JOURNAL

OF THE

FORESTRY COMMISSION.

No. 4: APRIL, 1925.

Editing Committee:

R. L. ROBINSON,
A. W. BORTHWICK,
H. A. PRITCHARD,
FRASER STORY.

CONTENTS.

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EDITORIAL.

Forest Policy.

A MARKED improvement and consolidation was effected in respect of Forest Policy during 1924. Early in the year the Commissioners presented a Memorandum to Mr. MacDonald's Government urging the necessity of getting back to the Acland Planting Programme (150,000 acres at an expanding rate, in the first 10 years) and proposing the establishment of forest workers' holdings in connection with afforestation operations. The Government accepted the proposals so far as they applied to the financial year 1924–25, and by means of a Supplementary Estimate for £275,000 made provision for the increased expenditure entailed thereby.

The five-year term of office of the Commissioners expired on November 28th, and they were reappointed *en bloc.* It was at the same time intimated that unless some unforeseen circumstances intervened, the expanding Acland programme and the new forest holdings policy would be maintained by Mr. Baldwin's Government.

By Order in Council under the Forestry (Transfer of Woods) Act, 1923, the chief Crown Woods and Forests (including New and Dean Forests, Tintern Woods, &c.) were transferred to the Forestry Commission. From January 1st, 1925, the Office of Woods and Forests ceased to exist as such, and became the Office of Crown Lands.

Census of Production of Home-grown Timber.

THIS year a census is being taken of all British industries and the production of home-grown timber is one of the subjects of enquiry. With a view to ascertaining the quantity, value and species of timber felled during the twelve months ending September last, schedules will shortly be issued by the Forestry Commission to woodland owners. This is the first census of the kind undertaken by the Commission, the somewhat similar enquiries of 1908 and 1913 having been conducted by the Board of Agriculture. It may be expected to prove very useful as a statistical record to be linked up with the Census of Woodlands, the completion of which now becomes a matter of urgency.

THE Journal germinated three years ago. It is therefore now emerging from the nursery stage, and like a young tree, if it is to obtain a firm root-hold and expand its leaves these leaves must be fed, and the more varied the diet the better. It is felt that a good deal of "wholesome meat," as they would say in America, is lost through a certain natural diffidence or reluctance on the part of young writers to commit their views, experiences and observations to print.

A word to the young Contributor.

Shade and shelter in forestry in the proper place are excellent things, but to hide his light under a bushel through want of confidence is not to be recommended in the case of the forester. A young writer is apt to think that unless he can present a paper written in the most approved literary style, in flowing language, all duly phrased and punctuated, it would be of no use; but such is not the case. On the contrary it is the facts and first-hand observations that count. It is the function of the Editors to do any dressing and trimming that may be required.

NOTES ON FORESTRY IN SWITZERLAND.

During a holiday tour in Switzerland and Northern Italy last summer I visited forests near Zürich, Chur, Zernez, Münster and Cavalese.

Zürich.

At Zürich I was fortunate enough to meet with Dr. H. Burger, of the Swiss Forestry Research Institute. Dr. Burger conducted me over the forest garden and showed me some of the research work on which he is engaged at present. The Scots pine investigation begun in 1907 with seeds from various countries, has reached an interesting stage, and hereditary tendencies are evident. Under the conditions obtaining at Zürich *Pinus sylvestris* from Riga seems to be the most promising of the pines, both as regards rate of growth and form of stem. Plants from Belgian seed grew best in the early years, but are now yielding less successful results. Seed from crippled, badly-grown Swiss trees gave rise to distinctly malformed trees which still show no sign of improvement.

There were many beds of pedunculate and sessile oak in pairs side by side, and these showed clearly in the case of *Q. pedunculata* the strong tendency to the production of lammas shoots which, however, had been attacked by mildew. *Q. sessiliflora* produces comparatively few of these late summer shoots, and to this may be attributable its comparative freedom from the pest.

Dr. Burger gave me some information about the European larch and drew attention to some of the results of Professor Engler's investigations. He advised me to see Mr. Enderlin, of Chur, who is an authority on the species, and he gave me a letter of introduction to him.

On telling Dr. Burger that we were endeavouring to get seed of the erect-growing mountain pine he said that, although the tree occurred in considerable numbers in the Lower Engadine, he was afraid that the seeds from that region might not be free from suspicion owing to the close proximity in which they stand to the common mountain pine. He expressed the opinion that it would be advisable to obtain the seed from the Pyrenees.

Very interesting graphs have been prepared recently at the Swiss Research Station showing the duration and progress of growth (over a number of years) of the commoner conifers. Measurements were taken each two days and results have been correlated with the prevalent weather conditions. In the case of the same species of tree from different sources the height growth seems to depend very largely on the length of the growing season at the place of origin, for example, spruce from a high elevation completes its growth a month or two earlier than spruce from a low elevation, and there is a more or less corresponding reduction in length of shoot.

Dr. Burger recently completed an investigation into the physical properties of soil. These have led him to the conclusion that there is a fundamental difference between agricultural soil and forest soil. Forest soil has a distinct structure built up by the action of vegetation and bacteria, but agricultural soil being worked from time to time cannot be said to have any definite structure, and once soil is broken up it takes a remarkably long time to regain its former condition. This is one reason why it is considered that natural regeneration by avoiding the disturbance of the soil is preferable to clear felling with subsequent replanting. Nowadays in Switzerland comparatively little restocking is done by artificial means.

Chur.

At Chur I met Forstinspektor F. Enderlin. It was interesting to hear from this forest officer, who was closely associated with the late Professor Engler and has made a life-study of the larch, that he was in many ways baffled by the peculiarities of that species. As he said, one can make fairly definite statements about, say, spruce and silver fir as regards their likes and dislikes and their behaviour under given circumstances, but not so larch, which very frequently acts contrary to expectation and remains more or less of a puzzle. In Switzerland it reaches its best development in the Engadine and at Burgwald (Gemeinde Valendas) it attains a maximum height of 50 metres (160 feet), but little, if anything, can be said definitely of the tree's preference in respect of aspect, climatic conditions and soil requirements. He suggested that most probably it would be advisable to obtain seed for use in Great Britain from moderate or even low elevations in Switzerland. This information was confirmed by others with whom I discussed the question.

Mr. Enderlin informed me that Danish foresters had recently visited Switzerland with a view to obtaining larch seed from the most suitable localities, and had come to the conclusion that for Denmark the seed should be taken from an elevation of not more than 750 metres (about 2,500 feet).

Zernez.

Proceeding to Zernez, in the south-east of Graubünden I spent a day or two with Oberförster Campel and Mr. Bezzola, of Roner's. The village of Zernez, at an elevation of 5,000 feet, is situated on the River Inn about 20 miles north-east of St. Moritz. It is in the heart of the Swiss larch district, and has the driest climate in Switzerland, the precipitation, including snow, amounting to only 80 cm. per annum. The winter is long and severe, larch needles not making their appearance before nearly the middle of June, and falling from the trees in October. Practically all the trees are conifers, consisting of larch, spruce, Cembran pine, Scots pine (*Pinus sylvestris var. engadinensis*), and mountain pines (*Pinus montana* and *P. montana uncinata*), there are no broad-leaved trees of any importance. Even the birch, rowan and mountain alder, although often present, take quite an inconspicuous place in the forest vegetation. There are no beech, silver fir or hornbeam—spruce is the only shade-bearer. An interesting forest map, which was kindly given to me by Mr. Campel, showed that there is a good deal of larch in the lower and again in the higher situations. Mixed forests of spruce, larch and pine occupy the slopes up to nearly

7,000 feet elevation, above which Cembran pine and larch continue the forest up to the limit of tree growth. Single larches are found up to 2,400 metres (8,000 feet).

Between Zernez and the Ofen Pass there are considerable stretches of practically pure *Pinus montana uncinata* where the tree grows to a height of about 50 feet or so, with a straight clean stem frequently about 1 foot in diameter at breast height. It occurs principally at elevations of about 5,500 to 6,500 feet, being succeeded above this elevation by the creeping form of mountain pine. Throughout the whole of the forest of *P. uncinata* there are occasional trees of a prostrate form.

The Zernez forests are worked on a rotation of 180–200 years. In altitudes from 5,500–7,500 feet larch is frequently the dominating species. Locally it attains greater height growth than any of the other trees, but seldom more than 80–90 feet, and, of course, usually much less. In productive capacity the larch is much inferior to the spruce, yielding, as it does, less than half the volume of timber per acre per annum.

Münster.

Mr. Bezzola accompanied me to Münster, where the seed-kiln owned by him is situated. The place was closed for the summer months, but Mr. Bezzola was good enough to open it for my inspection, and I was very favourably impressed with all that I saw. The seed-kiln is not a large one, but it is quite well equipped for its purpose, and during all the operations connected with the extraction of the seed Mr. Bezzola personally superintends and takes part in the work. The apparatus is of the usual type used on the Continent. In the heating chamber the cones are spread out to a depth of about 2½ inches in wooden trays. The cones when opened are transferred to a cylindrical revolving drum, where the seed is separated from the cones. After sifting and riddling, the seed is cleaned by fanners and then passed through a special process in order to get rid of the smallest seeds, these being usually infertile. It is claimed that in two respects the methods employed at Münster are superior to others :—

(1) No water is used in any of the operations. The cones are not damped nor are the seeds of pine and spruce sprayed in separating the wings from the seed.

(2) The removal of minute seeds is a direct gain, reducing weight and increasing the percentage of germination.

Larch seed is extracted exactly in the same way as pine or spruce seed except that the cones are kept in the heated chamber about twice as long as those of other species, and they are also given a much longer time in the revolving cylinder. There is no tearing apart of the scales of the cones by means of projectors, rakes, &c., inside the cylinder ; the cones are merely left to rub against one another while being tossed about, the friction thus created gradually wears down the ends of the cone scales and the seeds are free to drop out.

In the forests around Münster the larches were bearing a good crop of cones, but higher up the valley, *i.e.*, at elevations over 4,000 feet, the trees last summer were entirely unproductive.

Cavalese.

I went to Cavalese because it is in the centre of the larch district on the Italian side. The village stands at an elevation of 3,800 feet, and is situated close to the Dolomites in the middle of the Fiemme valley between Auer and Predazzo.

Although larch grows well in this district it does not seem to possess any particular advantage over the Münster valley. There is, however, a considerable stretch of country and a chain of mountains between the two places, so that if certain seasons should prove unfavourable to the production of cones in one of the valleys there is always the possibility that good seed may be procurable in the other, consequently it is well to bear in mind this alternative source. The forests near Cavalese occur at practically the same elevation as those at Münster.

Throughout Switzerland, North Italy and Austria the crop of spruce cones was quite exceptionally heavy last year, and as already mentioned, larch seed was abundant below an elevation of 4,000 feet.

FRASER STORY.

SEED EXTRACTION.

During a number of past seasons it has been my privilege and part duty to extract pine and coniferous seeds on a large scale at a central depot where consignments of seed cones, collected over a wide area, were received and dealt with. It will no doubt be interesting to sylvicultural enthusiasts and foresters generally, and especially to those who have not come into direct contact with the operations, or had actual experience of seed extraction, to know something of the method that has been adopted and proved successful.

The following are the heads of operations comprising the whole working :—

1. The gathering of seed cones, collection to the home depot; packing and labelling for dispatch.
2. Transport to railway station.
3. Railway freight to central depot station.
4. Transport to extracting depot or kilns.
5. Seed extraction proper, viz., firing, charging, extracting, damping, rubbing, cleaning, &c.
6. Testing, classifying, numbering for identification, packing, labelling, &c.
7. The distribution of clean seeds, transport to out-station, railway freight and delivery to its destination.

Passing reference will be made to these as the subject progresses.

The use of a hop kiln of modern structure was obtained. On the ground floor were three large furnaces separated by intermediate walls, forming three " airs " or " kilns " proper, having a second floor structure of lath and battens, above which is fixed a strong porous hair cloth. On the first floor was contained on the one side the full length of the building, the store-gallery, where consignments of seed cones were placed in order of receipt for examination, identification, measuring and charging into the kilns. On the further parallel side of the building was the " clearing floor," upon which the kilns were discharged for the actual extraction of the seed, treatment, hand rubbing, drying, cleaning, weighing and packing. Between these two compartments, running parallel the full length of the building, raised some 6 feet above the first floor level and reached by broad ladder steps to each " air," were the kilns already referred to, of square formation of floor. These were worked in rotation and charged from the store-gallery side, and after " firing " discharged to the clearing floor on the further side.

The method of " charging " the kilns varies little with regard to species, but the more common Scots pine seed cones may be taken as generally illustrative. Measured by imperial bushel—old and useless cones being thrown out when detected—these were laid 4–5 inches deep on porous hessian sheets, over the permanent porous haircloths, each consignment being carefully separated by old sacks and rolls of old hessian sheeting. The hessian sheets were sufficiently porous to allow a free current of hot air from the furnaces below to percolate through haircloth, hessian sheets and layer of seed cones, yet not wide enough in texture to allow seeds to fall through. Each kiln held an average charge of 100 imperial bushels, so that when in full working 300 imperial bushels were being dealt with at one time in varying stages of treatment, each kiln yielding 60–70 lb. of good seed. The charge being laid and details of species, quantity, consignor and place of collection entered upon the "charge sheet," the furnace was lit, the best clear burning anthracite coal being used, the starting temperature duly noted, usually 50° Fahr. The charge was subjected to a steady rise in heating, and recorded every three hours, until 120° Fahr. was reached, which has been proved a reliable limit, though if run to 125° and not maintained there would follow no injury to germination, but it is wise to keep to the 120° limit on a graduatory scale.

The period of completing the "firing" of the charge depends greatly on the prevailing weather and the time of the year. For instance, it takes much longer in December and January than in March and early April, the period approaching the natural opening of the seed cones. As soon as the temperature approaches 80° or 90° and the hot air rising steadily the seed cones begin to "speak" under its benign influence, and as the heat increases this susurrus activity becomes more marked as the seed cones open and expand their whorls, which expansion, when the charge is completed, is fully three times the depth of the original layer of seed cones. When the seed cones become "silent" the charge is fired and is ready for discharge to the clearing floor, each consignment being dealt with separately. This consists of shovelling the dried seed cones into riddles manipulated by workmen, and with steady shaking the seed is separated from the cones which are thrown into baskets and removed. The seed is carefully swept together and levelled out two or three inches deep, and slightly damped by a fine spraying watering pan to loosen the seed wing and left to react for a little time, when it is steadily and carefully rubbed by hand, spread out in a thin layer to dry, then passed through the cleaning machine, which not only cleans the seed but completes the drying process also, resulting in clean seed ready for testing, weighing, packing, numbering for identification and distribution. It is essential at this stage that the clean seed be kept thoroughly dry and frequently moved to prevent clinging and mildew, as in bulk is not a natural condition. It is very sensitive, and the prevailing weather has a marked effect upon it, so much so that I am convinced no seed can be accurately weighed, as with regard to weather and season it will vary quite easily 10 per cent. Each consignment forming the charge is thus dealt with, and the yield of clean seed entered upon the charge sheet and so recorded in rotation.

With the exception of Sitka most other generally known pines and coniferous seed cones have been dealt with, including Norway spruce, Corsican pine, Austrian pine, Douglas (Oregon) fir, Maritima, Pinea, Indian cedar, Macrocarpa, &c., to which the general process applies, as also the European larch seed cones up to the point of firing. Larch cones require somewhat special treatment in that a steady rising heat must be obtained and maintained at 120° Fahr., and during the last hour or so at 125°, and discharged steadily into a crushing machine while the cones are fully expanded and hot. If allowed to cool they partially close and become tough and leathery, and will not readily yield to crushing or flailing. In the crushing process—in which was used a close set oil-cake crusher—flailing and riddling, it follows there is much more dust and small chips intermixed with the seed, on account of which it takes much longer to clean, even with special shakers in the cleaning machine.

I would here refer to the preliminary operations already mentioned.

1. *The Gathering and Collection of Seed Cones to the Home Depot.*—Consignments received have been generally of a very high order resulting in a good yield and an excellent germination well over 90 per cent., in some instances 97 and 98 per cent. Unfortunately it has also to be recorded that it has not been unusual to receive old, spent and immatured cones; to quote an extreme case, 100 bushels did not yield 1 lb. of seed, with consequent loss of labour, transport, freight, &c., and also increasing the costs of working on the whole turnover of clean seed, therefore, care should be exercised that only matured cones of the current forestal year be collected; also the term "bushel" appears to vary in capacity according to locality. The legal imperial bushel has been applied at the extracting kilns and the results arrived at are on this basis; accordingly Scots pine seed cones should weigh in a good season 40 lb. and the average yield per bushel 10–12 oz. European larch should weigh 38 lb. and yield 9–10 oz., Norway spruce and Douglas fir 36 lb. and yield 8–9 oz. It has been estimated that the three former can germinate 70,000 trees per pound and the latter 40,000 trees. The importance of collecting good seed cones is therefore apparent. Other species such as Corsican and Maritime pines give a heavier yield of larger seed but less in number.

Seed cones for extraction at a central depot should not be collected after the 31st of March. This gives a small margin for delivery to the kilns, extracting and distribution of the seed before the season is too far advanced for sowing.

