TRANSACTIONS

OF THE

ROYAL SCOTTISH ARBORICULTURAL SOCIETY.

SECRETARY AND TREASURER,
ROBERT GALLOWAY.

VOL. XV.

EDINBURGH:
PRINTED FOR THE SOCIETY.
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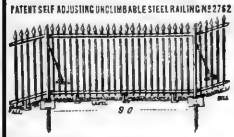

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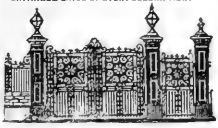

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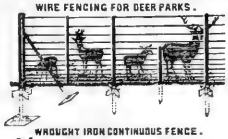

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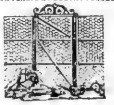

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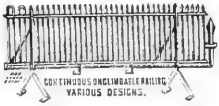

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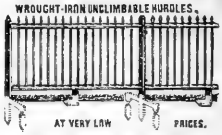

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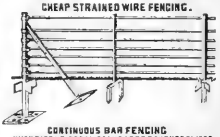

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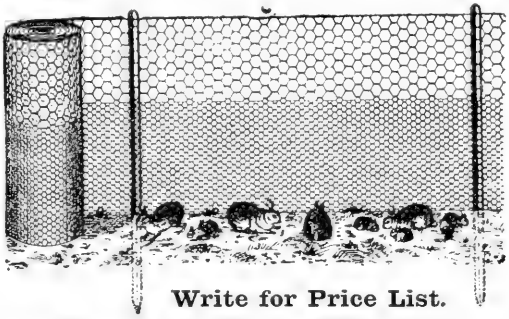

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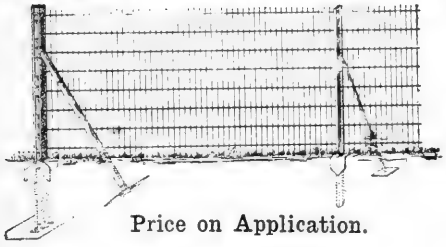

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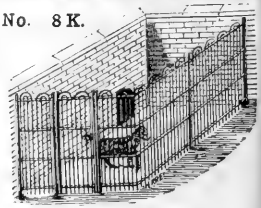

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Special Notices to Members.

HONORARY OFFICIALS.

The Council desires to direct special attention to the appointment of Honorary Officials of the Society recently made, with the object of affording to Members the opportunity of obtaining gratuitously scientific information upon subjects connected with Forestry.

The names and addresses of the present Honorary Officials will be found on page 13 of the *Proceedings* appended to this Part.

Members wishing for information should write direct to the Honorary Official they desire to consult, sending full particulars regarding the subject of inquiry, and also, if possible, any Specimens, such as pieces of stem, twigs and leaves, fruits and seeds, fungi, insects (in all stages of transformation) and their food-plants, etc., that bear upon and would help to elucidate it. The replies sent to Members by the Honorary Officials will, if of sufficient interest, be published in the *Transactions* of the Society.

FORESTRY NOTES AND QUERIES.

The Council begs to remind the Members that a few pages of the *Transactions* have been set apart for suitable Notes on subjects of interest connected with Forestry, which have come under the personal observation of Members, and that they are invited to send contributions. Notes should be short and duly authenticated.

It is hoped that, in the absence of an organ devoted to Forestry, advantage will be taken of this invitation by a large number of Members, and that much valuable information will thus be preserved and made available to every Member of the Society.

The Council also invites Members to submit Queries on Forestry Subjects, which, if suitable, will be inserted in the *Transactions*.

Notes and Queries may be sent to the Secretary at any time; but unless they reach him before the end of October, they cannot be inserted in the next issue of the *Transactions*.

THE SOCIETY'S CABINET OF LANTERN SLIDES.

The Council has resolved that the Society's Cabinet of 100 Micro-Photographic Slides—illustrative of the Structure of Timber, and suitable for the purpose of Lectures with Lantern Exhibitions—may be lent to any applicant who is willing to comply with the printed Conditions, copies of which can be obtained from the Secretary.

NEW MEMBERS.

The Council has prepared and printed a Memorandum containing particulars regarding the past and present work of the Society, which, it is hoped, may lead to the introduction of New Members. The Secretary will send copies of this document to any of the Members who may ask for them, and will forward a copy to any person likely to join the Society whose address may be sent to him by a Member.

