered desirable in this country, and require to stand considerably farther apart. Birch is apparently not regarded as a weed species, and has a good market. Furthermore, this species is looked upon as having a distinct silvicultural value in mixture with conifers, which it does not tend to suppress as is often the case in this country.

A. D. HOPKINSON.

REVUE DES EAUX ET FORÊTS, JUNE, 1926.

In an article entitled "Death of Oak" (*Q. pedunculata*) in the forests of Slavonia (Yugoslavia), Dr. Yossofovitch, of the Faculty of Agriculture, Belgrade, describes the serious crisis through which the Slavonian oak forests are passing. For the past 15 years large areas of fine oak have withered and perished, and already more than 50,000 hectares have been decimated. Mortality occurs in very varied conditions of age, soil and situation, and as an instance of the gravity of the trouble, it is stated that in the forests of the commune of Brod the number of dead trees increased from 765 in 1910-11 to 172,663 in 1911-12, and up to the present it is estimated that more than a million cubic metres of oak timber has perished throughout the country.

Opinion is divided as to the causes of the disaster. Generally the trouble is attributed to the caterpillars of the *Liparis dispar* L., the *Liparis chrysorhea* L., and the *Melacosoma neustria* L., and to *Oidium quercina*, but these possible causes do not seem to comprise the whole story, for most of the defoliated trees do not die at once but continue to grow, and finally to die two, three or four years afterwards, a behaviour which cannot be explained simply by reason of the action of the caterpillar or the mould.

The investigator's attention was ultimately directed to the fact that all the dead trees, without exception, had in their roots and even in the lower parts of their stems, the characteristic indications of *Armillaria mellea*. A large number of trees have been examined, both dead and dying, and the conclusion arrived at has been that the oaks died because they had lost their roots through rot following invasion by honey fungus.

The conclusions drawn are that the mortality is the result of successive attacks by the caterpillar and by the *Oidium* (*Microsphæra quercina*) and by *Armillaria mellea*, none of which by itself is calculated to cause such great havoc. The two first parasites enfeeble the vitality of the trees and predispose them to the action of the honey fungus which completes the fell work.

W. L. TAYLOR.

REVUE DES EAUX ET FORETS, DECEMBER, 1926.

An interesting paper is contributed by Mons. J. Molleveaux entitled "The Failure of the Late Oak in Vierzon." The late oak or "chêne de juin," so abundant in the district, is a local variety of the pedunculate oak which has developed the peculiarity of flushing its leaves exceptionally late in the season, a particularly fortunate adaption to the necessities of the neighbourhood, which is both subject and susceptible to late frost on account of exceptional humidity and numerous lakes.

The forest of Vierzon is situated on the borders of Sologne and Berry, on the Paris-Toulouse railway, and extends to 5,300 hectares. Of the existing stocking, 0·9 is oak, of which 0·4 is sessile and 0·5 pedunculate. The pedunculate oak includes the two varieties "early" and "late," the latter being the "chêne de juin."

Since 1908 attacks of *Oidium quercina* have been apparent, varying in severity from year to year, and until 1921 little damage resulted; but two visitations of caterpillar occurred in July, 1920, and mid June, 1921, on a scale never before recorded for the district. The caterpillar is described as 3 to 4 cm. long and 2 to 3 cm. in diameter, of the colour of a dead leaf, hairless, and provided at each extremity with two feet. Upon their appearance in July, 1920, these caterpillars increased so rapidly in numbers that they totally defoliated all the pedunculate oaks ("early" or "late"), especially where the canopy was close. These trees managed to effect the usual second flushing of leaves in August, but were obviously enfeebled and were attacked by mould. The second attack of caterpillar followed in 1921 and was so severe that in general the trees affected were unable to produce a further flush of leaves that year, and they succumbed by thousands. It is admitted that the 1921 drought may have had something (if only a little) to do with this disaster, but it is mentioned as noteworthy that the forest has resisted previous exceptional droughts as those of 1892 and 1893.

Investigation of the root systems of some of the dead trees has failed to disclose parasitic infection, honey fungus was not observed, and the trouble is attributed solely to the ravages of the caterpillars. It is unfortunate that this pest is not specifically identified in M. Molleveaux' paper.

Of great interest to British foresters is the positive declaration that in the parts of the forest attacked by caterpillars the sessile oak was immune, and it is also noted that this species, in high forest, is largely resistant to the mould.

W. L. T.

NOTES AND QUERIES.

Experiment on Weeding Seedlings.

In the spring of 1924 we carried out an experiment to observe the effect of weeding on Corsican pine seedlings. The seed was sown broadcast on a good, though stony, sandy loam, and covered lightly by sifting. The bed was divided into three equal divisions, as follows :—

(A) to be weeded and tended normally ;
(B) to be only partially weeded ;
(C) to be left entirely alone.