2. *Transport to railway stations.*—Special attention should be given to careful packing and to keeping all species separate even to very small quantities of a few cones; secure tying and separate labelling of each sack is desirable as much loss has been experienced by the bursting of sacks of doubtful utility and strength, and of careless tying, and in many cases labelless sacks. When many consignments of seed cones are being dealt with at the receiving station much confusion may be caused for want of separate labelling, as consignments are apt to get mixed. Consignors should always advise of dispatch.

3. *Railway freights to central depot station.*—These are heavy and increase the costs of the whole working very considerably, and apart from the cost there is always the risk of bursting sacks with repeated handling, with consequent loss to all concerned.

4. *Transport to extracting depot or kilns.*—The above remarks apply under this head, and it is at this stage that much care is necessary, both in handling and in separating the various consignments and

storing for extraction at the kilns. Here the necessity of good packing, tying, separate labelling and plain writing will be apparent. Much avoidable difficulty has been experienced in this respect, too harrowing to detail, fortunately not the rule but the exception.

These 4 preliminary operations accomplished, the processes of (5) *seed extraction* and (6) *testing, classifying, &c.*, intervene as already generally outlined.

7. *Seed distribution.*—It follows that the seed obtained must be distributed according to requirements at centres over a wide area and not unusually returned to where it was originally collected in seed cones, with consequent cost of transport from kilns to station, railway freight and transport at receiving station.

It is therefore suggested, from the point of view of economy and cheaper working the question of organizing a system of local seed extraction by means of forest kilns, by each forester in his own district in which the seed cones are collected, might profitably be considered.

The method is somewhat slower, but certainly cheaper and more economical and none the less effective whem embodying as nearly as human invention can interpret the natural elements operating, *i.e.*, sun (heating), wind (shaking and riddling) and shower (damping).

It may be helpful for future guidance and interesting to note that the Dominion Government (British Columbia) in the erection of their seed extracting plant at New Westminster* were fundamentally in error with their extracting device in using a large perforated revolving cylinder or drum, with its resultant powdering of the seed cones and no doubt injury to much of the seed by the friction in the cylinder, which has no parallel in nature. The closer nature can be followed the more satisfactory will be the results, and on these lines the following methods are suggested, beginning the work in the month of March and ending about the middle of April, the period when the seed cones come to the natural time of shedding their seed.

These forest kilns can be very cheaply made by unskilled lab ur—though cheapness should not give way to thoroughness—with comparatively small initial outlay in material, building, firing and working necessaries, and will give great scope for display of initiative and ingenuity, which I am sure will appeal to young and enthusiastic foresters.†

From experience it is peculiarly gratifying to see the seed collected and extracted by personal effort and sown, where human agency has every scope but beyond which it is utterly impotent, germinate into young forest trees. It is a ceaseless and ever-recurring wonder and calls forth a reverence for the creatorial works of the Creator of all the earth. This may be thought a digression and irrelevant to the confines of the subject ; but is it ? I speak in general to all interested in forestal work but more especially to the younger generation of foresters. No man's work will suffer from such reverence. Such

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* *Forestry Commission Journal*, February, 1923, page 31, paras. 3 and 4.

† The article proceeds to describe and illustrate with drawings proposals for small-scale kilns. It is unfortunately impossible to reproduce these in the Journal.

awakened powers of mind and heart which spring from this relationship will germinate an unassailable conception of responsibility and duty, and grow into a faithful, fruitful and enduring service.

Anthony Simpson.

LOCAL NURSERIES *VERSUS* LARGE CENTRAL NURSERIES.

It is the opinion of the writer that if there was a nursery on every scheme, and all seedlings or transplants to be planted on the scheme were raised from seed in that nursery, a more gratifying result would be obtained in the forest, and the cost of afforesting the scheme would be lower than is the case when the seedlings or transplants are received from a supply nursery.

It is well known that much removing and handling of seedlings or transplants is detrimental to their growth. This is especially the case with regard to seedlings or transplants of Corsican pine, which have very brittle roots and are therefore easily skinned or broken. Douglas fir is also a species that is very liable to suffer from the effects of much handling and packing. This latter species is particularly benefited by the judicious choice of planting weather, and this choice is more easily made and, in fact, can only be made if the plants are grown very near the area to be planted.

When seedlings or transplants are taken from a supply nursery many miles distant from the scheme they are subject to a great amount of handling which, often, is not as carefully carried out as one would desire. As these seedlings or transplants are usually two or three days in transit they are very liable to suffer from the prevailing elements. They are also liable to suffer from heating, and the weather prevailing at the time of their arrival may be very unsatisfactory for planting or even for sheughing-in. When they arrive at their destination they are usually mulched which in most cases is a beneficial operation, but does not sufficiently recompense the plants for the severe shock they have received.

On the other hand seedlings for lining out in the "scheme" nursery could be lifted from the seedbeds in that nursery and immediately inserted in the lines so that no detrimental effect may be brought about by their removal. In the same way transplants for planting out could be lifted from the nursery lines and immediately planted out in the area with less handling and much less risk of "drying out."

Transplants taken from a supply nursery with soil and climatic conditions differing greatly from that of the planting area may have great difficulty in establishing themselves in the new type of soil, and many of them may die while those which do establish themselves show poor growth. Owing to the stunted growth of these plants the grass chokes them, and the result is a heavy beating up bill and a great deal of cleaning.

On the other hand, transplants grown in a nursery on the scheme would in all probability establish themselves quickly in the plantation and would out-grow the grass rapidly, consequently the death-rate would be comparatively low.

The writer noted on a certain scheme that transplants taken from the scheme nursery and planted out in the year 1923–24 showed very vigorous growth and their leaders were easily visible above the grass, while transplants taken from a supply nursery and planted out practically at the same time as the others showed comparatively stunted growth and deaths occurred owing to the plants being suppressed by the grass.

Then again seedlings received from a supply nursery to be lined out may be attacked by a fungoid disease which may not be identified immediately on receipt of the plants ; thus a disease may be imported into a healthy nursery which otherwise would probably have remained free from disease, the consequence being a high death rate, inferior plants and a financial loss. If transplants which are attacked by a fungoid disease are received for planting out and the disease is not immediately recognised, it may spread to the plants in the adjoining area and much careful work may have been done in vain.

Truly, Rome was not built in a day, and a nursery cannot be formed and stocked within a week after a new scheme is commenced, so until the nursery is formed the best method to ensure good results will probably be as follows.

On the new scheme there may be areas suitable for the growth of Scots pine, Corsican pine and Douglas fir. In this case the planting area allocated for the first three years should be taken from the area suitable for Scots pine, as that species is able to withstand the effects of transport better than either of the other two. For the first planting season transplants will have to be obtained from a supply nursery. The scheme nursery should be commenced immediately the scheme is opened and Corsican pine and Douglas fir seed should be sown so that at the end of three years transplants of these species will be ready for planting out. In the first year also two-year Scots pine seedlings should be obtained from a supply nursery and lined out in the scheme nursery and these will be ready for planting out in the second year, thus having a better chance than transplants taken from another nursery and planted out.

If the forester in charge of a scheme was held responsible for the growth of the plants from the seed stage onwards his life would be a much more interesting one, and he would be able to produce the best type of forest that the scheme under his charge was capable of producing.

He could carefully watch the growth from the seedling stage onwards and do everything possible to ensure a profitable outturn from his nursery. Only healthy and vigorous plants would be planted out in the area, thus the death rate would be comparatively low and beating-up would be a very minor operation.

In the first place he would have the satisfaction of knowing that the seed was given every opportunity of favourable germination.

He would be able to line out during the most favourable weather for the operation and see that every care was taken with the plants. He would be able to manage the nursery so that seedbeds and transplant areas were kept clean, thus diminishing the opportunity for fungoid diseases to attack the seedlings or transplants. Again transplants would be lifted and planted out in the planting area under the most favourable weather conditions.

The conclusion then is that if every scheme had a nursery, and sufficient seedlings and transplants were raised in that nursery to plant the allotted annual area, none of the risks would have to be encountered that are so common when seedlings and transplants are imported from a supply nursery.

ROBERT R. DONALD.

SCREEFING, ITS MERITS AND DEMERITS.

The necessity for screefing depends on three main factors, surface vegetation, exposure, and cost. In the following article it is proposed to deal with certain aspects of each.

Surface vegetation can be divided for convenience into four types, viz. :—

(1) *Heather*, which includes *Calluna*, Bell-heather and *Erica.*
(2) *Grass*, including briars and all common herbaceous weeds.
(3) *Bracken* including ferns.
(4) *Juncus.*

Shelter is one of the most potent influences affecting tree growth, and the more the writer sees of every stage of growing woods the more evident does this fact appear; but the shelter should not be the harmful shelter of a dense canopy above the trees, whether in an underplanting, or in the first stages after planting when surrounded and covered by other types of vegetation. The shelter which best suits a tree at all times is that which protects its leading shoot while leaving headroom for free access to air and light. At no period in tree growth is such shelter so desirable as during the winter, when planting takes place. Screefing can be of great value in providing shelter of the type mentioned, and the point will be elaborated in the paragraphs dealing with the various vegetation types.

Heather.

Judging from comments made by various persons who have planted heather areas, it would seem that the value of screefing in such places is a debated point. The lack of unanimity of opinion is probably due to the fact that so many types of heather are found that comparison in results is misleading. Having had some experience on heather areas the writer has come to certain conclusions, which have been in the main supported by an officer who has wide knowledge of similar areas. The conclusions are as follows :—

First, that heather areas must be graded as long type, intermediary type, and short type.

Second, in the long and intermediary types, which have tough stringy roots, there is a very decided tendency, where no screefing is done, for plants to have their roots "hung," a common cause of mortality. In one area which the writer planted, it was almost impossible to firm the plant roots because of the springy root systems and long stalks of the heather. This was a "long type" area.

Third and last, that in long type and intermediary type heather screefing should almost always be carried out.

It has been argued that planting without screefing in heather has the effect of drawing up the young plants. To a large degree the writer has found this to be correct, and the fact that screefing prevents this must be placed to its demerit. On the other hand when screefing is not done many of the weaker plants are smothered by the weight of the heather where it is long, especially so during a wet season; and the difficulties of estimating the beating-up requirements are also great. In the "long type" area previously referred to it was very difficult to find the plants the summer after planting. If such an area should be beaten-up the following winter it would be inevitable that plants would be put in close to others of the earlier planting still existing. On the whole the advantages of screefing in heather may be said to outweigh definitely the disadvantages, since by screefing,

(*a*) The shelter of the heather is preserved while the plant has free access to light and air.

(*b*) Beating-up requirements can be easily estimated, thus reducing time and cost.

(*c*) Beating-up is at least 50 per cent. easier and costs should be correspondingly lower, whilst the appearance of the plantation in a few years' time is not spoiled by the spectacle of trees a few inches apart.

In short heather the conditions found in long and intermediary types do not exist, and screefing is not essential. The advantages are not considered to outweigh the cost.

For the purpose of classification *long type* heather may be said to be that over 3 feet in length whether upright or fallen; *intermediary* all from 9 inches up to 3 feet, and the *short type* all below 9 inches.

The long and intermediary types are usually found on moors which have not been used for game rearing, and mainly in the sheltered hollows, while the short type is more often met on moors where game rearing has demanded burning to induce a good crop of sweet heather of medium length.

Grass.

The question of screefing in grass vegetation is intimately linked up with the problem of exposure, since in many cases the grass type reaches from the lowest valleys to the summits of the hill ranges, and the characteristics of the valley vegetation differ greatly from those of the higher altitudes. Where conditions are normal, screefing on grass areas can be divided into two types :—

(*a*) The valley or sheltered position type. In such places there is usually a luxuriant growth of weeds—a growth which promotes mildew and in which it is difficult to find the plants. The object of screefing in such situations should be to clear as big an area as is compatible with the necessity for considering cost. The screefed patch should be shallow and wide, not less than 10 inches square.

(*b*) The hill or exposed situation type, where the grass is short but frequently forms a matted turf with a binding root system. Here the purpose of screefing is to get through the stringy roots to the mineral soil, while at the same time retaining as much shelter as possible. For these areas the writer has found a screefed patch of 6 inches square sufficient, provided the patch is deep enough. Variations are necessary according to ground, but a patch two-and-a-half inches deep with the turf pulled to the side next to the prevailing wind gives a very valuable help to a newly planted tree in an exposed situation, and since a hill slope is usually dry, the pocket formed by this method of screefing holds moisture longer than a shallow patch would. If an adjacent area is covered with bracken the screefing should not be too deep, because of the liability of bracken blowing into and filling up the patches.

There is yet a third type of grass, which, though not frequently met with, is interesting. This is the *molinia* type found in the Pennant sandstone areas, growing at high elevations on a rather damp and deep soil. It grows to about 2 feet in length and is very thick, with a deep going and very tough root system. Screefing *must* be carried out where such grass occurs, and yet so great is the resistance to the screefing tool that the grass must first be burned. The trouble which arises is that, being at high and exposed elevations, the burning leaves no shelter, and the plan which has been adopted on one estate where *molinia* is found has been to burn it in the autumn and winter burning season, screef the area in the spring following, before the grass grows, and plant the following autumn. Observation has shown that the grass does not grow in the patches the first year, and the shelter of the surrounding growth of the summer is obtained.

Bracken.

It is a debatable point whether bracken should be screefed at all. Usually a scrape with the foot or the planting tool while planting will expose the mineral soil, and if another penny or twopence a hundred were paid for doing this effectively, satisfactory results would in all probability be obtained. In the areas where bracken has been growing from time immemorial and there are deep deposits of bracken humus it would probably be best to use 18- to 20-inch transplants and pay a special rate for planting, the operation to include the thorough scraping away of the humus. The writer has seen bracken areas screefed and small plants used with the result that the humus drifted back into the holes and smothered the plants, causing a very high mortality.

Juncus.

Juncus, the last of the four vegetation types, is one on which data are lacking, but from present knowledge of a few small areas the writer is of the opinion that it is probably better not to screef, but to cut lines through the *juncus* with a reaping hook or scythe, and plant the trees, usually *Sitka*, without further preparation. Where there is a seepage away of water in these areas the *Sitka* will generally grow vigorously, but the tendency where screefing is executed for pools to stand round the plants, and at the least cause a very severe check. That screefing is apparently of very definite value is well exemplified by an instance related by a forester to the writer, where a plantation of larch and Scots pine formed on an old pasture field and notched with either the L or T notch, hung fire for many years (unfortunately the exact number is forgotten), and then one spring shot ahead in a remarkable fashion. Examination was made, and it was found that the root systems had only then penetrated the unusually thick turf.

F. R. HURWORTH.

HEELING-IN PLANTS ON FOREST AREAS.

Considerable damage may be done to young forest trees by being improperly heeled-in on the forest areas. The extent of the damage liable to be done is not always fully considered. On hill areas it is the usual custom to commence heeling-in on the same principle as used in the nursery without any preparation of the ground. This cannot be done satisfactorily. Another method is to heel-in plants in open drains. This also is an unsatisfactory method. The objection to the former is the utilizing of sods and turfs because these cannot be placed round the roots compactly enough to keep out frost and air, also the grassy side of the turf is frequently placed round the roots on one side of the trench which is unsatisfactory. Plants must have soil round their roots. There are several objections to the latter method :—(1) It involves the use of sods and turfs as in the former method. (2) In wet weather the turfs are liable to get swamped, and in the month of March and April they often get too dry and consequently the roots of the plants get dried up. (3) The main objection is that drains draw frost, and plants put in drains are very liable to get their roots frosted, even although there is a covering of grass or bracken put over them.

The method which I find most satisfactory is to take off the turf and trench or dig to a good spade's depth a few small patches here and there where necessary in dry sheltered areas, care being taken to keep out of frost holes. If stone walls are convenient, suitable places can often be got on the sheltered side of these. The areas thus selected are best prepared beforehand, a pick should be used if the ground is hard or stony. The extra cost is a minor item and more than doubly repays itself, and plants can be put in much quicker on arrival which is a great advantage. The size of these areas must of course be determined by the number of plants to be put in. Usually areas of 15 to 30 square yards are convenient, and if arranged properly they can be used for different species to be planted at different periods of the planting season. These areas should also be left if necessary and utilized in the same manner for plants for beating-up until plantations are established. Careful lifting of plants in the nursery, packing and protecting from frost, drought, &c., count as nil if plants are not properly heeled-in on arrival at the forest areas.

Very often plants are heeled-in in bundles and left longer than they should be, probably owing to weather or some unforeseen occurrence, to the detriment of the plants. The formula often used "plants to be planted within 10 days to be left in bundles, over this time loosened," holds good only when weather is suitable. In this uncertain climate of ours it is usually safest and best to loosen all bundles before heeling-in, an equal number of bundles being placed in each row to save counting again when re-lifting or to be more exact small sticks can be put in between every 1, 2, 3 or 5 bundles as chosen. All men working with plants should be instructed as to the delicate nature of their root system (this holds good especially in the nursery). They should be warned that careful handling is necessary at all times to protect root fibres. A common practice by inexperienced men if not watched is the throwing of bundles from where the cart unloads to the trench, anything from 5 to 10 yards. On no consideration should this be allowed or untold damage will be done.

A method often used to protect plants from frost is to cover thickly with grass or bracken. This is often overdone and is harmful. A very light covering only should be used, bracken being preferable. Too thick a covering has a tendency to make the plants tender and when they are taken out from under the covering and planted they suffer severely from cold winds. In wet weather a thick covering is very detrimental as it will bring on mildew and the needles of plants will turn black and decay. It is better to have no covering at all than too thick a one.