The Secretary will receive Applications for Membership at any time. Applicants who have been duly nominated, and who have paid their Subscriptions, are at once admitted to all the privileges of Membership, but their election must be confirmed at the next General Meeting of the Society.

ROBERT GALLOWAY,
Secretary.

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TRANSACTIONS

OF THE

ROYAL SCOTTISH ARBORICULTURAL SOCIETY.

I. Letter *from the President read at a General Meeting held on 3rd August 1896.*

46 Cadogan Square, 30*th July* 1896.

Dear Sir,—It is a disappointment to me to be unable to give an address to the Society for what should be the last term of my office as President, for, as our roll of members increases (and it must be a matter for general congratulation that good names are being constantly added to our lists), we should have no difficulty in finding a fresh President year by year. This must be useful, for it will attach a growing number of leading men to our cause.

I fear it will be quite impossible for me to reach Edinburgh on Monday, as the Scottish Rating Bill is down for that day. I have put some amendments on the paper in what I conceive to be the interests of Forestry, which I hope may be approved by the Society. I hope, in these circumstances, to be of more use in London than at the General Meeting.

I regret that no Government has as yet been able to take any decided action upon the Report of the Select Committee on Forestry. The Society must therefore continue and increase its efforts to secure recognition by the State of the need for a regular system of instruction and training for foresters. The visit of Professor Schwappach, and the paper he is to read, will draw public attention to the splendid provision made in all parts of Germany for this branch of instruction, as compared with the comparative absence of such provision in Scotland. The Professor

will, I fear, see signs of that deficiency in the course of his tour. He will recognise that we can grow timber for beauty, but that we have something to learn with regard to growing for profit. I should be surprised if, before Professor Schwappach leaves the country, he does not express the opinion that when we treat our woodlands as we treat our farm-lands, our timber area will be several times larger than it now is.

My only consolation in being absent is that, during the Rating Bill debate, I hope to bring points of interest for foresters before the House of Commons. If that Bill is merely a measure "for the relief of the occupiers of agricultural lands and heritages," we have, of course, no case. But if it be a measure for rating reform —to classify lands and heritages for purposes of rating in Scotland—then it is hard to see why woodlands (on which rates may be paid for a century without any profit from the crop) should be excluded from "rating reform." Again, as the Rating Bill makes special provision for the Highlands, I believe the Royal Scottish Arboricultural Society will agree that, by establishing a Forest School and experimental area in the Highlands, a great step would be taken towards social and economic improvement in these districts.

In discussing the future campaigns of the Royal Scottish Arboricultural Society, another foreign tour may be considered. I believe a trip to Norway and Sweden would not be very expensive to members, while it would afford an opportunity for examining into certain manufactures which should be developed at home. But Professor Schwappach can tell us all about that. I must thank the Executive and the members of the Society for the support they have given me, for the great pleasure and for the profit that I have derived from my association with them as President, none of which I shall forget. And with ever the most earnest wishes for the success of Forestry, and for the growth of the Royal Scottish Arboricultural Society,

Believe me,

Yours truly,

R. C. MUNRO FERGUSON.

The Secretary,
Royal Scottish Arboricultural Society.

II. *The Importance of Density in Sylviculture.*[1] By Dr Adam Schwappach, Professor of Forestry, Eberswalde, Prussia.

Forestry may be defined as the management of woods upon a definite system, which shall secure continuity in the treatment and in the returns. Leaving woods that are planted for beauty or for protection against storms, etc., out of account, the owner endeavours to obtain the maximum of profit consistent with the uninterrupted maintenance of the yield—"maximum of profit" being synonymous with the maximum difference between the cost of production and gross revenue. This goal is reached by the observance of a number of guiding principles, cultural and otherwise, of which I shall here confine myself to the discussion of but one, namely, the influence of density, or number of trees per acre. As will be seen later on, this question has an intimate bearing upon the result of investigations into the influence of different degrees of thinning and light-felling.

Other things being equal, the production of timber by individual trees stands in direct proportion to the physiological activity of their roots and leaves. The more extensive the roots, the better developed the crown, and the more perfect the proportion between both, so much the more completely is the tree enabled to utilise the nutritive substances in the soil and in the atmosphere, and, consequently, the greater will be the quantity of material which it will produce in a given time under the influence of light and heat. The best proof is found in the fact that, whereas a tree occupying an open situation in a park may produce rings an inch or more in breadth, a tree of the same species growing in a dense wood will show rings whose breadth is a mere fraction of this. On any given area we shall, therefore, obtain the maximum yield of timber if the density is so regulated that for any given age the number of trees is such as to admit of the perfect development of the crown and roots of each. On various occasions this view found expression in works on forestry early in the present century, as, for instance, in the writings of Cotta, and still more so in those of Liebich, a lecturer in the Polytechnic at Prague.