We counted the seedlings in July, when the effects of any weeds were hardly noticed. We then found, in round numbers, 10,000 seedlings in each patch.

The following summer it was impossible to count patches (B) and (C) owing to weeds. The most injurious weed was sheep's fescue, but couch-grass, knot-grass, scarlet pimpernel, thistles and sorrel appeared also in considerable quantity.

Finally, in the spring of 1926, the seedlings were lifted, and patch (A) was found to contain 7,000, patch (B) 6,000 and patch (C) 9,000. Thus it will be seen that the unweeded portion produced more plants, but I should like to call attention to the undermentioned observations, as otherwise a wrong conclusion may be drawn.

For weeding.

(1) A much better type of plant is produced.
(2) The greater light enables a large quantity of seed to germinate the second spring.
(3) Counting seedlings is made possible.
(4) The rootlets are much freer and more fibrous.
(5) The seed bed has a much better appearance.

Against weeding.

(1) Losses inevitably occur on account of seedlings being pulled up when weeding.
(2) Seedlings often die in a dry summer, owing to the ground being too loose through weeds being pulled out.
(3) Very expensive.

For non-weeding.

(1) A larger quantity of plants is produced.
(2) A great saving of labour costs results.

Against non-weeding.

(1) Owing to our damp, mild climate, weeds grow all the winter, and consequently cover a greater space than is desirable.
(2) The seedlings were short and very crooked, which made putting them in the boards difficult.
(3) Many buds did not develop into a proper leader.
(4) Counting seedlings is impossible.

Unfortunately, it was not possible to follow the results of the experiment in the lines, owing to the large losses caused by a very disastrous attack of *Lophodermium pinastri*.

D. N. Williams.

Timber Prices in the Midlands.

Largely on account of industrial troubles, the movement of timber in the Midlands during the year has been very restricted. There has been practically no demand for Scots fir, and only a little larch has changed hands at prices as low as 1*s.* per cubic foot. The lack of demand for softwoods still continues. On the other hand, there appears to be a more active market for hardwoods. A parcel of good oak recently sold for 5*s.* per cubic foot, whilst quite moderate oak has made up to 3*s.* and 4*s.* per cubic foot. Enquiries are being made for oak bark at about £6 to £6 10*s.* per ton hatched.

Good ash has been sold at 5*s.* per cubic foot, and poplar at 1*s.* 3*d.* per cubic foot.

An interesting feature of the market is a revival of the demand for brown oak for America, and merchants are actively searching the country for this timber.

A. P. Long.

Saw-Fly Attack at Rendlesham.

Last summer a very serious attack of saw-fly occurred over 1,500 acres of the forest. Trees from 5 years to 8 years old were attacked, and also older groups of Scots pine, 30-35 years old, up to 35 feet high. Ladders were used to aid in the extermination of the saw-fly.

Lophyrus pini were more numerous than *L. rufus*. The first attack began in June last and continued until early August. A second brood appeared in September and early October.

Large quantities of cocoons were collected and destroyed. As many as 57 saw-flies in a cluster were found on a single branch during the first attack, but the autumn attack was less severe, although extending over the same area and in some cases stretching beyond it.

These two attacks extended over 2,400 acres of forest, and the species which suffered were Scots pine and Corsican pine, with a Douglas fir here and there.

In the Tunstall forest area, 7 miles away, only an isolated attack occurred on trees 5-7 years old, but no autumn brood appeared.

Hand crushing of the caterpillers and the collection of cocoons were continuously carried out, the cost amounting to £194.

Large flocks of starlings, rooks, jackdaws, together with smaller birds, greatly assisted in extermination of the saw-fly.

At midsummer the Scots pine most severely attacked presented a dying appearance, and their growth was much retarded in consequence of the saw-fly injury. Later, however, a good recovery was apparent, and the autumn brood being kept in check allowed the trees to continue improving to the end of the season. Only five trees received permanent injury.

C. Hankins.

Spruce Plantations.

When, as has often happened, the stock of Norway spruce in nurseries is in excess of demand, a profitable method of disposing of them might be to plant them out for sale later as Christmas trees. If an area already dedicated to spruce were planted at 2 feet intervals, about three-quarters of the crop could be lifted in five or six year's time. They would sell as rooted Christmas trees at not less than sixpence each.

An acre planted at 2 feet carries 10,890 trees, and at 4 feet 2,722 trees. The difference, *i.e.*, 8,168, might be lifted in five or six years' time, realising £200.

The additional cost of planting at 2 feet intervals instead of 4 feet would certainly not exceed £5 and the additional cost of weeding also would not exceed that sum.