At times it may be noticed that on certain areas newly-planted trees are not taking root as they should do, no visible cause being seen, but if details were gone into faulty heeling-in would probably be found to be the cause in many cases.

Heeling-in plants on the forest area is a most important item, and too great care cannot be taken in every detail in connection with this operation.

S. H. A. Paterson.

PROTECTION AGAINST SHEEP DAMAGE.

The protection of young plantations from mountain sheep when afforesting areas which, for many years, have been grazed by them, demands the closest and most unremitting care, and the following remarks are based upon experience gained in South Wales.

The first twelve months after closing the area are the most critical, for then the sheep are untiring in their efforts to get back to their accustomed haunts, and walk the fence or wait patiently in flocks near the gates through which they have formerly travelled. If the fence is sufficiently good to withstand this first attack, half the battle is over, and the sheep will, in time, forget, and reconcile themselves to their new surroundings. It is futile to attempt to exclude sheep from an area if the fence is weak at any point, for if once they start to break in and establish the habit, subsequent difficulties will be infinitely greater than if the fence had been soundly repaired in the first place.

The efficacy of various types of fence may be summarized as follows :—

(*a*) *Hedges.*—It requires a very excellent hedge indeed to be proof against mountain sheep, and experience proves that in this locality (Llanover) a hedge cannot be accepted as an effective boundary. It has here always been necessary to erect a new fence alongside, or to fasten netting to the hedge to prevent the sheep forcing their way through. It may be added that these hedges are mainly beech and have been almost totally neglected for years past.

(*b*) *Wire Fences.*—The ordinary 7-strand wire fence, if well erected and in good repair, is very satisfactory ; it should be 4 feet high and well strained, and due precaution taken—especially on steep ground—by levelling, &c., to prevent the sheep jumping. The usual type of new fence erected here by the Commission is equally effective whilst it lasts, and consists of sheep netting, 3½-inch mesh and 3 feet wide, supported at top and bottom by a strand of plain galvanized wire, with an additional strand of barbed wire 9 inches above the top of the netting. This fence has the advantage of being cheaper and easier to erect than a 7-strand fence.

(*c*) *Walls.*—Mountain sheep have the reputation for amazing skill in getting over walls, and experience proves that this reputation is well deserved. To form an effective barrier a wall must be 6 feet high and must have a " coping " or top layer of flat stones projecting about 4 inches on the outer side. The problem of making an old wall into an efficient fence is an extremely difficult one ; if stone is near, it may sometimes be possible to repair it satisfactorily at a reasonable cost, but in many cases it is an open point as to whether when cost of upkeep is considered it would not be more economical to erect a new fence in the first instance. If the wall is fairly good up to a height of 4 or 5 feet from the ground it is possible to make a good fence by erecting one or several jumping wires along the top on its outer side. Barbed wires are most effective, and stakes should be about

15 feet apart if the wall is irregular ; a sufficient number must be used to keep the wire 3 to 4 inches from the wall at every point. If a single wire only is used it should be a shade lower than the top of the wall ; if other wires are necessary the extra ones should start a foot higher and be spaced at 12 inches. It is an excellent plan to fix the stakes, after driving them, by passing a short length of wire round them and through (or over) the wall, fixing the ends around a stake on the opposite side ; this makes the stakes firm against the wall and also supports the latter in weak places.

The cost of upkeep of old walls is often very high, at least 2*s*. per chain per annum being not unusual. Lengths of wall often fall down, especially in wet and frosty weather, and regular patrol is absolutely essential and expensive.

If the area is large the task of removing sheep from the forest is one which cannot usually be done efficiently without the aid of a dog. Mountain sheep are very quick and difficult to control, and any single-handed effort at chasing them out is not only exhausting but generally unsuccessful. Welsh or Scotch collies are the best breeds for this work, and it undoubtedly pays to obtain one of good pedigree as, to a large extent, their skill is inherited.

It is difficult for a forester or person engaged in removing trespassing sheep to train his own dog from a pup, as the work is too irregular, since to train a dog successfully requires regular work for the first twelve months or so, and it is therefore best to secure in the first place a dog about 18 months old which has been " broken " to its work in experienced hands. Unfortunately this is frequently difficult.

The dog should bring the sheep back to his master and then keep them by him until the place is reached when they can be turned out, as if he merely " courses " or drives them it is of little value, save in exceptional circumstances, such as when there are places where the sheep can jump over the wall or fence and cannot re-enter.

The establishment of friendly relations with local farmers and shepherds is of the greatest possible importance, and often very difficult, as the enclosure of large areas on which they have hitherto grazed their sheep deprives them of part of their means of livelihood, and naturally gives rise to a feeling of resentment, which may find practical expression in such ways as damage to fences or opening of gates and so forth ; shepherds have even been known to turn their sheep into young plantations at dusk, removing them before daybreak.

Thus much good can be done by securing the goodwill and co-operation of these people, for strong measures, in the absence of friendly relations, will often fail in their ultimate purpose—possibly on account of fire—but it cannot be too strongly emphasised that the forester must depend mainly upon a good fence, a good dog, and constant patrol backed by fairness and an unwavering firmness of purpose ; nor will these avail without patience, energy and tact. Already in places the neighbouring farmers are beginning to take a lively interest in our operations and their success, and many are forwarding them by all means in their power.

A. H. Gosling.

EMPLOYMENT OF CASUAL LABOUR.

One of the many problems which foresters under the Forestry Commission have to deal with is the employing of unskilled labour. Nearly all men employed, at least to begin with, are of the unskilled type, with not even the slightest elementary knowledge of forestry work, that is if local labour is employed, and this is nearly always the rule before outside labour is resorted to. Very often the Labour Exchanges have to be applied to and men procured from this source are, as a rule, unsuitable. It may be taken as a general rule that good men are seldom or never unemployed in rural districts, consequently suitable men are very often hard to get. The Commission's schemes are mostly in remote districts, and there is a very great difficulty in getting men to go and live in these out-of-the-way places.

Advertising for forestry workers is probably the best method of procuring suitable men, in that way one can often get men with some previous experience. I have known instances where unemployed men from Labour Exchanges in towns were procured, but this is about the most unsatisfactory method, and generally only done as a last resource. These men are taken on temporarily for a few weeks or months, and they know that at the end of that time they will be paid off, consequently they have no interest in their work. Very often these men are taken on for actual planting. This is, of course, inadvisable except in unavoidable circumstances, but it sometimes has to be done.

Usually agricultural workers turn out to be good men, as they have at least been used to hard work. One important item often forgotten is that men must have good eyesight, and foresters would do well to make this their first question when engaging men. It may seem hard to turn down otherwise good men on account of this, but sentimentality has got to be flung aside where this is concerned, as men with defective vision are, plainly speaking, no use. Good eyesight is essential for planting and keeping planting distances, and in cleaning and other operations, &c. It is not always suitable to engage men for certain work only, such as draining, &c., but this, of course, can be done, and good eyesight is not essential for this kind of work. It is surprising the number of men one comes across at the present day who have poor eyesight. I might divide labourers into three categories, viz.: (1) local men staying within a radius of five miles, and who reside at their homes; (2) local men whose homes are over five but within twenty miles and who stay in lodgings or bothy near their work; (3) outsiders whose homes are over twenty miles from their work, and who stay in lodgings or bothy. Of the three categories (1) and (3) are most satisfactory. The second is not; these men usually want to go home for the week-ends, very often on the Saturday morning, and if the beginning of the week is wet it is perhaps Tuesday or Wednesday, or later, before they are back. The rest of the men, being on the spot, will have lost perhaps very little time with wet weather during the time the others were away.

The next point which might be mentioned is the organisation of unskilled casual labour. Good gangers or squad leaders are required to handle men of this type to get the most out of them, much more so than in the case of men from private estates, as such men have usually a fairly general knowledge of their work; but the casual labourer with no experience has to be taught and watched more closely than more experienced workers. The casual labourers have usually knocked about and been on a good many labouring jobs in their time, and are in a good many instances what one might term "hardened cases," and only good gangers can get the most out of this class of men.

A word might be said here about the men being trained in the Commission's schools. These men on the successful completion of their course usually take up jobs as gangers or squad leaders. Now what I have seen of these men, and this is somewhat extensive, is that they have on leaving the schools very little experience, if any, as gangers. In the first instance they are in most cases often 20 and 21 on the completion of their course, and unless they have exceptional grit for their age they are no use in controlling men of the casual type, of ages ranging up to 40 years or more. I might suggest, and I think it would be to the benefit of the Commission and these men also, that they should be taught more of the actual ganger's work at the schools. During operations at the schools each man in turn could be put in charge of so many others and made responsible for the work of his gang. They should also be taught to shout out their orders in a clear, distinct tone, if I may put it, in a semi-regimental manner. They should also be taught to be firm. I have seen these men when put on as gangers giving men their orders in a tone little more than a whisper. This is no use. Casual workers of the present day require to be shouted at, any mildness on the part of the ganger is promptly taken advantage of. The average present day casual worker is out to do as little as he can for the money he gets, and thoroughly trained good gangers are necessary to counteract this and get as much as possible out of these men. There are, of course, exceptions to all rules—one does come across some very good men who are out to do their best, and they should, if possible, get some encouragement either by a slight extra remuneration or by putting them on the permanent staff, &c.

To return to the ganger or squad leader: in my opinion, with perhaps some exceptions, these men should, on the average, be 24 or 25 before they are put on for permanent gangers. They have usually more grit at that age, they can command more authority, and by their intellect and ability can get all work allocated to them done in a satisfactory manner.

The next point which crops up is accommodation. As previously mentioned most of the Commission's areas are in remote places, and to get men to stay there for any length of time suitable accommodation should be provided and made as comfortable as possible. It is not my intention to go into details regarding housing, &c., but I might mention that where bothies are available a caretaker should be provided to cook for the men and keep the bothies clean. Foremen and permanent squad leaders should be provided with separate rooms, and they should have a mess-room of their own.

I would also like to mention that where the Commission's schemes are situated in very unfrequented districts, some sort of recreation should be provided for men when off duty, such as football and other outside games for the summer, and some of the many inside games for the long winter evenings or on wet days when work cannot be done. Although men are earning their living by going and living in these unfrequented places the workmen of the present day require more than work and sleep, they require some recreation when off duty, and it is on this footing that I venture to put forward the plea that the Commission might in these unfrequented places provide footballs and materials for other games for workers. Proper accommodation and the provision of some forms of recreation would in my opinion be to the benefit of the Commission. There would be more contentment and the general work done would be better.

S. H. A. PATERSON.

FORESTERS' CLERICAL WORK.

It is believed that foresters who have a cash account are officially regarded as sub-accountants, yet how few of them have had anything like a decent training in accountancy. In the Journal of the Forestry Commission, No. 3, February, 1924, particular reference is made to this subject by Messrs. Pink and Newton, and it might be helpful if a forester expressed the point of view, so far as he knows it, of foresters on the subject. Mr. Pink states that it is not unnatural for the forester to look on clerical work as secondary, yet foresters have at times to make this work almost primary in order to get returns, &c., forward punctually, irrespective of how this may affect outside forest work. There is a temptation to avoid "strafes" perhaps to the detriment of other and more primary work.

Most foresters, it is thought, realise the necessity for records of State forests, and are willing to supply all material to make these up, but it is felt that there is a larger proportion of the forester's time spent on this than perhaps is advisable when this may perhaps mean too little time spent in the forest. To avoid this in future it is thought that much more could be done to assist the forester in his equipment so as to cut down to the absolute minimum the amount of time spent on clerical work.

Training of Foresters in this Branch.

Mr. Newton suggests a course for foresters, and it is thought that there are few foresters who would not wish to take advantage of such a course if it were made available. It could be conducted during the summer for a short period, and the general routine of the forester's office work could be thoroughly gone into.

Mr. Newton suggests that in addition a short time should be spent in the Divisional Office, and this also, it is thought, would be a good thing, enabling the forester to get a grip of the why and the wherefor of all the returns, &c. It might be suggested that the Divisional Accountant should visit each forest periodically. In this way foresters would receive first-hand advice on the correct methods of doing office work. Perhaps it should be suggested here that every forester should have a small office which should be recognised as part of his equipment, and the accountant could then advise as to the best methods of filing and keeping books. Part of the time of these visits could be spent in the office and part in the forest, where the accountant would get the lie of the ground. Such visits would be mutually beneficial, and by getting to know each other a much more friendly spirit would be maintained between "Head Office" and the forest, and at such visits the accountant could improve on the forester's office methods.

To sum up, it is thought that while it is essential for the forester to have a thorough grip of all costings, returns, &c., it is just as essential that much less time be spent on this branch of his work by :—

(1) Specialised training of the forester.
(2) The provision of an office fully equipped.

(3) An initial visit of the Divisional Accountant to set this office in order and lay down the best ways of working.
(4) Regular visits of the accountant to (*a*) improve the office methods of the forester; (*b*) enable the accountant to become better acquainted with the forester and the area.
(5) Perhaps one short visit to Divisional Office.

It is hoped that these suggestions may help because, as pointed out at the beginning of this article, there is a need to cut down to the minimum the time spent on clerical work.

J. McEwen.

SIXTY YEARS HENCE.

A Plea for a Truer Perspective.

Let us cast aside for a moment the affairs of to-day and glance at our forests sixty years hence. Let us imagine the forester of a future generation regarding the maturity of our labours. How will he criticise the results ? Will he dig out old and musty files ? No ! Will he wade through voluminous reports ? No ! Will he make intricate calculations with masses of figures ? No ! He will look at the growing trees and by them shall we be judged, even as we now judge the foresters of the past. Gone will be the forester, the figures, the files. Alone will remain the trees, the only vital link left, tall, majestic trees—a monument to our skill or a stunted growth, symbolic of the reverse. Our politics, our pay, our promotion, our very names, all happily lost in oblivion, but the forest standing there.

Now let us follow in more detail the judgment of our future forester. Upon what will he form his opinion of the woodlands before him ? Firstly and pre-eminently it will be upon the growth of the individual trees that his judgment will be based. He will judge the trees by comparative standards as we do now. The height, the girth, the volume, the form factor will be gauged and the vitality observed. In fact the results of our application of the whole gamut of sylviculture will come into question. His ideal tree and our ideal tree will probaby be very similar, so we know sufficiently well what lines his criticism will take.

Secondly the species of the tree will be considered—a vastly more complicated subject to pass judgment upon, but of less importance than the first. To some extent the subjects of growth and species are interdependent, but two main factors will form the basis of our future critic's opinion. Firstly, the suitability of the species or mixture of species for maintaining and increasing the fertility of the fresh soil, and secondly, the commercial value of the timber. No matter, he will argue, what commercial value a species may have it should not have been grown wholesale if it produced continued impoverishment of the soil.* Loss of fertility of soil leads to poor growth, so again we come back to the first and vital question of a good growth and all the complicated factors upon which this depends.

But to follow our future forester further. He will now perhaps consider the trees as a whole, that is to say, the forest, and here a great variety of subjects will come up for investigation. He will probably have by him a copy of the latest Working Plan or latest revision, and possibly he will have obtained copies of earlier plans and, perchance, the original one. He is not likely to search for the early financial accounts of the forest supposing they were available, but even if he found an account, and on glancing through discovered an error

* The foresters of Saxony have within the last twenty years or so become aware of the grievous error of their predecessors in promiscuously planting spruce in unsuitable conditions.

in a woodman's pay sheet, he would probably regard the matter with equanimity. On reading through the first working plan our successor might be dumbfounded to find that half or more of the forest was planted before the plan was prepared and before the system of rides and roads was projected. "What," he will exclaim, "were they thinking of? Forestry of all matters requiring forethought, and here they were rushing into this business without a plan, no wonder . . ."

Then all our forester's critical faculties will become keener. He will take out the maps and scrutinise them carefully. He may find considerable cause for criticism in the lay out of the compartments. They may be so shaped that it is almost impossible to make the coupes as they should be. There may be trees growing where obviously space should have been left for a road. The rides may be too narrow or unnecessarily wide. Our forester will remember the great works of Von Cotta and wonder why so little regard was paid to his teachings.

On the other hand, he may find all the matters arranged as he would desire them, so that his work of felling, extraction, re-planting will be rendered as easy as possible. He may find the compartments so shaped that he can conveniently make his coupes long and narrow, and so give the young trees the maximum degree of shelter, yet without endangering any of the standing crop to storm winds. His judgment of our work will be according to what he finds.

As he turns over the pages of the working plan his eye may light on a paragraph dealing with the choice of species, and this will undoubtedly be of interest. If the trees in the forest have grown well he will be anxious to know how we came to think of planting that particular species. The summary of all the factors of locality will have been a true one and our deductions correct. Alternatively if the forest growth is not good and the species inconsiderately chosen, he will be even more enticed into inquiring as to how this happened. Was our data incorrect or were our deductions faulty? Had we given the necessary time and consideration to cause and effect in tree growth? Had we been constantly utilising our powers of observation—constantly and earnestly examining the evidence available with an open mind? Or were we tied to our offices immersed in a sea of papers, reports, figures? Fortunately our forester will not find our files. They will by that time have passed through the pulp mill several times, but if he could he would be startled to discover that he might read through hundreds of letters, returns, reports and find no reference to the one outstanding subject of our work—the growth of trees.