The aim and object of forestry, however, consists not in the production of the greatest mass of wood, but in the production of the greatest revenue from a given area. Apart from cases that

[1] Read at a General Meeting held on 3rd August 1896.

do not at present come into the discussion, revenue is ascertained by multiplying the quantity of timber produced by its value per cubic foot. Manifestly, therefore, forestry means something more than the mere production of the maximum mass of timber. It means, in fact, the continuous production of the maximum yield of *high-priced* timber. This object, however, will not be attained by trees which, from their earliest youth, have had space enough for the unrestricted development of their crowns. Such trees are only of moderate height, and their boles are short, conical, and clothed with numerous thick branches. However much a tree with a great mass of foliage may beautify a landscape or please an artist, it is not capable of yielding the maximum amount of profit, and the price which it will bring will be in inverse proportion to the requirements of a purchaser for a long, symmetrical, and cylindrical bole. A timber merchant looks out for trees as long, straight, and cylindrical as possible, with the minimum number of knots. Not only do knots detract from the appearance of timber, but recent investigations in Germany and America have shown that the strength of timber is also very prejudicially affected by their presence.

Seeing that stems with the minimum of knots, and as cylindrical as possible, can only be obtained by curtailing the development of the crowns, the production of quantity must to a certain extent —under a system of intensive forestry—give place to the production of quality. The attention of a forester must therefore be directed towards selecting that particular density in a wood which will best combine the production of quantity and quality. Experience, supported by careful investigation, has shown that this goal can only be reached in woods which show a high degree of closeness at an early age.

The restriction in the quantity of light tends to diminish the production of leaves and branches, and it is found that under such circumstances the trees endeavour to grow in height as fast as possible in their attempt to obtain space for the development of their crowns. The most vigorous individuals will take the lead in this struggle, whereas their weaker neighbours will be overgrown and finally killed. The over-grown specimens, however, fulfil a useful function in the life of a wood; firstly, by shading the lower portions of the stems of the larger trees; secondly, by assisting in the removal of the lower branches of the dominant trees, against which they rub during gales; and thirdly, by

shading the ground. It must be mentioned, however, that there is a limit to the degree of density, and if this is exceeded, the development of even the most vigorous trees will be prejudicially interfered with.

It is only of importance to encourage growth in height and cleanness of stem during the time when the trees are making most of their height-growth, and the duration of this period will depend upon the species and the character of the situation. In this connection, also, the forester will have to determine what proportion of the stem he desires to see clear of branches. Nothing would be gained, for instance, by attempting to grow beeches with clear boles as long as those of the spruce or Scots fir.

After this stage has been reached, the forester should direct operations in such a way that the trees shall attain an average diameter which will satisfy the demands of the timber market. From this period onwards the encouragement of growth in thickness harmonises more and more with the production of the maximum *mass* of timber. To attain this object, it becomes necessary to see that the larger class of trees are accorded an increased amount of growing space. The most important question now comes to be: To what extent shall the wood be artificially interfered with, or, in other words, what amount of thinning is most advantageous?

In their struggle for existence a large number of trees perish, and these are utilised by the proprietor of the wood as soon as they can be turned into money. Besides trees which are totally dead, one finds others which, though still alive, are hardly making any growth, and beyond these there are others in all the various degrees of development up to the largest stems. According as the operation of thinning is confined to (*a*) the dead and dying, (*b*) those that are completely over-grown by their neighbours, or (*c*) those whose crowns are considerably curtailed, one has to distinguish three degrees of intensity in thinning, which may be defined as *weak*, *moderate*, and *strong*. If one goes further with the removal of trees, and fells those with fully developed crowns —as is sometimes done—the operation is called "lightening," "light thinning," or "felling for light."

A weak thinning exerts no effects, beneficial or otherwise, upon the trees that remain. Such an operation is confined to the removal from the wood of material that is without influence on

its future development. Consequently, where it is a question of providing more space for the trees that remain, such a thinning is absolutely useless.