An acre would have to be chosen readily accessible to a road, and of good soil conditions, where a prolonged check would be unlikely. The experiment would only be carried out on a small scale and would depend largely on the excess of Norway spruce plants available. Obviously, some of the plants would fail, but the price obtainable allows for a very large number of dead or unsuitable trees. The resulting crop of spruce at 4 feet spacing should benefit rather than be spoiled by the interplanting.

Where is the catch ? Surely not in the obligation to return low planting costs.

L. A. Newton.

Effect of Sea Air

I am given to understand that, in the Western Isles, it is a recognised fact that trees planted on the seaboard with a western exposure never thrive. The reason for this is attributed to the strong sea air being heavily charged with iodine, which has a deleterious effect on plant life, and stunts its growth.

It would be interesting to know if this is found in other parts and what effect others have found from similar conditions.

A. Inglis.

RANDOM JOTTINGS.

In this unkind world the man who gets things done always seems to get more credit than the unlucky one who, despite desperate efforts, is invariably defeated by insurmountable obstacles.

* * *

One finished job is worth a thousand gilt-edged excuses.

* * *

We all know the car that has made Mr. Henry Ford famous, but his originality and enterprise do not end there: he does not use "Forestry" in the woods whence he draws his timber and where he is planting the components of the aerial "flivver" of 1970; he chooses men who have no knowledge of timber or forestry but have a marked aptitude for controlling labour, and themselves doing exactly what they are told by the very small band of ultra-experts who supervise the whole thing. A new and ingenious idea which provides food for thought—and is apparently very successful!

* * *

A forester or foreman who can differentiate between good and bad workmen is oft-times quite as useful as one who can differentiate between, shall we say, *Hylobius* and *Pissodes*.

* * *

How difficult it is sometimes to remember that we are not a charitable or philanthropic institution, but that we exist to do the maximum amount of work for the minimum outlay, and that in the ultimate issue we shall all be judged by the success or failure of our plantations and by the cost of their establishment!

* * *

It might be helpful if we could all be reminded forcibly and frequently that every time any one of us causes the waste of even a few pence, he is adversely affecting the very work which is his livelihood. Let each one of us think of this next time he finds a plant nibbled by rabbits, cut off in weeding or badly planted, or unnecessary work being done "to find the men something to do."

* * *

The amount of "lead-swinging" and unpunctuality in a forest is a pretty exact measure of just what the forester *has allowed the men "to get away with"*—for they will always "try it on" and find out by experiment just how far they can "make it stick." Some of the best and most intelligent men, potentially the most useful, expend a surprising amount of ingenuity and skill on this, often largely for the sport of the thing. It is an interesting and amusing game, but—the forester must win it!

* * *

An ounce of respect is worth a pound of popularity.

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.

Travelling Officers.

Macdonald, James, District Officer (Sample Plots).
Ryle, G. B., District Officer (Working Plans).

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).

New Forest (*The King's House, Lyndhurst, Hants*).

Osmaston, L. S., Deputy Surveyor.
MacIver, L. E., 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, Victoria Garesfield, Rowlands Gill, Co. Durham*).

Hopkinson, A. D., Divisional Officer.
Mackay, J. H., District Officer.
Ross, A. H. H., District Officer.

Division 2 (*Castle Chambers, Shrewsbury*).

Sangar, O. J., Divisional Officer.
Lowe, G., District Officer.
Fairchild, C. E. L., Probationer District Officer.
De Uphaugh, F. E. B., Probationer District Officer.

Division 3 (51, *Queen Street, Exeter*).

Hanson, C. O., Divisional Officer.
Forbes, R. G., District Officer.
Russell, W. D., Probationer District Officer.

Division 4 (1, *Whitehall, London, S.W.*1).

Felton, A. L., Divisional Officer (acting).
Lovegrove, W. H., District Officer (temporary).
Whyte, J. P. M., Probationer District Officer.

Division 5 (*Bridge House, Santon Downham, Brandon, Suffolk*).

Long, A. P., Divisional Officer.
Ryder, D. C. D., District Officer.

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

SCOTLAND.

Assistant Commissioner's Office (25, *Drumsheugh Gardens, Edinburgh*).
Cameron, J., Acquisition Officer.
Newton, L. A., District Officer (Survey, etc.).

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

North-Eastern Division (156, *Union Street, Aberdeen*).
Annand, J. F., Divisional Officer.
Bird, D. H., District Officer.
Leven, J. K., Probationer 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.
Blair, J. H., District Officer.

FORESTERS.