Then again, our 1984 forester may enquire into results of our efforts as viewed from the social point of view. To do this he will have a perfect right, as our labours will have been all in vain if the people of the country have not benefited thereby. He may investigate the conditions under which the forest workers live. Will he find a healthy, happy and contented community, well housed and earning a fair wage? Will he find small holdings have been formed in suitable districts to employ them when work is short in the summer? Or will he find a shortage of houses and no holdings, discontent and disinterest?

Will he find many permanent employees—professional woodmen—whose art is handed down from father to son, and whose whole interest lies in the forest. Or will he find the casual labourer at work, picked up from here and there in the district—untrained, unskilled, uninterested, with nothing but a miserable bothy to go to when the day's work is done? Upon the system we have built up we will be judged.

But our forester will again turn to the trees, for if the trees fail all else will fail with them. They alone will stand in silent but eloquent testimony of our worth.

A. D. Hopkinson.

THE MODERN ASPECT OF FOREST ENTOMOLOGY.

In the American *Journal of Forestry* for October, 1924, Professor Tragardh, of the Swedish Forest Research Institute in Stockholm, discusses problems and methods in Forest Entomology. His views are of interest because they show that in Sweden, as in other countries, there is a new, broader outlook in forest entomology and a definite trend towards œcological work.

Tragardh deplores the harm done by the long association of entomology with plant pathology, of which entomology has been regarded as a mere adjunct. He endeavours to show that this view of entomology is wrong and is a bar to progress, and he discusses some of the problems in entomology in order to show that it is in reality a major branch of forestry in itself.

The main aspects of forest entomology he deals with are the adaptation of injurious insects to changing conditions, and the far-reaching effects which insect injuries inflicted in the early stages of a tree's growth may have, and finally he discusses that greatest of all our problems, the origin of insect outbreaks.

Of the adaptation of injurious insects to new conditions we need not say much. Such adaptations are familiar to all foresters. The pine-shoot beetle will attack larch and spruce when the breeding ground afforded by its proper host, the pine, is exhausted. The heather beetle, *Strophosomus lateralis,* will, if the heather be burned, readily attack the various conifers planted after burning. Such changes of host are often important, and the importance of this fact is fully recognised.

Less realised is the far-reaching effect of insect injuries inflicted on young trees. One of the most familiar cases, though not cited by Tragardh, is the deformed stem resulting from the attacks of the pine shoot moths, *Evetria buoliana* and its congeners. Equally familiar, in its first stages, is the deformation of the pine resulting from *Myelophilus* attack. On this subject Tragardh speaks with authority, for he has, in an earlier paper, shown that this deformation is never completely mended, and by stem analysis has shown that it results in quite a serious loss in timber production. Tragardh stresses the value of stem analysis and of investigation of insect injuries by analysis of sample plots, and there is no doubt whatever as to the need for such methods in assessing insect losses and insect conditions.

More important, however, than these problems is the question of the origin of insect outbreaks, and Tragardh gives some striking illustrations of the complex nature of this question and of the great need for more knowledge of it. Referring to the fundamental importance of such knowledge he points out how, in view of the heavy cost and great difficulties entailed in the use of insecticides in forestry, the forest entomologist " must concentrate all his efforts to develop methods by which devastations can be prevented." In many cases, he points out, these preventive measures must consist in giving closer consideration to a proper intermixture of tree species, and even to a suitable composition of the entire forest flora. The forest flora affects the forest insect fauna, including insects parasitic on such pests as the nun moth, oak tortrix and pine geometer, and Tragardh states that in two districts the presence and prevalence of flies of the parasitic hymenopterous genus *Pimpla*, important enemies of the nun moth, were dependent on the forest flora. Where the forest flora was rich, supporting a varied lepidopterous fauna, these *Pimpla* flies were abundant and tended to check the nun moth ; where the flora was poor *Pimpla* flies were rare or scarce, and nun moth outbreaks were frequent.

To sum up Tragardh's paper, it may be said that it is an excellent argument for what may be termed the " biological method " of insect control, a method which must more and more be recognised as the fundamental method and the only method which can give permanent results. This does not imply that the method is easily applicable, the reverse is the case, but if the time and money which in the past have been expended on spraying—with little result through the failure to recognise the true nature of insect devastation—could be devoted to research on œcological lines, sylviculture would be on a firmer basis and its results considerably enhanced by increased forest production. Even greater than the harm done to entomology by its subordinate association with plant pathology, is the harm done by the ineradicable ambition in man to deal with his insect problems at one sweep and his endless search for the ideal insecticide.

We must never forget that the forest is a biological complex, not merely a collection of trees, and that the forest flora and the forest insect fauna are just as much part and parcel of the forest as are the trees themselves.

Escherich in his account of the insect conditions in the primeval Bealowies forest, opens with the dictum " Forstentomologie bedeutet Waldhygiene " (" Forest entomology implies forest hygiene "), and the study of forest hygiene is the first step towards a better understanding of our insect problems, and not merely of our insect problems, but of our problems in mycology, in soil science and in sylviculture. If, for a moment, we turn from forestry science to medical science we may get a better conception of what hygiene means. One of the most serious afflictions of man is tuberculosis. For years the causative organism of it, the tubercle bacillus, has been known. Time and money have been spent in a search for anti-vaccines and other similar remedies without success. And still the incidence of tuberculosis is falling ; its killing power is markedly less. Why ? Because the conditions which favour tuberculosis have been studied, are better understood, and are being remedied. So it will be with our insect pests. We may never wipe out the pine-weevil, the cockchafer or the oak tortrix moth ; but we may produce forest conditions under which these pests are held in check and are comparatively harmless.

The great need is more knowledge of the inter-relations which exist between the forest conditions and the insect conditions. The day when the entomologist was content to identify insect pests and to treat them as isolated entities are over. The insect pest is now rightly regarded as a member of an insect association, and the entomologist seeks above all to learn more of these associations and their environment and to base his remedial measures on a knowledge of the forest conditions.

Progress will be slow but it will be better, far better, to concentrate on one or two outstanding problems and study them fundamentally than to continue the sorry policy of evading our problems by advocating remedial measures which can never be more than palliatives. That is the main aim of the forest entomologist to-day: to get down to the fundamental principles underlying the prevalence and increase of our insect pests. It is a newer broader aim, and it has this one great merit that it brings the entomologist and the forester into closer contact and will gradually lead to a broader conception of the practice of forestry, which is, after all, essentially a biological science, dependent on fundamental biological principles for its successful practice.

J. W. MUNRO.

CURRENT LITERATURE: REVIEWS AND ABSTRACTS.

NUN MOTH OUTBREAKS.

The Forstliche Wochenschrift "*Silva*" contains a brief article on the nun moth by Escherich, and another by Forstmeister Hohlfeld, of Saxony. Apparently in an earlier article in "*Silva*" (June 6th, Forstrat Ružička condemned tree-banding and advocated shooting on to the caterpillars the dried virus of the polyhedral disease.

Escherich defers his reply as to the efficiency of grease-banding (Leim-ring), and calls attention to the Americans' control of the catalpa sphinx moth by scattering arsenical dust from an aeroplane.

Personally I think Escherich is a little incautious there. It is one thing to distribute arsenic dust on a broad and large catalpa leaf and to poison naked caterpillars from 1 to 2 inches long. It is a very different thing to get arsenical dust to lie on needle-leaved trees and ensure poisoning of the hairy caterpillars of the nun moth.

Forstmeister Hohlfeld is most concerned with defending the "Leimring Methode." The object of the Leim-ring or grease band is to prevent the caterpillars from reaching the ground to pupate—the reverse of the process familiar in England, where grease-banding aims at preventing the winter moth from getting up to lay eggs.

Escherich and Sedlazek used a double ring, one at breast height and one at 10 metres up the stem, and Hohlfeld regards this method as moderately effective. It fails when the grease or "Leim" (tanglefoot in America) is of poor quality and in private woods double ringing is too costly.

Hohlfeld also refers to the examination for nun moth eggs as an indication of a threatening outbreak. This method was first advocated by Escherich, who advised the forester that if the nun eggs were becoming more numerous he ought to start grease-banding at once.

Hohlfeld suggests that regular grease-banding is no more costly than looking for eggs.

Forstmeister Splettstoezer in a brief note, records how after heavy rain he trapped the nun moth caterpillars in furrows made by a plough with small pits every few yards. Into these the larvae fell. Unfortunately his method implies the rain shower which cannot always be relied on.

On p. 216 a long expected protest against pure pine forest is given as encouraging the pine beauty moth.

J. W. Munro.

ZEITSCHRIFT FÜR FORST UND JAGDWESEN, APRIL, 1924.

The Great Importance of Moisture Supply for Timber Production on Diluvial Sands (Prussia).

By Professor Dr. Albert.

In this interesting article Dr. Albert shows, among other things, the value of soil analysis as an indication of the sylvicultural value and treatment of the sandy soils in Prussia.

Nieder Lausitz is a tract in north-east Germany, whose climatic and geological conditions are very similar to those round Eberswalde, but where many of the sylvicultural measures for soil improvement which are practised at Eberswalde have failed. The mechanical and chemical analysis of the soil fully explains this difference. The soils in the Nieder Lausitz fall into four well-marked divisions, each class showing progressively better tree-growing conditions according to texture, *i.e.*, fineness or coarseness of the particles (Scots pine is almost the only species grown).

The chemical analysis, the figures of which have been omitted from this review for lack of space, showed that all four classes of Lausitz soil have a fairly high mineral content for this type of sand, and it is clear that it is the relative proportions of coarse and fine sand which are the governing factors. The question is thus entirely one of the water retaining properties of the soil. The average rainfall at Eberswalde and in the Lausitz is the same, viz., 21·7 inches.

Dr. Albert considers that the so-called Siberia soils, which are now wholly unproductive, might be brought into cultivation by treatment with peat; the second class of soil carrying only lichen is generally considered the least fertile land of all, but chemical analysis sh wed that this was actually the richest of the four classes in the Lausitz, richer even than the best of the Eberswalde soils. The apparent poverty is due to lack of moisture and not to lack of mineral foodstuffs. These lichen soils can be greatly improved by covering the ground with twigs and branchwood, a process which has been carried out most successfully in the Lausitz for some years past. After a felling all the twigs and branches are piled in drifts between which seedlings of Scots pine are planted; such areas are quickly covered by a dense growth of moss and the pine plants make a most vigorous growth. The twigs quickly rot away and disappear in six to eight years, after which, if no fresh dressing is applied, the growth often falls off and the foliage turns a sickly yellow. The beneficial effect of the twig dressing is not so much due to the enriching of the soil with humus as in its action in reducing evaporation from the soil.

The two remaining classes carry good Scots pine stands.

Dr. Albert then discusses the advisability of growing pure pine in the Lausitz, and concludes that pine does not yield sufficient humus to keep the soil in an optimum condition, or an adequate supply of twigs and branchwood to maintain the twig dressings in the required amount. Beech and oak should be planted with the Scots pine on the appropriate classes of soils, giving, if necessary, a handful of marl or loam to the roots of each plant when planted. For the classes of soil too dry for these species recourse must be had to such species as birch, Robinia and aspen, and possibly also to the green Douglas which makes a little more demand on the soil moisture than Scots pine.

A final point may be mentioned. Dr. Albert considers the subdivision of soil particles employed, *i.e.*, 2·0–0·2 mm., 0·2–0·02, 0·02–0·002, and less than 0·002 mm. to be a great improvement on other methods of subdivision. This classification has been devised by the Swedish soil expert, Dr. Atterberg, and provides the most satisfactory basis for the mechanical analysis of forest soils.

W. H. Guillebaud.

ZEITSCHRIFT FÜR FORST UND JAGDWESEN, MAY, 1924.

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

By Professor Dr. Busse, Tharandt.

Dr. Busse began in 1912 an elaborate investigation in the above problem. Seed from carefully selected trees of different ages but of the same racial strain was collected, sown in a nursery, and the plants planted out in series of parallel plots, according to the most approved experimental methods. Busse's results may be summarised as follows :

(1) The seed of young mother trees of Scots pine is larger and heavier than the seed of old trees. (Young trees include trees from 16 to 55 years of age and old trees from 70 to 170 years of age.)

(2) With the careful method of extraction employed the germination was high (from 81 to 90 per cent.), and there was no correlation as far as output was concerned with age of mother tree.

(3) The seed of young trees gives rise to larger and stronger plants which develop more rapidly in the first few years.

(4) This initial advantage soon disappears, and by the end of 10 years there is no perceptible difference between the offspring of young and old trees.

(5) Where conditions are unfavourable to early growth the seed from young trees is likely to get away more quickly and become sooner established than plants raised from seed of old trees ; thus, other things being equal it is better to collect seed from young trees.

W. H. GUILLEBAUD.

ALLGEMEINE FORST UND JAGDZEITUNG, AUGUST, 1924.

ASCERTAINING THE AGE OF TREES FROM A COUNT OF THE ANNUAL RINGS. BY PROFESSOR O. FLURY, ZURICH.

In the first place Flury draws attention to the well-known fact that in sample plots the ring counts made at successive measurements commonly show a steady reduction in the apparent age as compared with the earliest count or with the age as established from documentary records.

These counts are usually made on dominated or suppressed trees removed in the thinnings, and various theories have been put forward to account for the disappearance of some of the rings. Flury now states, however, that even dominant trees in quite young woods show the same phenomenon, and he advances a new explanation to cover the facts.

After some difficulty a number of plantations were found whose age was definitely known, and in which it was quite certain there had been no beating up of any sort. The areas selected formed part of a series of experiments on racial strain of Norway spruce and other species, the history of all the plants being known from the date of sowing the seed.

Three spruce, one silver fir, and one Cembran pine plantations were investigated, and it was found that the age shown by a ring count made at soil level was from two to six years less than the real age of the trees, but that by grubbing up the root stock and sectioning it below the surface of the ground the number of rings increased until in almost every case the full tale of rings was found 6 inches to 8 inches below soil level.

Flury's explanation is that the increasing weight of the trees causes them to sink in the soil, and that even in 20 to 25-year old woods, the subsidence is sufficiently marked to sink the original stem collar to a depth of about 6 inches below the soil level. This takes place not only on the soft peaty soils at Weiermatt, where such a sinking might be expected, but also on the stiff clay soils of the Adlisberg. It is probable that in older trees the process is continued, but it is difficult to get reliable evidence.

Flury also made ring counts on the large roots springing from the rootstock of the trees examined, and from these some interesting conclusions are drawn. These major roots are always considerably younger than the tree itself, but while scarcely any date back to the nursery period there are several dating from the planting year and the year or two following, *e.g.*, spruce from Weiermatt, real age 25 years, planted out when 5 years old.

The number of annual rings of roots at varying depths below the surface are given in the following table :—

Distance below soil level.		*Diameter.*		*No. of Rings.*
ins.		ins.		
2	...	3	...	12
$2\frac{1}{2}$	...	3	...	13
3	...	4	...	16
7	...	5	...	21
8	...	6	...	19
10	...	3	...	16
11	...	5	...	16

In the above case the root occurring at 7 inches below soil level dates from the year of planting, the upper roots are all younger and adventitious, being developed from the stem of the young spruce as it slowly sank into the soil. As a result of this investigation Flury states that in spruce the greater part by far of the final root system of the tree is of adventitious origin.

Finally a good example is given of the capacity of spruce to form adventitious roots. During some trench digging operations in a mixed wood the lower stems of a row of trees were buried in soil to a depth about 3 feet. After a lapse of four years the trenches were filled in and again the tree stems uncovered. It was found that the spruce had developed a copious root system above the original soil level, the largest roots were 2 inches in diameter and showed four annual rings, indicating that they had started to form the first season after being buried. Beech, oak and Scots pine trees which had been similarly covered with soil failed to develop any adventitious roots to speak of. Flury states that the spruce showed no signs of ill-effect as a result of either the formation or subsequent uncovering of these latter formed roots, but continued to make unchecked growth.

W. H. Guillebaud.

CENTRALBLATT FÜR DAS GESAMTE FORSTWESEN. VOL. 50, PARTS 1/3.

Siberian Larch, near Raivola, Finland.

(*The original article appeared in Vol. V, "Transactions of the Finnish Forest Research Institute." Author, Dr. L. Ilvessalo, Helsingfors. The following note is translated from an extract given by Professor Cieslar, Vienna.*)

The woods referred to in the article are situated in the province of Raivola, close to the Russian-Finnland frontier. They lie in latitude 60° 14′ N. on both banks of the Lintula. The area extends to 26 acres of pure larch and almost 8 acres of larch mixed with pine spruce. The larch is *L. sibirica.* The most westerly boundary of the natural province of this larch passes through a point about 120 miles to the east of the woods described in the article, The oldest parts of the woods were formed by sowing in 1738, and they were intended to provide timber for shipbuilding. Younger parts of the woods were laid down in the period 1773–1821. Investigations into the progress of growth were commenced in 1903. Seven sample plots were then installed and the results were first published in the *Transactions* of the Petrograd Forest Research Institute. Only dead trees were removed during the history of the woods.

The climate of Raivola is more insular in character than that of the natural home of the Siberian larch. The growth period is 141 days; the sky is commonly overcast and the relative humidity of the atmosphere is high. The average precipitations amount to about 23·62 inches; of that quantity about one-third falls in the period June–August. This latter circumstance must be considered along with the fact that the temperature in the period is low. The soil is deep, being about 1 foot to 18 inches, and it is free; the humus layer is thick, and below the humus there is a sandy or loamy soil. The subsoil is sand or hard clay. The woods belong mainly to the *oxalis* type.