A moderate thinning is also without appreciable influence on the development of the trees that remain, and differs only from a weak thinning in enabling the forester to obtain a larger quantity of wood, which is also of somewhat higher quality. Such a degree of thinning is practised in all woods up to the end of the period during which height-growth is principally made. It is also practised right through the rotation in the case of woods of those species of trees—more especially the Scots fir—which naturally, and without any artificial assistance, lighten themselves. This matter will be further dealt with later on.

It is only when the degree of thinning is what is called "strong" that the operation has sufficient influence to produce a marked improvement in the development of the crowns of the remaining trees, and to induce more rapid growth. In Germany a strong thinning is only practised in woods where the stems average about 8 inches in diameter. At a later period diameter-growth, which is now synonymous with increase in value per cubic foot, may be encouraged by going even beyond a strong thinning; that is to say, the wood may be "*lightened.*"

Finally, it may here be mentioned that some, especially the French, recommend a system that may be defined as the extension of the thinning to the dominant class of trees. Under this system, when a wood is about thirty years old, the most vigorously growing trees are given so much room that their crowns are practically isolated, and in this way the growth of such trees is encouraged to the greatest possible extent. Having secured this isolation in the dominant trees, the forester leaves the rest of the wood intact (beyond the removal of stems actually dead), and in this way he secures the cleaning of the stems of the dominant trees and the encouragement of their height-growth, and, at the same time, the ground is properly shaded.

Until the forestal investigation stations had, within recent years, carried out careful researches into the growth of trees, people held very indefinite ideas regarding the influence exerted by the different degrees of thinning and lightening. Now, however, we possess definite information on the subject, and I shall, as shortly as possible, give a brief resumé of the results of recent research.

Apart from the case of the Scots fir, the three degrees of thinning result in the production of almost exactly the same *quantity* of timber. A partial exception to this almost general statement is furnished by beech woods, which, according to investigations in Denmark, may, in favourable situations, be made to yield an increased quantity of timber if thinnings are begun strongly, though cautiously, at a comparatively early age. In the case of Scots fir woods, on the other hand, which, even without interference, become naturally so thin that the individual trees develop large crowns, the degree of thinning that is designated "moderate" results in the production of the largest mass of timber.

Apart, then, from the case of the Scots fir, and, under exceptional cases, the beech, the selection of the degree of thinning is determined by other considerations than that of production of quantity. One object in view is the encouragement, by early moderate thinnings, of the development in youth of stems which will ultimately furnish high-class timber. At a later period, the woods should be managed in such a way that the timber produced shall be concentrated on comparatively few trees, and in this way we have increase both in value per unit and in mass; and the intermediate returns, in the shape of strong thinnings, tend to raise the financial returns from the area.

Until quite a recent date erroneous ideas were also held regarding the influence of light-fellings. It was generally considered that this system of thinning resulted in the production of a larger quantity of timber than could be got from a continuously close forest. The results of careful researches prove that if Scots fir woods are lightened, even at a very early age, the trees are not able to make any very considerable use of their opportunities. They also go to show that it is desirable to take steps at a moderate age to secure cleanness of bole and the conservation of soil fertility, and this is accomplished by the establishment of an underwood.

Even in the case of such trees as the beech, which respond quickly and favourably to light-thinning, the results which have attended the investigations were somewhat unexpected. The smaller class of trees, with their poorly developed crowns, are not able to take advantage of the more favourable conditions that are offered to them, while the larger trees have already developed such good crowns in the close wood that the admission of a

further supply of light is practically without effect. The only trees which are capable of responding satisfactorily to the new conditions are those of medium size. If, however, one thins the wood to such an extent that these medium-sized trees have the opportunity of making materially accelerated growth, one finds that, even with a light-felling only slightly in excess of a strong thinning, one soon reaches the limit where the gross production begins to decline in consequence of the reduction of the number of trees. The result is that one obtains a less aggregate yield of timber than would be got from a close wood, in spite of the fact that the growth of a certain number of individual trees has been stimulated.

Besides the considerations affecting quantity and quality of timber, the question of thinning is intimately connected with the conservation of the soil fertility, on which the productive capacity of the ground and the maintenance of the yield so largely depend. We know from experience that if woods are over-thinned on light sands or on steep declivities, there is a danger of sand-drift in the one case, and of the fertile surface soil being washed away in the other.