Name and Address.	*Grade.*	*Forest.*
England and Wales.		
Division 1.		
Price, A.; Low Dalby, Pickering, Yorks.	II ..	Allerston.
Bewick, W. J.; Thrunton, Whittingham, Northumberland.	II	Rothbury.
Laney, H.; Foresters' Lodge, Beck Wythop, Thornthwaite, Keswick, Cumberland.	II	Thornthwaite.
Anderson, J. T.; Craig Villa, Falstone, Northumberland.	II	North Tyne.
Division 2.		
Harrison, P. M.; Castle View, Wigmore, Kingsland, Leominster.	I ..	Mortimer.
Williams, Jack; 2, Cambrian Terrace, Dolgelley, Merioneth.	I ..	Vaughan and Hengwrt.
Clark, J. S.; Pool House, Pottal Pool, Penkridge, Stafford.	II ..	Cannock Chase.
Jones, H. W.; Linmere, Delamere, Northwich, Cheshire.	II ..	Delamere.
Squires, C. V.; Brookbatch, Acton, B'shops Castle, Shropshire.	II ..	Walcot.

Name and Address.	*Grade.*	*Forest.*
England and Wales.		
Shaw, J. L.; Diosgydd Isaf, Bettws-y-Coed, Carnarvonshire.	II ..	Gwydyr.
Anderson, J. W.; Alwyn Cottage, Tynycefn, Corwen, Merioneth.	II ..	Cynwyd.
Harris, W. A.; Chamberlayne Lodge, Arley, Bewdley, Worcestershire.	II	Wyre.
Fraser, R.; Esgairangell, Aberangell, Cemmaes Road, Mont.	II	Dovey.
Divison 3.		
Brown, T.; New Lodge, Chawleigh, Chulmleigh, Devon.	I ..	Eggesford and Halwill.
Edwards, J.; Crown Office, Tintern, Chepstow, Mon.	I	Tintern and Chepstow.
Butter, R.; Underdown, Haldon, Exeter.	I	Haldon.
Kennedy, D.; New Mills, Whitebrook, Chepstow.	II	Tintern.
Wallington, A. W.; Parish's Lodge, Overstowey, Bridgwater, Somerset.	II	Quantocks.
Williams, D. N.; Broadwood Farm, Dunster, Taunton, Somerset.	II	Exmoor.
Dyer, H. C.; Botany Bay, Tintern, Chepstow, Mon.	II	Tintern.
Hollis, G.; 29, West Street, Maesteg, Bridgend, Glam.	II	Margam.
Wallington, H. J.; Mount Ararat, Verwood, Wimborne, Dorset.	II ..	Ringwood.
Colwill, S. W.; Woodlake, Bloxworth, Wareham, Dorset.	II ..	Wareham.
Gosling, A. H.; (Employed on relief at various forests).	II ..	—
Division 4.		
Simpson, A.; Forest Lodge, Alice Holt, Farnham, Surrey.	—	Alice Holt and Woolmer.
Forgan, W.; The Centre, Eversley, Basingstoke, Hants.	I ..	Bramshill.
Butler, R.; Jewsley Cottage, High Street Green, Chiddingfold, Godalming, Surrey.	II ..	Chiddingfold.
Jones, T.; Piddington Lodge, Northampton.	II ..	Salcey.
Nelmes, F.; Prior's Heath, Goudhurst, Kent.	II ..	Bedgebury.

Name and Address.	*Grade.*	*Forest.*
	England and Wales.	
Johnson, A. E.; Park Villa, Stelling, Canterbury, Kent.	II ..	Lyminge.
Cottenham, W.; C/o Mrs. Fox, Woodnewton, Peterborough, Northants.	II	Rockingham and Westhay.
Gulliver, G. H.; Hazelborough Lodge, Syresham, Brackley, Northants.	II	Hazelborough and Brackley.
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.	II ..	Swaffham.
McGlashan, J.; The Nursery, Lynford, Brandon, Suffolk.	II	Thetford.
Tribe, W.; Laughton Lodge, Laughton, Gainsborough, Lincs.	II ..	Laughton.
New Forest Division.		
Aston, O. R. T.; Signal House, Parkhurst Forest, Newport, I. of W.	II ..	Parkhurst.
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.
	Scotland.	
S.E. and W. Division.		
Cameron, Hugh; Inverliever, Ford, Argyleshire.	II ..	Inverliever.
Macintyre, J.; 4, Doncaster Street, Newcastleton, Roxburghshire.	II ..	Newcastleton.
Spraggan, D.; Guithas Cottage, Ardgarten, Arrochar, Glasgow.	II ..	Ardgarten.
Reid, J. M.; Auchindarroch, Duror, Oban, Argyll.	II ..	Glenduror.
Paterson, S. H.; Red Lodge, Barcaldine, Ledaig, Oban, Argyll.	II ..	Barcaldine.