The following figures refer to the originally formed pure larch parts of the woods.

No. of plot.	Area.	Planted or sown.	Planting distance.	Age in 1921.	No. of stems per ac.	Av. height.	Av. diam. B.H.	Vol. over bark.
	Acres.		Feet.	Years.		Feet.	Inches.	cu. ft.
1	4·35	Sown	—	183	190	122·7	16·6	14,900
2	23·08	Planted	13–14	183 in N. 148 in S.	135s.	125	17¾–18½	11,500
3	6·25	Planted	13	148	149	125·3	16·61	12,700
4	3·88	Planted	14 & 10½	110	120	113·8	15½	7,750
5	7·90	Planted	14	148	135	119·4	—	9,300

General Notes.—In plot 1 the highest tree measures 137·8 feet. There is a natural spruce undergrowth of 85–115 years, which gives a further volume yield of 1,410 cubic feet. In plot 2 there is also a naturally sown spruce undergrowth. In plot 3 there is a wind-sown spruce undergrowth of 70–85 years.

In the mixed woods the larch has been grown without any attention to the light demands of the tree, and it is everywhere inferior to the pure larch.

A comparison between plots 6 and 9 of the mixed larch plots allows a comparison between the development of sown and planted larch as follows:—

	Sown larch.	Planted larch.
Age	100–110 years.	100 years.
Stems per acre	106.	118.
B.A. per acre	95·5 sq. ft.	105 sq. ft.
Mean B.H. diameter	14·95 inches.	14·56 inches.
Mean height	95·14 feet.	95·14 feet.
Vol. per acre	4,100 cu. ft.	4,700 cu. ft.

An eighth plot of exceptionally high volume was added to the original number of sample plots by Ilvessalo. The plot shows that in Raivola the Siberian larch may produce a higher volume return per acre than either spruce or pine, and that yields of 11–14 thousand cubic feet per acre may be obtained.

Plot 8 is probably the highest volume producing larch wood in Europe: the following figures give an idea of the character of the plot:—

Volume per ac. larch only	23,400 cu. ft.
Volume per ac. larch and spruce ..	29,400 cu. ft.
Mean height	127·6 ft.
Mean B.H. diameter	17·28 in.

Height growth in the older larch woods has now ceased and the increment per cent. in volume of the older trees is low.

Bark volume per cent. varies between 25 and 13; in trees of 183–148 years of age it is about 16.

Form factor lies between 0·38 and 0·52. The average figure is 0·44.

Wind blown trees are common where the soil is loose. Windbreaks are not common. *Dasyscypha* is not present in the woods, but heartrot caused by *P. Schweinitzii* has been noted.

J. FRASER.

THARANDTER FORSTLICHES JAHRBUCH, 1924.

Cultivation of Broad-leaved Trees.—Forstmeister Graser, in concluding his lecture on the cultivation of broad-leaved trees in the Erzgebergr, gives as his reasons for the lack of success attained:—

(*a*) The lack of sufficient quantity of beech in mixture with the more valuable species, oak, ash, &c.

(*b*) The planting of broad-leaved trees on large bare areas without sufficient shelter.

(*c*) The use of too few and too large transplants.

He recommends further developing of the selection system and natural regeneration.

Nun moth.—Prell, of Tharandt, writes an interesting account of an investigation he undertook to discover why certain spruces were left untouched when all the surrounding trees were eaten bare by the larvae of the nun moth.

His conclusion is that the cause of immunity of these trees is due to the larger quantity of tannin contained in their needles.

Smoke Damage.—In a practical article Forstmeister Konig gives the result of his experience regarding smoke damage in the neighbourhood of Freiberg (Saxony), where the emission of sulphur dioxide from the large smelting works has long been a source of danger to the surrounding forests. With reference to the relative immunity of different conifers he gives it as his opinion that Austrian pine suffers least and spruce most. Both Scots pine and Weymouth pine appear considerably less affected than spruce. Larch being deciduous was planted with great hopes, but experience has proved that this species is little if any more capable of resistance than spruce. Among the broad-leaved trees birch and aspen appear to be the least harmed by the fumes.

The writer appears convinced that the soil becomes also poisoned in the course of time, and emphasises the necessity of its cultivation if good results are to be obtained in replanting. He recommends that areas to be dealt with should be completely ploughed, and where raw humus is present in unduly large quantities that lime should be applied.

Cause of Reduced Increment.—For many years past the basis upon which the felling regulations of the Saxon State forests have been built is to be found in the endeavour to obtain the greatest interest per cent. on the capital value of the land and timber involved.

Owing to the reduction in increment of the spruce forests which has of late years caused the authorities considerable anxiety this economic basis of management has been considerably criticised. Geheimer Forstrat Martin, in an interesting if rather technical paper, seeks to show that the cause of this reduction in increment is due not to the economic theories (of which he is one of the chief supporters) upon which the management is based, but to faulty sylviculture. As he points out clear felling is not an essential result of the economic management, and this method, combined with faulty thinning he condemns as being largely to blame for the present reduced increment. So great is the movement now existing in Saxony against clear cutting that a new word (Dauerwald) has been coined to express systems of sylviculture whereby the soil is never laid bare.

Dr. Martin concludes his discussion of the subject by asserting that there is no real conflict between the natural and economic theories of management provided that the latter are properly understood and properly employed.

A. D. Hopkinson.

REPORTS OF THE SWEDISH INSTITUTE OF EXPERIMENTAL FORESTRY, No. 20, 1923.

Botany, Hydrology and Development of a North Swedish Bog-complex.

The first article in this number is of very great interest and importance—more so than the title would imply. "Degerö Stormyr" is a research into botany, hydrology and development of a north

Swedish bog-complex, by Carl Malmström. It is the outcome of at least ten years' experience of the area dealt with, and of four years' continuous work on the task in hand.

There are immense tracts of boggy ground in North Sweden, and the problem of dealing with these has occupied the attention of the Research Institute since 1909. Malmström took on this work in 1919, and this report is the result. He has concentrated particularly on the following aspects of the question: vegetation, water conditions, peat, geological structure and development of the bog-complex of Degerö Stormyr. He has been fortunate in having the co-operation of many eminent scientific workers, and Professor H. Hesselman in particular.

The work is divided into six chapters, and is illustrated by a number of photographs, plans and maps.

Chapter I gives a descriptive survey of the natural conditions of the area and deals with the situation, boundaries and physiography of Degerö Stormyr, the temperature and rainfall, and influences of cultivation. The bog-complex is located in south-east Västerbotten, at a latitude of 64°, and covers about 6·5 square kilometres at an elevation of 750–200 feet above sea-level. The bed-rock is gneiss, which is rarely exposed. The soils are exclusively morainic and peat deposits. Low morainic mounds are scattered above the general surface of the peat, and these usually carry some pine and spruce. The surface is rather irregular on the whole. The average depth of peat is about 9–12 feet, 25 feet in the deepest part. Ten small lochans occur over the area, and a fair-sized lake of 28 acres in extent. The water supply is mainly atmospheric, the mean annual rainfall being less than 20 inches.

Chapter II deals in detail with the vegetation of Degerö Stormyr. The principles of classification and methods of analysis are described, the terminology of R. Nordhagen being followed. The various plant societies occurring in the bog-complex are very fully dealt with. To judge from these descriptions several of the societies are replicas of some found in this country, especially in north-east Scotland, and a large number of the species are common with us. A section of this chapter deals with the tendency of these bog plant associations to extend and their succession. This is followed by a very interesting section dealing with random ecological studies of plant associations, *e.g.*, a study of the amount of available mineral matter in the soils ; a study of the oxygen content in the water in the different plant associations ; a study of the water level in the ground, and a discussion on the origin of " troughs " and " crests " in peat bogs. The value of the different species of Sphagna as soil moisture indicators is emphasised.

Chapter III deals with Peat Soils and Deposits, and is a very valuable portion of the work. Various types of peat are described and methods of investigating peat soils. Much space is also given to the determination of the " mother-societies " of peat deposits, *i.e.*, the plant societies from which they have arisen. The peats of Degerö Stormyr are then dealt with in detail. In the investigation of these numerous pits were dug and samples collected, so that five transverse sections through the bog could be mapped. These sections are shown. Accompanying this is a list of the peat fossils met with. By means of these fossils the mother-societies can often be identified, and from a study of the sections some idea of the succession of the societies is obtained.

Chapter IV is another valuable chapter in which the water conditions of Degerö Stormyr are described. This is probably the chapter of most practical value and importance. The writer goes very carefully into the hydrology of peat soils in general. He has devised a method for determining the degree of permeability to water of various kinds of peat, and he finds that quite large differences occur. The water supply and drainage of Degerö Stormyr is then described in detail. An important section is given over to the water courses in the bog-complex, not only on the surface but *under* the surface of the peat. These subterranean courses are really former surface water courses which have been overgrown. Then follows a discussion on various swamping processes, of which three types are described. The last section of the chapter deals with the planning of a drainage system for Degerö complex on the basis of the results of the hydrologic investigation. Methods now in use are criticised. The principles to go upon should be: (1) provision of a better escape for the surplus water by deepening of outlet ditches and streams; (2) provision of girdle drains round the solid ground bordering the bog to prevent surface water reaching it, and to check its growth: and (3) facilitate the delivery of the water in the bog to the main outlet ditches. The tap-drains should be dug in those peat layers which are least compact and most permeable. As such layers occur over the former water-courses, irregular winding drains will probably be best. The writer states, however, that these rules are not important on shallow peat soils, which are very uniform. In such cases one should concentrate on the provision of a more direct escape to the terrestrial supplies. Practical suggestions for the draining of Degerö Stormyr are then given.

Chapter V deals with the history of the development of Degerö bog-complex, and is of considerable interest. It contains a long discussion on the value of pollen grain analyses as a means of determining the age of peats, of correlating different deposits and of illustrating the composition of the former forests. A critical attitude is adopted. From his own data the author concludes that the rate of growth of the peat in the last 4,000 years has been much slower than in the period just following the retreat of the ice sheet, 7,000–8,000 years ago. There has been great variation in vertical growth from $1\frac{1}{4}$ to $6\frac{1}{4}$ feet in 4,000 years.

Chapter VI deals with the climate in the coast region of Västerbotten during post-glacial times, as shown by the data. The evidence appears to show no clear change in climate since the retreat of the ice sheet.

No paper of greater ecological importance and practical value to forestry has yet been published. There is a German *résumé* and a lengthy bibliography.

Otiotthynens Ovati.

An article by Spessivtseff, assistant in the entomological section, is a contribution to the knowledge of the morphology and biology of

Otiotthynens ovati. The larva of this beetle had caused severe damage to three-year spruce in a Swedish nursery, attacking the roots. In the second year of the attack 400,000 plants were destroyed.

Deformation of the Root System of Pine by Spit-Planting.

Edvard Wibech, who is in charge of the regeneration research in Lappland, contributes an article of considerable interest on the above subject. The article is in two parts, the first of which gives a general survey of German and Swedish literature on the subject. The second part gives the data upon which the writer bases his conclusions.

The planting tools used appear to have been of two types, namely Paulis's conical spade and Lindberg's model, with a thicker, more cylindrical form. These are used for making conical or cylindrical holes in the ground, into which the plants are placed. Loose earth is then filled in around the plants.

The summary of the results obtained is briefly as follows:—Spit-planting carried out in the way described on moraine ground, in the case of a large percentage of pine plants, results in an unnatural position for the roots, which is followed by a deformed root system in the young trees. This deformation is always more frequent and more pronounced the older the plants used. With one-year plants half to two-thirds of the plants develop deformed roots and about one-fifth so markedly deformed that they cannot live; with two-year plants two-thirds of all the young trees have abnormal roots, and a quarter markedly abnormal roots. The corresponding figures for three-year old plants are three-quarters and one-quarter.

For some years the marked deformation of the roots may have no effect on those parts of the tree above ground; in fact, the growth of such parts, especially the very base of the stem, may be stronger than normal even up to 15 years. This fact should be noted, since when it comes to thinning young spit-planted woods it may lead to a wrong choice of individuals. Sooner or later, however, the trees with markedly deformed roots die off after a short period of decline, as may be seen in north Swedish plantations. A further research, however, in somewhat older plantations is required to confirm the cause of such deaths.

The danger which accompanies spit-planting is not confined to this method, but probably, though to a smaller degree, also occurs in all planting with bare roots, *e.g.*, planting in open pits.

The best method of preventing root deformation is to be looked for in suitable choice and handling of material rather than in the choice of planting method. The method in use has advantages of economy and suitability for remote localities.

The old methods, which were believed to make planting safe, *i.e.*, choice of age, transplants with well-developed root-systems; pruning of these and puddling before planting out, have proved to be faulty and calculated to lead away from instead of towards the object desired, which is to produce the natural form of root-system. In order to obtain natural root-systems after spit-planting, material should be used whose root-systems can develop their side branches *after* planting. This is attained either by using quite young plants with mainly unbranched roots or using older plants, whose root-systems, by shortening of their *side branches* immediately before use, acquire the same form as the one-year plants. New branches grow out from the cut surfaces, which come to take up the correct position in the ground. It is necessary, however, for the success of such a plantation, that at first there should be no lack of water in the soil to which the maimed roots are naturally very sensitive.

Since spit-planting, in order to be a success, thus requires a careful individual handling of each plant and has also to be rather delicately steered between, on one hand, the Scylla of drought, and on the other, the Charybdis of root deformation, it must be owned that sowing of seed is to be preferred to planting with bare roots in all cases where the former has any chance of success.

The Importance of the Origin of Pine Seed.

The fifth article is a long and important one on "The Origin of Pine Seed: the Most Important Sylvicultural Problem in Lappland," by Professor Gunnar Schotte, Chief of the Research Institute.

Seed was collected in 1909 from trees in various localities of ages ranging from 50–100 years. The cones were gathered on the standing trees with Mårtensons cone-value. The localities were 24 in number ranging from Smaland in the south, latitude 57°, to Norrbotten, latitude 66°. The seed was sown in 1909 in nurseries at eight different places. The plants were left two years in the nursery, in one case three years, and were planted out in the field in 1911–12. Thirteen research plots were laid down, ranging from latitude 60° 45′ to latitude 67° 12′. The total area of these plots was 39 acres, and they contained 223 different sections. In addition four plots were sown in the field.

The main part of the article consists of detailed descriptions of the various plots, and gives a working plan of the experiment. Then follows a discussion of the results under five heads, namely: (1) Percentage of plants destroyed; (2) crookedness of plants; (3) height-growth; (4) resistance to *Phacidium infestans*; and (5) longevity of needles.

The conclusions of practical value are as follows:—

In the cultivation of pine forests the greatest possible care should be taken that the seed used for the formation of plantations is suitable. Preference ought to be given to seed from the planting locality, but if pine seed has to be brought from another locality it should be taken from a district with a climate approximately similar to that of the planting area.

As a guide the temperature during the vegetative period can be used. In the present instance the country has been divided up into temperature zones according to the mean temperature during the months of June–September. A movement of pine seed in one and the same zone may be carried out with little risk. Quite good planting results should also be got with seed from a zone with a temperature 1° warmer. Precautions, however, should be taken in moving seed to the north, not to take seed from a warmer zone more than about 3° of latitude from the planting ground. In such a movement also attention should be paid to differences in altitude. Lastly, good planting results can certainly be obtained by moving seed from a colder zone to a warmer. A movement of seed from a milder to a harsher climate across two of the zones described is to be condemned at all costs. The difference in the mean temperature between two adjoining zones is 1° C.

The research further shows that *Phacidium infestans* generally, and more especially in Upper Lappland, attacks plants from a milder climate to a much greater extent than those which come from a climate more like that of the planting locality; that plants from a harsher climate seem more or less hardier against *Phacidium* than plants from seed of the locality, and that the age of the needles on 10–13-year old pine plants of south Swedish origin is, in Lappland, greater than it usually is in the milder climate from which the plants have originated.

The reason for the early forest plantations in Lappland being failures to so great an extent is mainly due to the fact that for the locality in question unsuitable pine seed was used.

In a footnote Schotte mentions that the same researches do not apply to Norway spruce.

Forest Entomological Report.

Forest Entomological Report II completes this volume. It deals with *Chelosia morio*, Gett., *Pissodes piniphilus*, Herbst., *Orchestes testaceus*, Müll, and with *Trichogamma evanescens*, Wertes, and other parasites attacking *Lyda signata*.

M. L. Anderson.

SKOGSVÅRDS FÖRENINGENS TIDSKRIFT—SEPTEMBER-OCTOBER, 1923.

Carbon Assimilation of Forest Trees.

This issue of the Swedish Forestry Society's Journal contains two lectures, delivered at the 1st Scandinavian Forestry Congress, on Carbon Assimilation of Forest Trees. The first is in Danish, by P. Boysen Jensen, the second in Swedish, by M. G. Stålfält.

Hardwoods.

The article by Boysen Jensen deals more particularly with hardwoods. He approaches the subject of the effect of thinning upon timber production from a new angle, namely, from the plant-physiological point of view and endeavours to show why there should be an increase in production as a result of heavy thinnings.