But apart from these cases, recent advances in our knowledge of the chemistry of soils have shown us that if woods are too thin, that is to say, if the surface of the ground is insufficiently shaded, or if the close leafy canopy is suddenly and strongly interrupted, the results may be most prejudicial to the productive capacity of the soil. On the other hand—apart from certain exceptional conditions, which may here be neglected—there is nothing to be feared in this connection from having woods too dense.

Amongst the undesirable effects that follow insufficient stocking of the ground, I may mention the destruction of that porous or crumbly character of the soil which is so intimately associated with fertility, and the encouragement of the formation of sour raw humus. If the force of falling rain is not mitigated by a canopy of branches and a mantle of good humus on the surface of the ground, it will be found that the soluble plant-food is washed out of the upper strata of sandy soil, while in the case of a loam the porous or crumbly character of the soil is destroyed by the battering and consolidation to which it is subjected. In the case of calcareous ground, the soil undergoes very undesirable changes in structure if allowed to become too dry, as will

happen if the direct rays of the sun are not effectively excluded.

Simultaneously with these undesirable changes, the covering of the ground also alters for the worse. Sandy soils soon become covered by a dense turf of fine-leaved and shallow-rooted grasses, and this felted mass of roots not only exhausts the moisture in the soil, but also prevents the entrance of additional supplies in the form of rain-water. On more fertile soils the herbage which appears on the surface of the ground is composed of better species of plants, but in this case also the development of the trees is materially interfered with.

Hardly anything exerts such a prejudicial influence upon the fertility of soil as the accumulation thereon of large quantities of undecomposed vegetable matter (raw humus). In a wood of normal density, raw humus is either not formed at all, or only to a very limited extent, and the soil-covering is loose and favourable for tree-growth.

If a wood is not sufficiently close, or if its canopy has been incautiously interrupted, the soil—especially where the situation is poor—generally becomes covered with raw humus. Simultaneously with the formation of this material, heath usually appears on the ground, and this rapidly increases the stock of raw humus, and especially so under the unfavourable climatic conditions of a high rainfall and a low temperature, such as prevail in mountainous districts or near the coast. Under such circumstances the area may gradually be changed into a bog, as has happened in the case of the large boggy moors in North Germany, which were at one time covered by forests.

In other cases the rain washes the organic acids out of the humus, and carries them into the upper strata of the mineral soil, where they render a large part of the plant-food soluble, and in this condition it is carried into the subsoil, and precipitated in the form of a moor-pan, a formation which is often met with on a large scale, and which is extremely prejudicial to all kinds of plant life.

The principles that should guide forestal practice, so far as they are concerned with the maintenance of the factors of production in the soil, are thus intimately bound up in the preservation of a porous or crumbly consistency in the soil, and the prevention of the formation of raw humus.

Keeping in view the production of high-class timber and the

conservation of soil fertility, we may, from what has been said, deduce the following conclusions:—

(1) That the area should be closely stocked to begin with, and that, up till the period when the greater part of height-growth has been made, a wood should be kept dense.

(2) That from this time onwards the thinning should gradually become stronger, such strong thinnings beginning earlier, and being carried further, when quantity rather than quality is the object in view.

(3) That in the case of Scots fir woods, closeness should be maintained as far as possible right through the rotation.

(4) That where increase in diameter is accompanied by an increased value per cubic foot, the degree of thinning may be pushed to its fullest extent, for in this case any appreciable reduction in the total yield of timber will be more than counterbalanced by the increased value of what is obtained.

(5) If thinning has been carried so far that a close canopy cannot be restored by the accelerated development of the crowns of the remaining trees, the forester must secure sufficient shading of the ground, either by encouraging the growth of the seedlings that naturally spring up underneath the parent trees, or an underwood —a so-called soil-protection wood—must be established artificially by seeding or planting.

III. *Report on a Visit to the Forests of Scotland in August* 1896. By Dr Adam Schwappach, Professor of Forestry, Eberswalde, Prussia.

In accordance with the desire of my Scottish friends, I beg to submit to the consideration of the members of the Royal Scottish Arboricultural Society the following short account of the impressions which I took home with me from my tour in Scotland.

On August 4th, along with the members of the Society, I visited the parks and woods of Airthrey, Keir, Blair Drummond, and Lanrick Castle. On August 5th we traversed the beautiful Lochs of Katrine and Lomond, but at Balmaha I had to say "good bye" to the party, in order that I might fulfil some engagements that had been made for me to visit the north of Scotland.