Name and Address.	*Grade.*	*Forest.*
	Scotland.	
Simpson, A. N.; Tulliallan Nursery, Kincardine, Fife.	II ..	Tulliallan Nursery.
Anderson, R. T.; Glenbranter, Strachur, Argyll.	II ..	Glenbranter.
Fraser, A. M.; Aros Mains, Oban, Argyll.	II ..	Salen.
Graham, A.; Eshiels Cottage, Peebles.	II ..	Glentress.
Kennedy, J. A. M.; 38, Maxwell Street, Dalbeattie, Kirkcudbrightshire.	II ..	NewGalloway,Auchenninnes and Screel Hill.
N.E. Division.		
McEwen, J.; Teindland Cottage, Orton, Morayshire.	Head	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, Hayton Road, Woodside, Aberdeen.	II ..	Seaton Nursery.
Mitchell, F. M.; c/o Kennedy, Kintessack by Forres, Morayshire.	II ..	Culbin.
Robbie, J. D.; c/o Davidson, The Crook, Alves, Forres, Morayshire.	II ..	Monaughty.
N. Division.		
Cameron, J.; Auchterawe, Fort Augustus, Inverness-shire.	Head ..	Inchnacardoch and Portclair.
Watson, H.; Beaufort School, Kiltarlity, Beauly, Inverness-shire.	I ..	Beaufort.
Anderson, W.; Polloch House, Glenfinnan, Inverness-shire.	I ..	Glenhurich.
Warren, A.; Beaufort School, Kiltarlity, Beauly, Inverness-shire.	I ..	Beaufort.
Mason, W.; Nevis, Fort William, Inverness-shire.	II ..	Nevis.
McEwan, J.; Portclair, Invermoriston, Inverness.	II ..	Portclair.
McClymont, W.; Craig Cottage, Achnashellach, Ross-shire.	II ..	Achnashellach.
Mackay, K.; Slattadale, Achnasheen, Ross-shire.	II ..	Slattadale.

Name and Address.	*Grade.*	*Forest.*
	Scotland.	
MacAlpine, J. A. ; Ratagan, Glenshiel, Kyle, Ross-shire.	II	Ratagan, Glenshiel and Inverinate.
Murray, W. ; Shore Street, Strome Ferry, Ross-shire.	II	North Strome and South Strome.
Macintosh, W. ; Aultsigh Cottage, Invermoriston, Inverness.	II	Craig nan Eun.
Gunn, J. ; Auchterawe, Fort Augustus, Inverness-shire.	II	Inchnacardoch.
Rose, A. ; Smithton, Culloden, Inverness.	II	Culloden.
	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	—

REGISTER OF IDENTIFICATION NUMBERS.

Forest Year, 1926.

The order of arrangement is as follows :—

Serial number (preceded by the last two numbers of the forest year in which supplies were received); quantity; species; crop year; origin; vendor.

26/1 202 lbs.; *Larix europaea*; 1925; Austria (Cavalese, altitude 4,265 feet); J. Stainer.

26/2 294 lbs.; *Larix europaea*; 1924; Austria (Cavalese, altitude 3,281-5,269 feet); A. Grunwald.

26/3 10,433 lbs.; *Quercus sessiliflora*; 1925; Bavaria; H. Keller Sohn.

26/4 14 ozs.; *Pinus sylvestris hamata*; Jan., 1925; Russia (Borzham, altitude 3,500 feet); gift from Russian Government.

26/5 536 lbs.: *Pinus sylvestris*; 1925; England (East); own collection, extracted at Santon Downham.

26/6 4 ozs.; *Picea sitchensis*; 1925; U.S.A. (Washington, Olympic Mountains, altitude 200 feet); gift from U.S. Forest Service.

26/7 8 ozs.; *Picea sitchensis*; 1925; U.S.A. (Oregon, Coast Mountains, Siuslaw, altitude 150 feet); gift from U.S. Forest Service.

26/8 8½ lbs.; *Pinus pinaster*; 1925; Portugal (Leiria); gift from Portuguese Government.

26/9 3 ozs.; *Pinus sylvestris nevadensis*; 1925; Spain (Sierra Nevada); gift from Spanish Forest Service.

26/10 3 ozs.; *Picea sitchensis*; 1925; U.S.A. (California, Siskiyou, altitude 200 feet); gift from U.S. Forest Service.

26/11 21 lbs.; *Pinus insignis*; 1925; U.S.A.; T. J. Lane.

26/12 6¾ lbs.; *Pinus Peuke*; 1925; N.E. Macedonia; W. Kraus.

26/13 2 ozs.; *Pseudotsuga Douglasii*; 1925; U.S.A. (Oregon, Crater National Forest, altitude 4,300 feet); gift from U.S. Forest Service.

26/14 2 ozs.; *Pseudotsuga Douglasii*; 1925; U.S.A. (Washington, Chelan National Forest, altitude 1,100 feet); gift from U.S. Forest Service.

26/15 200 lbs.; *Pseudotsuga Douglasii*; 1925; U.S.A. (Washington Coast); The Manning Seed Co.