He deals with the material and agencies necessary for timber production and assesses the gains and losses of matter in the life-processes of the tree. He then shows how the various factors are affected by heavy thinning and examines each gain and loss in detail. Curves of assimilation against light intensity are shown for elder to illustrate how a maximum of assimilation is reached with comparatively low light intensity, while the increase in the intensity thereby does not encourage greater assimilation. He then shows diagrammatically how an undulating canopy is in a position to assimilate three times as much as a flat canopy, and argues that as heavy thinning induces large crowns, and a canopy with relatively large surface area, production must be greater.

Losses by leaf-fall, branch-fall, &c., are mentioned.

Some new data are given on loss from the wood of the stem by respiration as ascertained by D. Muller. Loss of material from branchwood of ash was 19 per cent. per annum. For beech, 8·3 per cent. and for spruce 11·2 per cent. In 34 years old ash with a height of 15 metres, the percentage loss was 2·8 per cent. per annum.

It is then suggested that trees, grown in the open, probably establish an equilibrium between gain by assimilation and loss by respiration in stem and branches, whilst in a dense wood, the correct proportion between stem and crown is upset, so that relatively a much greater amount of material formed by assimilation is lost by respiration from the stem and branches. Spruce is cited as an extreme example of the evil effects of too close a canopy.

Frequent and careful thinnings are advocated as the correct procedure. He argues that timber production should be greater—(1) because the deeper crowns result in greater assimilation, and (2) because the tree works more economically in a heavily thinned stand.

Soil factors are briefly dealt with.

It is proposed to initiate a very intensive research on four sample plots, two of beech and two of ash, into the gains and losses of material in lightly and heavily thinned woods and the methods of measurement proposed are described. One feature of these is the determination of leaf-surface and material in the leaves per unit of area by weight from felled sample trees. Loss by respiration is also to be determined from sample trees. It is hoped that useful information will be gained, especially as the research, which is to cover 10 years, breaks entirely new ground.

Scots Pine and Spruce.

In Stålfält's article the carbon-assimilation of Scots pine and spruce are specially dealt with, particularly in relation to temperature and light intensity, and results of original researches are given. In the temperature study the light intensity was kept at one-tenth of the sun's light on a clear summer day, while the temperature was varied between 5·5° and 32·5°.

Two pairs of graphs are given, one for pine and one for spruce. The first of each pair deals with temperature and the second with light intensity.

The temperature graphs show that assimilation increases with temperature for both species but more rapidly with spruce. The ncrease is fastest at first but falls off gradually. A sudden drop occurs in spruce at 25° and immediately above that irregular fluctuations take place in both species.

Respiration curves are also shown beside the assimilation curves. This also increases with the temperature. Between 25°-27·5° (pine, 22·5°-27·5°) the respiration curve increases more rapidly than the assimilation curve.

Rise in temperature has not the same effect on the two species. Spruce assimilation increases most rapidly up to 15°. The rise thereafter to 25° is not so marked. With pine the increase is more even from 5° to 17°. Between 17°-23° pine is rather insensible to change in temperature.

Still higher temperatures result in a fall for both species. and this is true at a few degrees lower for pine than for spruce, being 21°-22° compared with 25°. It thus seems that spruce demands more warmth than pine and also endures higher temperatures better. In relation to its maximum assimilation, pine assimilates more strongly at 5° than spruce and is more irregular above 22°. Compared with other plants which have been dealt with, both tree species have relatively smaller use for warmth above 12°.

In regard to light intensity, the graphs show that with both trees the more light the better, even up to the full light of a clear summer day. This is quite different for other species which have been examined, where a maximum is attained at half or less of full light. Pine compared with spruce requires less warmth and more light.

It would seem that the most favourable condition is direct sun light with a temperature of 22° for pine and one of 25° for spruce, but as a matter of fact, the temperature in the needles is always 5° or even more higher than the air temperature, so that about 15° and 20° would be more favourable.

It is stated as remarkable that with both species the power of assimilation is preserved practically unimpaired in the older needles of previous years. Only the oldest spruce needles show any appreciable fall-off. Conifers may thus produce food earlier in the spring and later in the autumn than hardwoods.

Some interesting remarks are made on the time of closing and opening of the stomata and it is concluded that the most effective days for assimilation are sunny days following rain.

It is pointed out that the usual temperature varies between 5° and 16°, just over the range where the assimilation is most susceptible. Falls of temperature in summer are thus of great importance to assimilation in such conditions.

The results have an important bearing on the effect of the climate upon growth. In the growing season, northern latitudes have less warmth but more light than southern latitudes, where too great heat hinders assimilation. There is thus a compensation for low temperatures in northern latitudes.

Gases in the Atmosphere.

The third article by Lundborg on Gases in the Atmosphere consists mainly of a review of the literature on the subject, drawing attention to the unsatisfactory state of our knowledge generally on the problem.

A description of an experiment carried out by the writer is given with details of the instrument and method used. Protected cloth screens soaked in barium hydrate were exposed to the air around a sulphite factory and the SO_3 in the air interacted with the hydrate to form barium sulphate. In this way the relative quantities of SO_3 in the atmosphere at the stations selected were determined. As was to be expected, the higher SO_3 content was to the N.N.W. and E. of the source of the fumes, *i.e.*, away from the direction of the prevailing winds.

Measures of protection are dealt with. An American electric method (Cotrell's process) and a Continental method of " dissipator chimneys " of dealing with the nuisance at the source are mentioned.

Palliative sylvicultural measures are also described.

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SKOGSVÅRDS FÖRENINGENS TIDSKRIFT—NOVEMBER-DECEMBER, 1923.

SPRUCE ROTS.

The first article is of general interest. It is by Torsten Lagerburg and deals with the " Importance of Spruce Rots and their Effect on Production."

Polyporus (*Fomes*) *annosus* is given first place in order of importance and a review of existing knowledge regarding its distribution is given. Its mode of attacking young and old trees is dealt with, and amongst species of trees mentioned as hosts are *Pseudotsuga* and *Quercus rubra*. In addition, Rostrup's list of hardwoods attacked in Denmark is quoted. Some remarks are made regarding reasons for the severity of attacks on old arable land. Numerous references are made to Hiley's work *The Fungal Diseases of the Common Larch*, particular attention being paid to Hiley's infection experiment.

New work has been carried out by Lagerburg into the H-ion concentration of culture solution which the fungus prefers. Cultures of various P_H values were prepared and it was found that the tendency of the fungus was to alter all of these to a P_H value of 4·1. At the same time it was found that growth was most luxuriant in the culture originally of a P_H value of 5·9. Lagerburg, drawing attention to the fact that old agricultural ground usually has a P_H value of 6·0, concludes that on such ground the fungus probably finds conditions which suit it best. Greater acidity, he points out, will probably reduce the virulence of the disease. In neutral solutions, however, there is a considerable fall-off in the productivity of the fungus. He concludes with a few remarks on the need for care in planting and on the difficulty of combating the fungus.

Other fungi damaging spruce are dealt with in less detail.

Polyporus (*Trametes*) *pini* is next dealt with, being distinguished from the last in being a stem fungus and not a root fungus.

The so-called "Spring-or well-rots" are next described. These are strictly localised in the stem below breast-height and the species he mentions in this connection are *Polyporus vaporaria*, *P. Schweinitzii* and *Armillaria mellea*.

Top-rots or rots attacking the upper part of the stem, where it has been broken over by snow, &c., are given. This is a subject to which the writer has given much attention and his work has yielded fresh information. From his culture experiments he has shown definitely that *Stereum sanguinolentum* is responsible for at least some of the damage.

Rots resulting from fungi lodging in blaze-marks are also described. It appears that sometimes trees are blazed and not cut for five years or more. *Stereum sanguinolentum* commonly occurs under these conditions.

Two fungi attacking stored timber are also described, *Corticium evolvens* and *P. abietinus*.

The article is illustrated by several excellent photographs.

Technical Qualities of Paperwood.

The second article by Astrid Cleve v. Euler deals with the amount and variation of the lignin content of Swedish pine and spruce. It is the fourth of a series of researches into the technical qualities of paper-wood. Several diagrams are given showing variations in resin content and lignin content in various stems in both outer and inner wood.

CO_2 in Living and Stored Wood.

A short article by Hilding Bergström deals with "Changes in Sawdust and Wood-shavings during Storage" and specially touches upon the content of CO_2 in the wood of growing trees. In the wood of living pine, 6·2 per cent. of CO_2 and 14·4 per cent. of O_2 was found, while in spruce the figures were 5 per cent. and 16·7 per cent. respectively. It is suggested that the CO_2 may be borne to the leaves by the ascending sap and there utilised in assimilation. Apparently further researches are intended.

M. L. Anderson.

EXPERIMENT STATION RECORD.

Vol. 50, No. 1.

Soil.—A second contribution to the subject of hard-pan on certain Italian soils by A. De Dominicis, is summarised.

Conditions necessary to the formation of hard-pan are said to be (1) a dry climate and a subsoil consisting of a rocky mass rich in $CaCO_3$ and possessing a very active capillary system; (2) $CaCO_3$ dissolved in the capillary water and the presence of sufficient colloidal matter in the circulating water, and (3) the opportunity for hard-pan formation at the point of contact of soil and subsoil.

Protection.—E. C. Stakman in Minnesota has found the following fungi to be more or less universal in the soil and to cause damping off of conifer seedlings Fusarium, Pythium, Rhizoctonia, Botrytis and possibly Alternaria. He found no evidence that one kind was more susceptible than another to any one species. All except Botrytis were found in beds previously treated.

VOL. 50, NO. 2.

Utilisation.—According to W. B. Greeley in the *Lumber World Review* (1923), the waste in the utilisation of timber is estimated at 40 per cent. of the world's annual cut.

A study of the suitability of Western American species for sleepers is reported by O. M. Butler in the *Journal of Forestry* (1923). Western larch, Douglas fir, Port Orford cedar and redwood have the greatest strength values. Redwood, Port Orford and Incense cedars were found most durable. Except Western yellow pine, all species were relatively impermeable to preservative material. Douglas fir, Western larch, Sitka spruce and Alpine fir were more impermeable than Lodgepole pine, red and white firs and Engelmann spruce.

Soil.—Studies of evaporation from bare and cultivated clay and sandy soils have been carried out in Denmark by T. Westermann (1922). Evaporation was found to be always greater from clay than from sandy soils. On bare soils, evaporation was less than the total precipitation but became much greater where vegetation began to develop. Luxuriance of growth had also a marked effect upon the intensity of evaporation. Legumes were found to cause the greatest use of water per unit of soil surface, potatoes least. (Might be of practical value in nursery work.)

Protection.—E. A. Hartley (*Ohio Journ. Sci.* (1923)) describes a specially designed cage of sheet celluloid, found to be very satisfactory for rearing aphids, their parasites and scale insects.

J. Eriksson (*Arkiv. Bot.* (1922)) considers that the blister rust fungus (*Peridermium strobi*) on Weymouth pine winters within the cells of the tissues of the youngest joints or of the winter buds. After 20 years study of the hollyhock rust, resulting in the successful treatment of that disease without injury to the host plant, he suggests it may be possible to treat young pine seedlings so as to produce immunity from the blister-rust.

Nursery work.—Electroculture work in 1922–23 carried out in Britain is reported in the *Journ. Min. Agr.* (1923) and similar work has also been done in 1920–21 in France, in both cases on field crops. In both cases increased plant growth and crop yields resulted. Very marked increase in grain yield—up to 118 per cent.—was noted in Britain. It appeared that reproductive growth was accelerated as distinct from vegetative growth.

H. H. Kimball and B. G. MacIntyre (1923) have tested the efficiency of smoke screens for frost protection in America. The smoke was made by burning white phosphorus. The results confirm previous conclusions that the most effective and economic method of frost protection is to heat the lower layers of air by burning a cheap fuel. The cost of smoke cover, made by any known chemical method, is greater than heating by burning crude oil.

F. W. Harris [*Ecology* (1923)] studied frost lift in western yellow pine seedlings in 1919-20. Temperature, moisture, ground cover, shade and the anatomy of the plant were all found to be important. Injury is greatest in soils containing most water. Snow, brush and ground cover, litter and pebbles reduced; while shading is thought to have increased frost-lift.

Stem girdle of young spruce trees by excessive heat is described by C. F. Korstian and N. J. Fetherold in *Phytopathology* (1921) No. 12. This can be prevented to a slight extent by frequent watering, but the most effective control is to incline the trees slightly to the south at the time of transplanting.

Vol. 50, No. 3.

Sylviculture.—Martin-Zédé has found in France that care in resetting young trees in the same position with reference to the points of the compass resulted in a reduction of deaths from 50 per cent. to 6-8 per cent.

D. Dunning has some observations in a U.S. Dept. Agr. Bull. on regeneration fellings in the forests of California.

F. J. Lewis, in the *Canadian Alpine Journal*, discusses the factors governing tree-growth at the upper limit of vegetation, and expresses his belief that wind and snow, rather than temperature, are the limiting factors.

Sample plots.—R. Summerby in connection with replication in relation to accuracy in comparative crop tests, states that large plots were more accurate than small ones. Increase in length of plot had greater effect in decreasing errors than increase in width. Frequent replication of small plots was more accurate than the use of the same area with fewer and larger plots. The Probable Error cannot be reduced below 2 per cent. nor can differences of yield of less than 6 per cent. be determined with certainty, unless 8 to 16 replications are made.

From Ceylon, C. H. Gadd advises the use of small duplicate plots over a large area for experiment with rubber plants.

Vol. 50, No. 4.

Sylviculture.—In his fourth study in tolerance of New England forest trees, G. P. Burns, of Vermont Station (*Bull.* 235, 1923) deals in detail with a method of determining the comparative light requirements of forest trees. He claims that for the first time, light requirement has been referred to a definite measurable standard. Pot-grown trees, enclosed in sealed jars filled with CO_2, are submitted to different light intensitites. The light is supplied by a special lamp and is recorded by means of a vacuum thermocouple. The effect of the light on the plant processes is to increase or decrease the organic material in the tree, which is reflected by a corresponding loss or gain of CO_2 in the jars. The point where the processes of respiration and photosynthesis balance is taken to be the minimum light requirement of the tree. The results were as follows:—Bull pine, 306; Scots pine, 287; White cedar, 186; Tamarisk, 176; Douglas fir, 136; Lodgepole pine, 136; Red oak, 133; Engelmann spruce, 106; White pine, 104; Norway spruce, 87; hemlock, 84; beech, 75, and sugar maple, 34.

These results point to Douglas fir being more light demanding than is usually supposed. The comparative shade-bearing capacity of White pine (*P. strobus*) is interesting. This method might be applied with interesting results to varieties within a species, *e.g.*, Scots pine, and to the remainder of our popular species.

Soil.—A series of studies on soil colloids by A. N. Sokolovskii (1919) leads to the general conclusion that these represent the active portions of soils and govern their physical and chemical properties and that the absorptive capacity of a soil is proportional to its content of colloidal material, *e.g.*, ammonia absorption was found to be greater in soils rich in lime.

It is stated also that soil acidity depends more on the inability of soils to absorb bases than on the actual amount of acids present.

A *résumé* is given of the results of studies of various treatments of deep peat agricultural soils, containing 90 per cent. of organic matter, by M. E. Sherwin (*Jour. Elisha Mitchell Sci. Soc.* 39 (1923)). These soils are said to have been unproductive, through accumulations of iron compounds. Lime and other fertilizers were applied. Results showed that *kainit* was beneficial, presumably because its potash helped the plant to withstand toxic iron. The chlorine in the kainit may have aided the passage of potash into the plant, while the sodium furnished a base to combine with nitrates and reduced the amount of ferric nitrate in the soil. *Sodium nitrate* acted beneficially in the same way as the sodium in the kainit. *Acid phosphate* was harmful and aided accumulation of toxic iron.

Nursery work.—A summary of data on the phosphatic situation in Germany by F. Aerebor (1923) refers particularly to the supplies of phosphoric acid in the soil. Tests have shown that there are larger supplies of total phosphoric acid in soils than have been suspected The difficulty is to render it available to crops. Lupines and serradella seem specially able to assimilate soil phosphoric acid, and it is concluded that their cultivation on a large scale would increase the supply of phosphoric acid.

Weed control.—It appears from a report of work with fertilizers by O. Nolte in Germany that potassium ammonium nitrate has a harmful effect on dandelion and sorrel.

Control of damping-off.—W. F. Bewley (*Journ. Min. Agr.* 28 (1921)) recommends a remedy for this disease, called Cheshunt compound. This contains two parts by weight of copper sulphate and 11 parts of ammonium carbonate, both reduced to a fine state and thoroughly mixed. The dry mixture is kept in glass or stone before use, when ½ oz. is dissolved in hot water which is then made up to one gallon.

Soil organisms are killed by the solution, immediately after which planting may occur without injury. It is said to be valuable against damping off of many seedlings and to give promising results with other root diseases. It will not cure seedlings already attacked.

Vol. 50, No. 5.

Sylviculture.—H. H. Chapman (*Journal of Forestry*, 1923, No. 7) reports that Lobiolly pine has very strong powers of recovery after suppression, even after a period of 63 years.