On account of illness, Professor Somerville and Colonel Bailey were unable to start with me on my extended tour, but Professor Bayley Balfour most kindly undertook to act as my guide. On the 7th of August Professor Somerville and Mr Dunn joined us at Dunkeld, and accompanied us on our delightful excursion of August 8th.

After leaving Balmaha I had the pleasure of again sailing over the whole length of the magnificent Loch Lomond. From Ardlui the Highland Railway brought us to Banavie, where we arrived on the evening of August 5th. The 6th of August was occupied with the passage of the Caledonian Canal, which I found most interesting. We were met in Inverness by Mr Gossip, who conducted us to the most beautiful points of that charming town. The view over Inverness and the Moray Firth from the cemetery —which is unequalled for situation and beauty—was most impressive. Our visit to Mr Gossip's nursery had unfortunately to be undertaken so late in the evening that we had not the opportunity of making such a careful inspection of it as we should have liked. It was interesting to find that the Highland one-year old seedling pines were very much smaller than similar seedlings grown on the Continent, and similarly with regard to larches grown from Scottish and Tyrolese seed.

On August 7th we spent some hours in the extensive pine woods of the Countess of Seafield in the neighbourhood of Grantown, and in the evening we visited the magnificent larch

woods, as well as the gardens and grounds belonging to the Duke of Athole at Dunkeld. There we inspected the first larches ever planted in Scotland, and an inscribed stone standing near informs the visitor that one of the trees, which appears to be still in good health, was planted in 1738, and is 102 feet high. The distinction of being the oldest example of its species in Scotland does not appear to be quite so well established in the case of a magnificent Douglas Fir growing near, a similar claim being advanced in favour of a specimen at Murthly Castle.

To me the most interesting day proved to be the 8th of August. After an early visit to the nursery and a pine wood near Dunkeld, we inspected the wonderful collection of exotic trees at Murthly Castle, over which we were most kindly conducted by the proprietor, Mr Stewart Fotheringham. Later on in the day we visited the grounds and woods of Scone Palace, and finally reached Edinburgh at half-past nine. My trusted mentor, Professor Bayley Balfour, accompanied me to the steamer at Leith, where Messrs Mackenzie and Erskine were waiting for me, and with whom I spent a very pleasant hour till the boat sailed at eleven o'clock. On the voyage to Hamburg I had time to reflect on the very successful results of my trip, which had made me acquainted with so much that was beautiful and interesting, and during which I had received so much kindness, and this I take the present opportunity of gratefully acknowledging.

In submitting my views to the members of this Society, I would ask them to bear in mind that my visit was of but short duration, and consequently I may have made some mistakes, or have been insufficiently informed on certain points.

It will be convenient to arrange what I have to say under the following three heads:—

(1) Forestry,
(2) Afforestation of waste lands, and
(3) Exotic conifers.

1. The most extensive as well as the most scientific system of forestry, according to German notions, was met with in the large pine forests belonging to the Countess of Seafield, in the neighbourhood of Grantown. These woods occupy a soil overlying gneiss, such a soil, in fact, as would for the most part be placed in the third class—to some extent also in the second class

—according to German methods of classification of forest soils. The older woods are showing satisfactory growth, and, with the exception of those in the neighbourhood of the Castle, are exclusively regenerated by naturally sown seed. At Curr Hill it was an interesting experience for me to find a wood about twenty years old and a hundred acres in extent, which had been regenerated naturally, and which was showing a density and uniformity which, without artificial assistance, could not have been obtained in Germany, where the young trees suffer much during the felling of the seed-trees.

In other parts of the forest, *e.g.*, Millton Wood and Drumindunan, I found exactly the same state of things as we are accustomed to meet with in woods that have originated through natural regeneration in Germany. I refer to the condition of things where one finds some parts of the ground sufficiently stocked, but the rest so incompletely supplied with plants as to preclude the possibility of perfect density without artificial assistance. Woods of this character, from which the seed-trees have been removed, contain numerous over-branched trees, amongst which one meets with small areas which are sufficiently dense, and where the growth is satisfactory. Such woods were only too common on the Seafield property, and it struck me as remarkable that nothing was done by transplantation to fill up the gaps in these natural woods, an operation that would certainly prove very profitable.