26/16 1,184 lbs.; *Larix leptolepis*; 1925; Japan; Yokohama Nursery Co.

26/17 6,736 lbs.; *Pinus sylvestris*; 1925; England (East); own collection, extracted at Alice Holt.

26/18 29 lbs.; *Quercus Mirbeckii*; 1925; Morocco (Atlas Country); gift from French Forestry Service.

26/19 22 lbs.; *Pinus montana* var. *uncinata*; 1925; France (Pyrenees, Mont Louis); gift from French Forestry Service.

26/20 268 lbs.; *Larix europaea*; 1924; Switzerland (Vintschgau); J. Roner.

26/21 4 lbs.; *Pinus montana* var. *pumilio*; 1925; Switzerland; J. Roner.

26/22 22 lbs.; *Cupressus macrocarpa*; 1925; U.S.A.; T. J. Lane.

26/23 2,285 lbs.; *Pinus Laricio*; 1925; France (Corsica); J. Grimaldi.

26/24 17 lbs.; *Alnus incana*; 1925; Austria; A. Grunwald.

26/25 596 lbs.; *Picea sitchensis*: 1925; U.S.A.; The Manning Seed Co.

26/26 991 lbs.; *Pinus Laricio*; 1925; France (Corsica); O. J. Rossi.

26/27 976 lbs.; *Fagus sylvatica*; 1925; Austria (Carpathian Mountains); J. Rafn.

26/28 195 lbs.; *Quercus rubra*; 1925; Holland; J. Rafn.

26/29 30 lbs.; *Pinus canariensis*; 1925; Canary Islands; J. Rafn.

26/30 23 lbs.; *Pinus insignis*; 1925; California; J. Rafn.

26/31 ½ lb.; *Picea pungens*: 1925; U.S.A. (Rocky Mountains); J. Rafn.

26/32 12 ozs.; *Pinus densiflora*; 1925; Japan (Seoul, Corea); gift from Japanese Government.

26/33 10 ozs.; *Pinus densiflora*; 1925; Japan (Ibaraki); gift from Japanese Government.

26/34 9 ozs.; *Pinus koraiensis*; 1925; Japan (Hōzan, Corea); gift from Japanese Government.

26/35 7 ozs.; *Pinus Thunbergii*, Parl.; 1925; Japan (Ibaraki); gift from Japanese Government.

26/36 5 ozs.; *Pinus Thunbergii*; 1925; Japan (Honmyoji, Kumamoto); gift from Japanese Government.

26/37 4 ozs.; *Pinus Thunbergii*, Parl.; 1925; Japan (Noshiro); gift from Japanese Government.

26/38 2 ozs.; *Pinus Thunbergii*; 1925; Japan (Kumamoto); gift from Japanese Government.

26/39 4 ozs.; *Pinus densiflora*; 1925; Japan (Honmyoji, Kumamoto); gift from Japanese Government.

26/40 1 oz.; *Pinus densiflora*; 1925; Japan (Honmyoji, Kumamoto); gift from Japanese Government.

26/41 6 ozs.; *Larix leptolepis*, Gord.; 1925; Japan (Nagano); gift from Japanese Government.

26/42 5 ozs.; *Larix dahurica*, Carr., var. *Principis-Ruprechtii*; 1925; Japan (Hōzan, Corea); gift from Japanese Government.

26/43 1 oz.; *Chamaecyparis pisifera*; 1925; Japan (Yatsugadake, Shinano); gift from Japanese Government.

26/44 ½ oz.; *Abies holophylla*, Max.; 1925; Japan (Kōryō, Corea); gift from Japanese Government.

26/45 ½ oz.; *Pinus funebris*; 1925; Japan (Mōzan, Corea); gift from Japanese Government.

26/46 4 ozs.; *Larix Kaempferi*; 1925; Japan (Nagano); gift from Japanese Government.

26/47 730 lbs.; *Pinus maritima*; 1925; France (Landes); Vilmorin-Andrieux.

26/48 112 lbs.; *Juglans regia*; 1925; Central France; Vilmorin-Andrieux.

26/49 1,900 nuts; *Juglans nigra*; 1925; France; Vilmorin-Andrieux.

26/50 1,182 lbs.; *Picea sitchensis*; 1925; Canada (Queen Charlotte Islands, British Columbia); Canadian Government.

26/51 69 lbs.; *Pseudotsuga Douglasii*; 1925; Canada (Shusway Lake, British Columbia, elevation 1,700 feet); Canadian Government.

26/52 3 lbs.; *Pseudotsuga Douglasii*; 1925; Canada (Coastal Region and Vancouver); Canadian Government.

26/53 9 lbs.; *Pinus ponderosa*; 1925; Canada (Kamloops, British Columbia); Canadian Government.