Ecology.—The " Value of Mineralogical Examination in Determining Soil Type," by J. Hendrick and G. Newlands (*Journ. Agr. Sci.* 13 (1923) No. 1) is a valuable paper from the Univ. of Aberdeen. giving the results of examinations of different types of soil. It was found that the soils, which were all of glacial origin, differed considerably in mineral content, dependent upon the nature of the rock from which the soil was derived. Soils from the drifts of sedimentary rocks were almost entirely of quartz with small quantities of silicates, while soils of basic igneous drifts at the other extreme, contained almost no quartz and much silicates.

The results as a whole, show that a short examination affords a useful method of grading soils according to the reserve of bases which they contain in the form of silicates.

Forest Botany.—" Carbon Assimilation," D. Thoday (*So. African Journ. Sci.* 19 (1922)) gives a critical review of recent findings by workers regarding some of the fundamentals of carbon assimilation.

Nursery work.—Some effects of cover over coniferous seedlings in New England are discussed by J. W. Toumey and E. J. Neethling. (*Yale Univ. School Forestry Bull.* 9, 1923.)

T. S. Hansen (*Journ. Forestry* 21 (1923) No. 7) has studied the effect of 15 fertilisers upon Norway pine and White pine seedlings sown in beds. Results were negative, control plots being best. The author believes that coniferous seedlings require very little plant food from the soil, and that, even in light sandy soil, healthy seedlings can be produced over a period of years.

A joint experiment carried out by the German seed testing station at Hohenheim and the Swiss Agric. Exper. Station at Oerlikon into the germination of White pine seed, showed that the Swiss method was much better. The seeds are soaked in spring water and laid away in a cool cellar for 30 days and then brought out into a warm chamber with a temperature from 22° C.-27° C. The effect of the low temperature is thought to be important.

H. Faes and M. Staehelin have carried out experiments on the destruction of the larvae of cockchafers (*Ann. Agr. Suisse* 24 (1923) No. 2). The grubs are remarkably resistant. Carbon disulphide affected them but the action of hydrocyanic acid gas and of chloropicrin was much more rapid.

Utilisation.—" Low Temperature Tars and Wood Preservation," R. P. Soule (*Amer. Wood Preserver's Assoc. Proc.* 19, 1923). Studies seem to indicate that the low temperature creosotes have the same penetration and absorption as ordinary creosotes. Their resistance to evaporation and leaching is greater, and their toxicity is much higher.

VOL. 50, NO. 6.

Soil.—A paper by A. P. Kelley on " Soil Acidity, an Ecological Factor " (*Soil Sci.* 16 (1923) No. 1) from the Univ. of Pennsylvania gives results of a study on five soil types.

Soil acidity increased to a depth of 15 cms. after which it decreased, the increase being greatest in the most sterile soils. Soil activity and soil productivity seem to be related. Slight variations from time to time in acidity show that plants growing there cannot be sensitive to slight variations. Excessive drying increased acidity and *vice versa.*

Absorbing roots were found chiefly in the least acid portions of soil and associated with fungi in the top 15 cms. of more acid soils, the fungi being less abundant in more alkaline soils.

"Significance of Mica Minerals as a Source of Potassium for Plants," V. M. Goldschmidt and E. Johnson (1923). Potash-bearing minerals and the availability of their potash contents have been investigated in Norway. The average K. content of Norwegian rocks was found to be with felspar 15 per cent., muscovite 5 per cent., and biotite, 10 per cent. The last two are of most importance owing to their wide occurrence and the relative ease with which the K. becomes available.

It is concluded that the acid and salt solutions in the soil have a marked solvent action on the potash in mica minerals, and that this is an important factor in plant life in Norway.

Vol. 50, No. 7.

Nursery work.—A report by W. Gleisberg from the Proskau Plant breeding station deals with seed stimulation as a means of higher production. 15 per cent. solutions of magnesium chloride and magnesium sulphate were used and immersions were made for two to three hours, when increased yields were obtained from certain plants.

Sylviculture.—S. B. Show has some results to give of experimental plantings in N. California. The importance of shade is emphasised, especially in dry seasons. Sequoia was particularly susceptible. Larger plants endured exposure better than smaller. There were more survivals in the shade of dense brush than in that of open brush. Poorly planted trees survived better with abundant shade.

Vol. 50, No. 8.

Soil.—From France, A. Demolon and P. Boischot report studies which show that the passive biological nature of peat is mainly due to its poverty in available elements, especially P_2O_5. Results of partial sterilisation of peat by heat are not due to destruction of toxins or protozoa but rather to favourable chemical modification of the peat.

From Norway, T. Gaarder and O. Hagem show that nitrification in the soil bears a fixed relation to H-ion concentration, that the optimum P_H value for nitrate formation is around neutral point or P_H 7, and that for nitrite formation about 7·8. Further studies are in progress.

From Oregon, W. L. Powers reports progress of a study of sulphur in relation to soil fertility. The leguminous plants respond markedly, potatoes moderately. A combination of sulphur, rock phosphate manure and lime has given maximum yields in recent experiment.

From Denmark, H. R. Christensen's work indicates that the lime requirement of Danish soils is clearly related to the growth of azotobacter in the soil. Strong growth shows good lime supply.

Protection.—J. V. Hofmann and W. B. Osborne, junr., conducted studies in Washington State into the connection between forest fires and the relative humidity. Fires did not spread when the relative humidity was more than 60 per cent. Between 50 to 60 per cent. rate of progress was slow and there was danger only in highly inflammable material. Between 40 to 50 per cent. there was greater danger. Between 30 to 40 per cent., 30 per cent. of the fires soon spread beyond control. Crown fires occurred when the humidity falls to 25 per cent. or less.

It is interesting to note that C. J. King in Arizona has found that the saturating of the soil with formaldehyde solution around centres of infection was an effective control against a root-rot fungus on cotton.

Sylviculture.—Notes on the White cedar of Virginia (*Chamæcyparis thyoides*) by A. Akerman suggest its possible value for swampy soils.

Vol. 50, No. 9.

Soil.—H. W. Johnson, of the Iowa Station, describes in *Soil Science* Vol. 16 (1923) an apparatus devised for physical soil analyses, after Oden's pattern. It appears to be able to register automatically.

Protection.—In Bulletin 4 of the Amer. Meteor. Society summaries of various papers on forest fires and weather conditions by various writers are given. 41 per cent. of forest fires in California and 35 per cent. in the Northern Rocky Mountains region are caused by lightning. Evaporation appears to be a better index of fire risk than precipitation.

W. S. Moir in a bulletin of the U.S. Dept. Agr. deals with the blister rust of White pine in Europe. In Russia it has been known for 65 years. Later severe attacks were reported in Finland. In some plantations more than 90 per cent. of the trees were affected and one-third were killed. It is not deemed advisable to plant White pine in Denmark, Belgium, Norway, Germany and elsewhere.

Sylviculture.—E. Rosseels in Belgium describes the beneficial effect of planting white alder with poplars and ash, said to be due to fixation of nitrogen by root nodules. In one case, Canadian poplars with the alder had an average diameter of 44 cms., while those without the alder showed only 29 cms.

Vol. 51, No. 1.

Protection.—A new method of applying corrosive sublimate for destroying earthworms is given by E. J. Marshall. A stock solution of corrosive sublimate 8 ozs., ammonium chloride 8 ozs., and water 1 gallon is prepared, 1 pint of which will contain the 1 oz. of corrosive sublimate to add to each barrel of water used.

Soil.—From Norway, B. H. Cranner reports pot experiments, the results of which indicate that biotite and sericite are satisfactory sources of potassium for certain crops.

From Russia, A. A. Kaluzhskii announces that sulphur in the soil increases the availability of rock phosphate. Large additions of sulphur increased the yield 5·5 times.

Vol. 51, No. 2.

Soil.—H. J. Harper describes in detail the phenoldisulphonic acid method of accurate determination of nitrates in soils in the *Indust. and Engin. Chem.*, vol. 16, 1924.

From Italy, U. Pratolongo has produced an extensive review of the latest facts, theories and opinions in regard to soil reactions, acidity and alkalinity, &c. He gives an extensive bibliography.

Vol. 51, No. 3.

Soil.—H. J. Page (*Jour. Agr. Sci.* England, Vol. 14, 1924) describes the perchlorate method of estimation of potassium in soils.

J. Constantin (*Rev. Sci.* Paris, Vol. 61, 1923) briefly discusses the problem of mycorhiza living in relation to roots of trees, more particularly conifers.

Sylviculture.—O. J. Lakari has investigated the seed-years of Norway Spruce in S. and Central Finland. Attention is drawn to the fact that age determination of spruce is uncertain owing to its adventitious roots and lack of distinct annual rings. Productive seed-years occur at intervals of three to five years. Seed-years of Scots occur usually one year before the spruce. Dry and warm summers are followed two years later by abundant seed years for Norway spruce and three years later for Scots pine.

E. Münch, in Germany, has an article on the bud expansion of Norway spruce and its relation to frost injury. Individual trees show variations in their time of bud-bursting. This is said to be due to stands being of mixed origin. Late budding favours height-growth. Up to 16 years of age buds open later every year. Trees from valleys open their buds later than those from the hills. Late-budded trees seemed to be more shade-bearing and of faster growth than early budders.

J. V. Hofmann deals in Bull. 1200 (1924) of the U.S. Dept. Agr. with the natural regeneration of Douglas fir in the N.W. Pacific Coast Region. Best growth is found on well-drained soils. Seed-crops are produced every two to three years. Buried seed lies dormant for long periods, thereafter germinating.

From Holland, H. van Vloten advises thinning of Scots pine when quite young to prevent damage by overcrowding.

M. L. Anderson.

THE AUSTRALIAN FORESTRY JOURNAL.

January-November, 1924.

This Journal may be described as mainly of a semi-technical nature and comprises chiefly articles on yield, afforestation including planting methods and selection of species, and the forestry programmes and accomplishments in the various States of the Commonwealth; as in other countries with large areas of natural forest, the logging-methods of the past have been extremely wasteful and attention is drawn to this, with a plea for betterment in the future, this plea seems in a fair way to fulfilment. It is of interest to note that the exotic trees now being largely planted in Australia are principally from the Pacific Coast and correspond with those being used in this country ; the most important factor, in Australian forestry, at least as regards conifers, would appear to be the rapid growth of *Pinus insignis* which there obtains ; this tree attains a height of 80 feet in 16 years, in some cases, and is thus planted at a spacing of 8 feet × 8 feet and the net result of the high yield per acre, with low cost of establishment, is that many private companies have been formed which are growing timber as a commercial proposition. It is stated that in (*e.g.*) New Zealand the cost of establishing a plantation at 8 feet × 8 feet should in no case exceed £7 per acre, inclusive, and as even wider spacings (up to 20 feet) are advocated for long rotations, it is evident that with such a high rate of growth, forestry is anything but unattractive as a commercial venture.

In the May number there is an interesting article (reprinted from the Canadian magazine) on the gathering of forest-trees seed, and in the June issue a simple and straightforward description of planting-methods including an unusual method of notching, which would seem to have several good points, and to be applicable to certain soils in this country.

A French tree-felling machine is described in the February number (p. 49), and would seem well worth a trial in this country where the ground is sufficiently level to permit of its transportation with ease from tree to tree. This machine is called the *Scie-Rabot* and is manufactured in Paris by Serin et Cie. of 11, Rue de Belzunce ; it has a 6 h.p. 2-cylinder internal combustion engine, and uses a bandsaw of sufficient size to deal with a tree up to 5 feet in diameter, which it can fell in five to six minutes. As the saw can be rotated through 90 degrees so that it can be used for cross-cutting as well as felling, and the whole thing (weight is stated—probably incorrectly—to be 6,600 lbs.) is mounted on a two-wheeled cart, there is little doubt that provided the weight is such that it can be moved by hand from tree to tree (as would appear from the photos) the machine is worthy of the earnest attention of foresters in this country.

The September, October and November issues contain the commencement of a series of articles on Forest Entomology, and deal with *Tomicus solidus* (Eichhoff), *Aesiotes notabilis* (Pascoe), and others. In the November number occurs a description of a new and interesting botanical key evolved by Messrs. S. L. Kessell and C. A. Gardener.

For the rest the publication contains mainly articles which, whilst interesting, are primarily of domestic interest, and reprints from other forest journals, &c.

O. J. Sangar.

NOTES AND QUERIES.

Pine Weevil (Hylobius abietis).

Pine weevils were very numerous on one part of Auchenínnes this summer, 30,000 were caught by means of bark and billet traps on an area of about 4 acres growing Jap larch and Scots pine. These were attacked very severely early in May, the attack continued right on to the end of October, but by the end of the summer the trees had recuperated wonderfully, and put on a fairly good growth. This area previously carried a young conifer plantation which was cut out. The area is consequently full of stools, affording ideal breeding places for the weevil. One curious feature which I noticed was the large number of common crows which frequented this area when the weevil attack was at its height. I am strongly of the opinion that the crows were devouring large numbers of the weevil, but I could not get near enough to shoot one to prove this. It would be interesting to know if others have had a similar experience.

S. H. A. Paterson.

Stone Walls (making Rabbit Proof).

When there is a good stone wall round an area to be planted it is always advisable to consider whether it can be utilised as a rabbit fence when this is necessary, thereby saving a good bit in fencing costs. Round P24 at Screel Hill there is a stone wall 5 feet high, originally built this height to keep out goats. I found that it would be possible to peg it up and make it rabbit proof. This I had done, and it has proved very effective; it cost 1*d.* per yard. Round part of P25 there is also a fairly good wall though not quite so high as above-mentioned. This also I am utilising against rabbits by pegging up and running along the top an 18 inch width of netting. The cost will be 2*d.* per yard including netting, again saving a good bit in fencing costs.

S. H. A. Paterson.

Blackgame (Tetrao tetrix).

Blackgame were very numerous at New Galloway and Screel Hill last winter. They did a fair amount of damage amongst newly-planted larch, and from the time the buds began to burst out in the spring they kept picking off the young shoots till well into June. On one area especially at New Galloway of 2 or 3 acres the plants were completely stripped of every bud. A few old greyhens (female birds) were nesting near this area and made it their feeding ground. One day I found a grey hen which had been killed by a fox, I opened it and found its crop crammed with the buds and needles of larch, anything from 2–3 oz. From this it may be gathered how many plants one bird would have to strip to get a single feed, and the damage that even a few Blackgame can do. These plants have recuperated wonderfully during the summer, and have put on some growth, but, nevertheless, they have been severely handicapped, once more showing what destructive pests Blackgame are and the damage they are capable of doing amongst young forest trees.

S. H. A. PATERSON.

BULLFINCHES.

Bullfinches have at different times on a neighbouring estate here proved very troublesome in young plantations, mostly larch. They can be very destructive. They pick out the buds of the larch in the same manner as blackgame, but they will attack much older plants. They can be very destructive to young larch 5 and 6 feet high, but as plants of this size have a much better recuperative power than newly planted ones, damage by bullfinches seldom proves fatal. They are not troublesome on open hill areas except along edges of old plantations which they frequent. They are usually worst on small areas planted amongst older woodlands. Their natural food is usually the seed of heather. They are more destructive to the buds of forest and fruit trees in severe winters.

S. H. A. PATERSON.

SPRUCE IN MIXTURE WITH OTHER SPECIES.

Some doubt appears to exist regarding the suitability or otherwise of planting Norway spruce pure, and as large areas of this species are being planted, and will continue to be planted in the future the writer's experience of a plantation, which in its earlier stages was a mixture of larch, Scots pine and spruce, with the latter species representing the final crop, may be of some interest and I trust value.

The plantation was one of four acres, situated in Northumberland, about 600 feet above sea-level, more or less sheltered, the soil consisting of a sandy loam overlying the boulder clay. The method of planting was as follows : two Scots pine, two larch and one spruce, in lines 4 feet apart. The larch, owing to the prevalence of larch canker, were all removed when 12 years old, while the Scots pine were cut out and sold for pitwood when 20 years old, thus leaving the spruce pure on the ground. The latter species was felled in 1924 at the age of 39 years, and yielded some remarkably fine trees, a summary of which is set out below :—

Number of stems per acre ..	365.
Mean height (to 4 inches) top	54 feet.
Vol. per acre (T.o.b. felled)	5,640 cubic feet.
Total volume	22,561 cubic feet.

There can be little doubt from the information at the disposal of the writer—whose father had the supervision of this plantation throughout the 39 years—that the protection afforded the spruce up to its twentieth year contributed largely to the success of the plantation, and I am in agreement with the course adopted in removing the pines at this stage, as the spruces were rapidly overhauling, and in many cases, beginning to suppress the pines. Other species might suggest themselves as being more suitable as a mixture with spruce, but the Scots pine and spruce in this plantation proved a first-class mixture with the spruce as the final crop.

T. E. ANDERSON.

REGISTER OF IDENTIFICATION NUMBERS.

Forest Year, 1924.

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.

24/1 2,409 lbs. ; *Pseudotsuga Douglasii ;* 1923 ; Canada (Coastal region and Vancouver) ; Canadian Government.

24/2 1,070 lbs. ; *Pseudotsuga Douglasii ;* 1923 ; U.S.A. ; Gift from Mr. C. L. Pack.

24/3 10 lbs. ; *Abies nobilis ;* 1923 ; U.S.A. (Washington State) ; T. J. Lane.

24/4 2 lbs. ; *Pinus Jeffreyi ;* 1923 ; U.S.A. (California State) ; T. J. Lane.

24/5 2 lbs. ; *Picea alba ;* 1923 ; U.S.A. (Vermont State) ; T. J. Lane.