26/54 264 lbs.; *Pinus sylvestris*, var. *rigensis*; 1925; Latvia (Selburg, elevation 390 feet); Latvian Ministry of Agriculture.

26/55 55 lbs.; *Larix europaea*; 1924; Silesia (Sudeten); A. Gebauer.

26/56 1,116 lbs.; *Castanea vesca*; 1925; Jugoslavia; A. Grunwald.

26/57 20 lbs.; *Thuya plicata*; 1925; Canada (Fraser Valley, British Columbia); Canadian Government.

26/58 206 lbs.; *Pinus contorta*; 1925; Canada (Alberta); Canadian Government.

26/59 6 lbs.; *Pinus ponderosa*; 1924; Canada (North Kamloops, British Columbia); gift from Canadian Government.

26/60 3 lbs.; *Pinus ponderosa*; 1923; Canada (Long Lake, British Columbia); gift from Canadian Government.

26/61 2 lbs.; *Pinus ponderosa*; 1923; Canada (Salmon River, British Columbia); gift from Canadian Government.

26/62 572 lbs.; *Castanea vesca*; 1925; England (East); own collection.

26/63 7 lbs.; *Pinus maritima*; 1925; England (East); own collection.

26/64 2½ lbs.; *Pinus Banksiana*; 1925; England (East); own collection.

26/65 1 lb.; *Fagus sylvatica*; 1925; England (East); own collection.

26/66 3½ lbs.; *Juglans regia*; 1925; England (East); own collection.

26/67 1 lb.; *Pinus Laricio*; 1925; England (East); own collection, extracted at Brandon.

26/68 92 lbs.; *Acer Pseudoplatanus*; 1925; England (East); own collection.

26/69 6,140 lbs.; *Quercus pedunculata*; 1925; England (East); own collection.

26/70 50 bushels; *Quercus pedunculata* and *Quercus sessiliflora*; 1925; England (East); own collection.

26/71 20 bushels; *Fraxinus excelsior*; 1925; England (East); own collection.

26/72 244 lbs.; *Castanea vesca*; 1925; England (North); own collection.

26/73 236 lbs.; *Pinus sylvestris*; 1925; England (North); own collection.

26/74 92 lbs.; *Acer Pseudoplatanus*; 1925; England (West); own collection.

26/75 166 lbs.; *Castanea vesca*; 1925; England (West); own collection.

26/76 896 lbs.; *Quercus sessiliflora*; 1925; England (West); own collection.

26/77 2 lbs.; *Juglans* (? *nigra*); 1925; origin unknown; J. C. Wheeler & Co., Gloucester.

26/78 357 lbs.; *Pinus sylvestris*; 1925; Scotland (East); own collection, extracted at Seaton.

26/79 5 lbs.; *Pinus sylvestris*; 1925; origin unknown; Moray Estates Development Co.

26/80 6½ lbs.; *Pinus sylvestris*; crop year unknown; Scotland; Altyre Estate.

26/81 4½ bushels; *Pinus sylvestris*; crop year unknown; Scotland (East); G. J. Cameron, Newtown St. Boswells.

26/82 3 lbs.; *Thuya plicata*; crop year unknown; Scotland; Altyre Estate.

26/83 4½ lbs.; *Thuya plicata*; 1925; Scotland (East); Altyre Estate.

26/84 5 lbs.; *Larix leptolepis*; crop year unkown; origin unknown; Landowners' Co-operative Forestry Society, Edinburgh.

26/85 3 lbs.; *Larix europaea*; crop year unknown; Scotland; Altyre Estate.

26/86 4 lbs.; *Abies nobilis*; crop year unknown; Scotland; Altyre Estate.

26/87 2 lbs.; *Cupressus Lawsoniana;* crop year unknown; Scotland; Altyre Estate.

26/88 65 lbs.; *Acer Pseudoplatanus;* crop year unknown; Scotland (East); own collection, extracted at Tulliallan.

26/89 17 lbs.; *Fraxinus excelsior;* crop year unknown; Scotland (East); own collection, extracted at Tulliallan.

26/90 11,700 transplants (18–36 inches); *Fraxinus excelsior;* crop year unknown; origin unknown; English Forestry Association.

26/91 4,000 transplants (2 + 2); *Fraxinus excelsior;* crop year unknown; origin unknown; Sir Francis Acland.

26/92 212,000 seedlings (3 years); *Fagus sylvatica;* crop year unknown; origin unknown; St. Giles Estate, Wilts.

26/93 20,000 transplants (2 + 1); *Fagus sylvatica;* crop year unknown; origin unknown; St. Giles Estate, Wilts.

26/94 12,500 transplants (10–14 inches); *Fagus sylvatica;* crop year unknown; origin unknown; J. O. Boving, Tring.

26/95 30,000 transplants (2 + 1); *Fagus sylvatica;* crop year unknown; origin unknown; English Forestry Association.

26/96 8,000 transplants (1 + 3); *Fagus sylvatica;* crop year unknown; origin unknown; English Forestry Association.

26/97 2,000 transplants (2 + 1); *Fagus sylvatica;* crop year unknown; origin unknown; Sir Francis Acland.

26/ 98 11,760 transplants (2 + 2); *Pseudotsuga Douglasii;* crop year unknown; origin unknown; Sir Francis Acland.

26/ 99 19,000 transplants (2 + 2); *Pinus Laricio;* crop year unknown; origin unknown; Sir Francis Acland.

26/100 20,000 transplants (2 + 1); *Pinus Laricio;* crop year unknown; origin unknown; Lovat Estates, Beauly.

26/101 65,000 transplants (12–30 inches); *Larix leptolepis;* crop year unknown; origin unknown; J. E. Dalgliesh, Market Weighton.

26/102 12,000 transplants (2 + 1); *Larix leptolepis;* crop year unknown; origin unknown; F. J. Green, Tring.

26/103 30,000 transplants (6–12 inches); *Larix leptolepis;* crop year unknown; origin unknown; J. O. Boving, Tring.

26/104 68,000 transplants (2 + 1); *Larix leptolepis;* crop year unknown; origin unknown; J. O. Boving, Tring.

26/105 60,000 transplants (3 + 2); *Larix leptolepis;* crop year unknown; origin unknown; J. O. Boving, Tring.

26/106 32,400 transplants (2 + 1); *Larix leptolepis;* crop year unknown; origin unknown; W. Treseder, Ltd., Cardiff.

26/107 20,000 transplants (2 + 1); *Larix leptolepis;* crop year unknown; origin unknown; Manchester Corporation Waterworks, Thirlmere.

26/108 20,000 transplants (2 + 2); *Larix leptolepis;* crop year unknown; origin unknown; Manchester Corporation Waterworks, Thirlmere.

26/109 2,000 transplants (2 + 2); *Larix leptolepis;* crop year unknown; origin unknown; Duke of Somerset.

26/110 600,000 seedlings (1 year); *Pinus sylvestris;* crop year unknown; origin unknown; F. J. Green, Tring.

26/111 8,400 transplants (2 + 2); *Castanea vesca;* crop year unknown; origin unknown; W. Treseder, Ltd., Cardiff.

26/112 4,000 seedlings (2 years); *Castanea vesca;* crop year unknown; origin unknown; Holkam Estate.

26/113 3,000 transplants (9–24 inches); *Castanea vesca;* crop year unknown; origin unknown; English Forestry Association.

26/114 10,000 transplants (2 + 1); *Larix leptolepis;* crop year unknown; origin unknown; B. Reid & Co., Aberdeen.

26/115 20,000 transplants (2 + 2); *Larix leptolepis;* crop year unknown; origin unknown; Howden & Co., Inverness.

26/116 17,700 transplants (2 + 2); *Larix leptolepis;* crop year unknown; origin unknown; Dreghorn Nursery.

26/117 3,000 transplants (2 + 1); *Larix leptolepis;* crop year unknown; origin unknown; Dreghorn Nursery.

26/118 150,000 seedlings (2 years); *Pinus sylvestris;* crop year unknown; Scotland; Dreghorn Nursery.

26/119 10,000 seedlings (2 years); *Pinus sylvestris;* crop year unknown; France; Dreghorn Nursery.

26/120 200,000 seedlings (2 years); *Pinus sylvestris;* crop year unknown; Scotland (East); F. J. Tennant, Innes.

26/121 15,000 seedlings (2 years); *Pinus sylvestris;* crop year unknown; Scotland (West); Arran Estates

26/122 4,000 transplants (2 + 2); *Picea sitchensis;* crop year unknown; origin unknown; Dreghorn Nursery.

26/123 70,000 transplants (2 + 2); *Picea sitchensis;* crop year unknown; Scotland (East); Landowners' Co-operative Forestry Society, Edinburgh.

26/124 20,000 transplants (2 + 2); *Picea sitchensis;* crop year unknown; origin unknown; Howden & Co., Inverness.

26/125 18,000 transplants (2 + 3); *Picea sitchensis;* crop year unknown; origin unknown; North of Scotland College of Agriculture.

26/126 1,900 transplants (3 + 3); *Cupressus Lawsoniana;* crop year unknown; origin unknown; North of Scotland College of Agriculture.

26/127 4,000 transplants (3 + 3); *Thuya plicata;* crop year unknown; origin unknown; North of Scotland College of Agriculture.

26/128 1,000 seedlings (3 years); *Abies nobilis;* crop year unknown; origin unknown; North of Scotland College of Agriculture.

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