24/6 642 lbs. ; *Pinus maritima ;* 1923 ; France (Landes) ; Vilmorin-Andrieux.

24/7 100 lbs. ; *Quercus rubra ;* 1923 ; Italy ; Vilmorin-Andrieux.

24/8 15 lbs. ; *Hippophae rhamnoides ;* 1923 ; France ; Vilmorin-Andrieux.

24/9 31 lbs. ; *Pinus montana* var. *pumilio ;* 1923 ; Switzerland ; J. J. Roner.

24/10 2,107 lbs. ; *Larix europaea ;* 1922 ; Italy (Tyrol) ; J. J. Roner.

24/11 223 lbs. ; *Larix europaea :* 1923 ; Austria (Tyrol) ; J. Jenewein.

24/12 900 lbs. ; *Picea excelsa ;* 1923 ; Austria (altitude 980–1,640 feet) ; J. Stainer.

24/13 724 lbs. ; *Pinus laricio ;* 1923 ; Corsica ; J. Grimaldi.

24/14 533 lbs. ; *Pinus laricio ;* 1923 ; Corsica ; O. J. Rossi.

24/15 1,273 lbs. ; *Picea sitchensis ;* 1923 ; Canada (Queen Charlotte Islands, British Columbia) ; Canadian Government.

24/16 70 lbs. ; *Abies grandis ;* 1923 ; Canada ; Canadian Government.

24/17 24 lbs. ; *Larix europaea ;* 1923 ; Silesia (Sudeten) ; A. Gebauer.

24/18 68 lbs. ; *Alnus incana ;* 1923 ; Silesia ; A. Gebauer.

24/19 15 lbs. ; *Pinus ponderosa ;* 1923 ; Canada (Long Lake, British Columbia, altitude 3,000 feet) ; Canadian Government.

24/20 10 lbs. ; *Pinus ponderosa ;* 1923 ; Canada (Salmon River, British Columbia, altitude 2,200 feet) ; Canadian Government.

24/21 1 lb. ; *Pinus ponderosa ;* 1923 ; Canada (Kamloops, British Columbia, altitude 1,100 feet) ; Canadian Government.

24/22 1 lb. ; *Pseudotsuga Douglasii ;* 1923 ; Canada (Craigellachie) British Columbia, altitude 1,400 feet) ; Canadian Government.

24/23 1 lb.; *Pseudotsuga Douglasii;* 1923; Canada (Shuswap Lake, British Columbia, altitude 1,200 feet); Canadian Government.

24/24 1 lb.; *Pseudotsuga Douglasii;* 1923; Canada (Louis Creek, British Columbia, altitude 2,600 feet); Canadian Government.

24/25 1 lb.; *Pseudotsuga Douglasii;* 1923; Canada (Salmon River, British Columbia, altitude 2,200 feet); Canadian Government.

24/26 12 lbs.; *Thuya plicata;* 1923; Canada (Lower Fraser Valley, British Columbia); Canadian Government.

24/27 1 lb.; *Sequoia sempervirens;* 1923; U.S.A. (Fort Bragg, California); American Government.

24/28 1 lb.; *Pseudotsuga Douglasii;* 1923; U.S.A. (Fort Bragg, California); American Government.

24/29 10 lbs.; *Torreya californca;* 1923; U.S.A. (Fort Bragg, California); American Government.

24/30 350 lbs.; *Pinus laricio;* 1923; Corsica; J. Pantalacci.

24/31 222 lbs.; *Larix europaea;* 1923; Switzerland (Western Alps); J. Rafn.

24/32 66 lbs.; *Pinus montana* var. *uncinata;* 1923; France (Mont Louis, Pyrenees); French Government.

24/33 216 lbs.; *Larix europaea;* 1923; Austria (Tyrol); A. Grünwald.

24/34 1,094 lbs.; *Pinus sylvestris;* 1923; England (Eastern Counties); own collection, extracted Bentley.

24/35 365 lbs.; *Pinus sylvestris;* 1923; England (Southern Counties); own collection, extracted Bentley.

24/36 79 lbs.; *Pinus sylvestris;* 1923; England (Western Counties); own collection, extracted Bentley.

24/37 87 lbs.; *Pinus maritima;* 1923; England (Southern Counties); own collection, extracted Bentley.

24/38 35 lbs.; *Pinus austriaca;* 1923; England (Eastern Counties); own collection, extracted Bentley.

24/39 90 lbs.; *Larix europaea;* 1923; England (Western Counties); own collection, extracted Bentley.

24/40 ¾ lb.; *Picea omorika;* 1923; Serbia; The Landowners' Co-operative Forestry Society, Edinburgh.

24/41 500 lbs.; *Pseudotsuga Douglasii;* 1923; U.S.A. (Thurston-Pierce and Lewis Counties); The Manning Seed Co.

24/42 ½ lb.; *Picea excelsa;* 1923; Switzerland (altitude 5,250 feet); gift from Swiss Forestry Service.

24/43 ½ lb.; *Picea excelsa;* 1923; Switzerland (altitude 2,300 feet); gift from Swiss Forestry Service.

24/44 ½ lb.; *Larix europaea;* 1923; Switzerland (altitude 4,430 feet); gift from Swiss Forestry Service.

24/45 ½ lb.; *Pinus austriaca;* 1923; Switzerland; gift from Swiss Forestry Service.

24/46 $\frac{1}{2}$ lb.; *Pinus montana* var. *uncinata*; 1923; Switzerland (altitude 5,900 feet); gift from Swiss Forestry Service.

24/47 48$\frac{3}{4}$ bushels; *Quercus pedunculata* and *Quercus sessiliflora*; 1923; England (Swaffham); own collection.

24/48 805 lbs.; *Quercus pedunculata*; 1923; England (Chiddingfold); own collection.

24/49 56 lbs.; *Castanea vesca*; 1923; England (Alice Holt); own collection.

24/50 8 bushels; *Pinus laricio*; 1923; England (Dunster-Luttrell Wood); own collection, extracted Bentley.

24/51 330,000 transplants (2 + 2); *Pseudotsuga Douglasii*; crop year unknown; origin unknown; English Forestry Association.

24/52 270,000 seedlings (1 year); *Larix leptolepis*; crop year unknown; origin unknown; English Forestry Association.

24/53 300,000 seedlings (2 years); *Larix leptolepis*; crop year unknown; origin unknown; English Forestry Association.

24/54 290,000 seedlings (1 year); *Larix europaea*; crop year unknown; origin unknown; English Forestry Association.

24/55 595,000 seedlings (2 years); *Picea sitchensis*; crop year unknown; origin unknown; English Forestry Association.

24/56 380$\frac{3}{4}$ lbs.; *Pinus sylvestris*; 1923; Scotland (N.E.); own collection, extracted various centres.

24/57 1$\frac{1}{2}$ lbs.; *Pinus sylvestris*; 1923; Scotland (N.W.); own collection, extracted Tulliallan.

24/58 51 lbs.; *Pinus sylvestris*; 1923; Scotland (S.E.); own collection, extracted Tulliallan.

24/59 1$\frac{3}{4}$ lbs.; *Pinus sylvestris*; 1923; Scotland (S.W.); own collection, extracted Tulliallan.

24/60 12 lbs.; *Pinus sylvestris*; 1923; origin unknown; Howden & Co., Inverness.

24/61 1$\frac{3}{4}$ lbs.; *Picea excelsa*; 1923; Scotland (S.E.); own collection, extracted Tulliallan.

24/62 4 lbs.; *Betula alba*; 1923; Scotland (S.E.); own collection, extracted Tulliallan.

24/63 30 lbs.; *Acer pseudoplatanus*; 1923; Scotland (S.E.); own collection, extracted Tulliallan.

24/64 8 lbs.; *Larix europaea*; 1923; Scotland (N.E.); own collection, extracted various centres.

24/65 40,000 transplants (2 + 2); *Pinus sylvestris*; 1919; Scotland (Lower Morayshire); J. Jones & Son, Huntley.

24/66 80,000 transplants (2 + 1); *Pinus sylvestris*; crop year unknown; origin unknown; Smith & Meldrum, Forfar.

24/67 500 transplants (2 + 2); *Pinus montana* var. *uncinata*; 1919; Austria (Tyrol); Howden & Co., Inverness.

24/68 90,000 seedlings (3 years); *Larix europaea;* crop year unknown; origin unknown; Ministry of Agriculture, Ireland.

24/69 ¾ lb.; *Larix europaea;* 1923; Scotland (S.E.); own collection, extracted Tulliallan.

24/70 20,000 transplants (2 + 2); *Pinus sylvestris;* 1919; Scotland (Aberdeenshire); Reid & Co., Aberdeen.

LIST OF TECHNICAL STAFF.

Officers on Divisional, District and Analogous Scales.

Since the last issue of the Journal changes have occurred as follows:--

Headquarters.

Dr. H. M. Steven, transferred from Scotland, is acting as Research Officer for England and Wales, working from the Imperial Forestry Institute, University of Oxford.
Dr. M. L. Anderson now acts as Research Officer for Scotland.
Mr. J. Macdonald appointed Forest Officer on Probation for Sample Plot work.

England and Wales.

Mr. W. L. Taylor appointed Acquisition Officer (acting).
Mr. W. H. Guillebaud appointed Divisional Officer (acting), Division 5.
Mr. W. H. Lovegrove appointed District Officer (temporary), Division 5.
Mr. G. B. Ryle appointed Forest Officer on Probation, Division 1.
Mr. J. M. Rayden (since deceased) appointed Forest Officer on Probation, Division 2.
Mr. A. H. H. Ross appointed Forest Officer on Probation, Division 2
Mr. R. G. Broadwood, appointed Forest Officer on Probation, Divisions 3 and 4.

The undermentioned officers have been transferred to the Commission in connection with the transfer of the Crown Woods :—

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

Mr. V. F. Leese, Deputy Surveyor.
Mr. L. E. MacIver, Personal Assistant.
Mr. J. F. A. Roberts, Assistant.
Mr. W. J. Yarr, Assistant.

Dean Forest (Whitemead Park, Parkend, Lydney, Glos.).

Mr. L. S. Osmaston, Deputy Surveyor.
Mr. J. Roper, Survey Clerk.

Dean Forest (Mines).

Mr. W. Forster Brown, Deputy Gaveller.

Scotland.

Mr. J. Cameron transferred from Board of Agriculture for Scotland and reappointed Acquisition Officer.

Mr. G. Home reappointed District Officer, N. Division.

Mr. W. H. Whellens reappointed District Officer, S.E. and W. Division.

Mr. J. Hunter Blair reappointed District Officer, S.E. and W. Division.

FORESTERS.

A revised list is appended. Promotions since the last issue of the Journal are indicated by an asterisk :—

Name and Address.	*Grade.*	*Forest.*
	England and Wales.	
Division 1.		
Meldrum, J. A. K., Jessamine Villas, Thornton Dale, Yorks.	I	Allerston.
*Argent, C. D., Red Lodge Farm, Cockley Cley, Swaffham, Norfolk.	II	Swaffham.
*Anderson, T. E., Blooms Gorse Farm, Rufford, Notts.	II ..	Clipstone.
Jones, T., Piddington Lodge, Northampton.	—	Salcey.
Gulliver, H., Hazelborough Syresham, Brackley, Northants.	—	Hazelborough, Brackley Hatch.
Division 2.		
Williams, J., Dolafon, Llanrwst, Denbighshire.	I	Gwydyr.
Clark, J. S., Gipsey Green, Teddesley, Penkridge, Stafford.	II	Cannock Chase.
Price, A., Dolforgan Villa, Kerry, Newtown.	II	Kerry.
Harrison, P. M., Castle View, Wigmore, Kingsland, Leominster.	II	Mortimer.
*Dyer, H. C., Linmere, Delamere, Northwich, Cheshire.	II	Delamere.
Williams, Jack, 2, Cambrian Terrace, Dolgelley, Merioneth.	II	Vaughan.
*Squires, C. V., Brookbatch, Acton, Bishops Castle, Shropshire.	II	Walcot.
Divisions 3 *and* 4.		
Brown, T., New Lodge, Chawleigh, Chulmleigh, Devon.	I ..	Eggesford, Halwill.

Divisions 3 and 4—(continued).

Edwards, J., The Cottage, Rheola, Resolven, Neath.	I ..	Rheola.
Butter, R., Underdown, Haldon, Exeter.	II	Haldon.
Gosling, A. H., Cross Keep, Cwmcarn, Cross Keys, Newport, Mon.	II	Llanover.
Johnson, F., Crown Lodge, Tintern, Chepstow, Mon.	I	Tintern, Chepstow.
*Jones, G. W., Gurllus Grove, Trelleck Road, Tintern, Chepstow, Mon.	II	Tintern.
*Kennedy, D., c/o Powell, New Mills, Whitebrook, Monmouth.	II	Tintern.
Shaw, J. L., The Cot, St. Arvans, Chepstow, Mon.	II ..	Tintern, Chepstow.
*Hollis, G. W., 100, Tan-y-Groes Street, Port Talbot, Glam.	II	Margam.
*Williams, D. N., Broadwood Farm, Dunster, Taunton, Somerset.	II ..	Exmoor.
*Wallington, A. W., Parish's Farm, Over Stowey, Bridgwater, Somerset.	II ..	Quantocks.
Walker, A. E., Crown Lodge, Oxenhall, Newent, Glos.	— ..	Dymock.

Division 5.

Hankins, C., Tangham Farm, Capel St. Andrew, Woodbridge.	Head ..	Rendlesham.
Butler, R., Jewsley Cottage, High Street Green, Chiddingfold, Godalming.	II	Chiddingfold.
Forgan, W., The Centre, Eversley, Basingstoke.	II	Bramshill.
McDougall, J., Broomhouse Farm, Brandon, Suffolk.	II	Thetford.
*Nelmes, F., Priors Heath, Goudhurst, Kent.	II ..	Bedgebury.
Simpson, A., Forest Lodge, Alice Holt, Farnham, Surrey.	— ..	Alice Holt, Woolmer.

School Division.

Bewick, W. J., Thrunton, Whittingham, Northumberland.	II ..	Rothbury.
*Lancy, H., Rose Cottage, Thornthwaite, Keswick, Cumberland.	II ..	Thornthwaite.

New Forest Division.

Smith, Edward, Denny Lodge, Beaulieu, Brockenhurst, Hants.	Keeper	New Forest.

New Forest Division—(continued).

Gulliver, Herbert, Wilverly Lodge, near Sway, Lymington, Hants.	Keeper	New Forest.
Sims, Stephen, Ashley Lodge, near Godshill, Salisbury.	Keeper	New Forest.
Aston, Sidney, Wood End Cottage, near Wickham, Hants.	—	Bere.
Aston, Orlando, Signal House, Parkhurst Forest, Newport, I. of W.	—	Parkhurst.

Dean Forest Division.

Smith, Frank, Worcester Lodge, near Coleford, Glos.	Head	Dean.
Watson, W., Herbert Lodge near Cinderford, Glos.	Keeper	Dean.

Scotland.

S.E. and W. Division.

*Shaw, R., Kinshaldy, Leuchars, Fife.	II	Edensmuir and Tentsmuir.
Watson, H., Stranfearnan, Fearnan, Aberfeldy.	I	Drummond Hill.
Macintyre, J. F., 4, Doncaster Street, Newcastleton, Roxburghshire.	II	Newcastleton.
Paterson, S. H., c/o Waugh, Station Road, Dalbeattie, Kirkcudbrightshire.	II	New Galloway, Aucheninnes, Screel Hill.
Reid, J. M., c/o Cameron, Auchendarroch, Duror, Oban.	II	Glenduror.
*Anderson, R. T., Glenbranter, Argyll	II	Glenbranter.
Simpson, A. N., Tulliallan Nursery, Kincardine, Fife.	II	Tulliallan Nursery.
Spraggan, David, Eshiels Cottage, Peebles.	II	Glentress.
Cameron, Hugh, Inverliever, Ford, Argyllshire.	II	Inverliever.

N.E. Division.

McEwen, J., Teindland Cottage, Orton, Morayshire.	I	Teindland.
Sinclair, Wm., Craibstone Nursery, Bucksburn, Aberdeenshire.	I	Craibstone Nursery.
Lamb, J. A., Seaton Nursery, Hayton Road, Woodside, Aberdeen.	II	Seaton Nursery.
*Mitchell, F. M., c/o Kennedy, Kintessack by Forres, Morayshire.	II ..	Culbin.

Northern Division.

Cameron, J., Auchterawe, Fort Augustus, Inverness-shire.	Head	Inchnacardoch, Port Clair.
Anderson, Wm., Polloch, Glenfinnan, Inverness-shire.	I	Glenhurich.
MacAlpine, J. A., Ratagan, Shiel by Kyle of Lochalsh.	II	Ratagan.
Mackay, K., Slattadale House, Loch Maree, Acnasheen, Ross-shire.	II	Slattadale.
Mason, Wm., South Laggan, Invergarry, Inverness-shire.	II	South Laggan.
McClymont, Wm., Craig Cottage, Achnashellach, Ross-shire.	II	Achnashellach.
McEwan, Jas., Portclair, Invermoriston, Inverness.	II	Port Clair.
Rutherford, Jas., Inchree, Onich, Inverness-shire.	II	Glen Righ.
Warren, Alexander, Beaufort School, Beauly, Inverness-shire.	I	Beaufort School.