The lack of uniform success that has attended natural regeneration in the neighbourhood of Grantown is no doubt due to the varying quantity of raw humus existing in and on the soil, a substance which opposes the greatest obstacles to the system of sylviculture which is practised on that estate. When a wood is in the seed-felling stage, the soil offers satisfactory conditions of growth for the young seedlings only when the humus is in a certain stage of decomposition. This period lasts for but a short time, and unless the seedlings take root during this period it is hopeless to expect a further supply of seed to produce a supplementary stocking of young plants. When at Grantown I had also the pleasure of inspecting a wood, about twenty years old, at Croft-na-Haven, which had been established by planting, and which was growing in a most satisfactory manner. Mr Thomson informed me that from 2500 to 3000 plants were used per acre, and that this is the usual number employed in the woods under

his charge, a number that corresponds to what we are accustomed to in Germany.

The main difference in the management of woods in Scotland and in Germany is found in the manner of thinning. The specimens of thinning that I met with at Dunkeld, Scone, and Airthrey were entirely opposed to what we would consider good practice in Germany. It was therefore a greater pleasure to find that Mr Thomson practised and recommended a system more in consonance with scientific principles. It seemed to me during my short visit, that woods are greatly over-thinned in Scotland, and are too much managed like the trees in a park. The great mistake that Scottish foresters make is to start thinning too early, in order to give the trees sufficient room to develop large crowns, and to grow rapidly in thickness. The object would appear to be an attempt to induce the woods to furnish some saleable produce, such as sleepers, at the earliest possible age.

However desirable early returns may be from the point of view of the landlord or of the forester, the fact must not be lost sight of that they are obtained at a great sacrifice. Trees grown in woods managed in this way have not the opportunity to clean their stems naturally of dead branches, and therefore it is necessary to incur considerable expenditure on artificial pruning—an operation which is practically out of the question on a large scale. The thinnings obtained at a very early age are of such poor quality as to be of little or no value. Growth in height is interfered with to an extraordinary extent, and the production of a well-shaped bole becomes almost an impossibility. Further, when a wood is thinned to its utmost extent it does not contain a reserve supply of trees to serve as substitutes for those that have lost their leaders, or are otherwise defective. This matter is of special importance in Scotland, where the squirrel does an amount of damage to trees that is unknown in Germany: in consequence of the removal of the bark from the upper part of the stems, the trees develop misshapen crowns, and are greatly reduced in value. Had we a plague of squirrels in Germany such as is found in Scotland, we should set about reducing the numbers by diligent shooting.

It cannot be too much emphasised that strong and early thinning prevents the production of the maximum mass of timber, and at the same time makes the formation of valuable timber impossible. If the commencement of strong thinning were

delayed for other ten to twenty years, the woods would give a permanent yield of timber fit for sleepers, while the main crop would develop into heavy timber suitable for all structural purposes. Instead of removing well-formed trees in the early thinnings, one ought to fell only such as are badly shaped, and I am afraid that this system is at present too little practised.

Apart from the Scots fir, I found that the woods which I visited consisted for the most part of the larch—especially near Dunkeld—and the oak. During the time at my disposal, I was not able to make close inspection of the system on which the larch woods are managed, but it is probable that my views do not clash to any great extent with those of Scottish foresters regarding the sylvicultural treatment of this tree.

At Scone Palace I inspected a very fine oak-wood, from ninety to one hundred years old. The trees were showing vigorous growth, and one can only regret that the ground was not more fully stocked, as would have been the case under a different system of management, and which would have resulted in the production of finer and more valuable stems.

Between Callander and Balmaha I saw numerous woods of oak coppice on the lower slopes of the hills. These woods are managed on a rotation of twenty-one years, and furnish tanning bark and light timber, the latter being partly used for firewood. On the steep slopes with a shallow soil the system of coppicing is to be commended, but, with tanning bark as the main object, the manner of thinning appeared to leave much to be desired. Tanning bark should be as smooth on the surface as possible, and the stems which furnish it should be long and clean. I found, however, that owing to severe thinning about the seventh and fourteenth years, the bark was coarse and inferior in quality, and the stems were short and branchy. It also appeared to me that many of the stools were too old, and should have been replaced by fresh saplings. The presence of standards in a coppice is also objectionable. These have, for the most part, originated in stool-shoots, and in the shallow soil are short and bushy. They thus cast too dense a shade on the coppice poles, whose growth is materially interfered with.

At Airthrey I found the ash growing well, in conjunction with the sycamore and beech—a mixture which gives satisfactory results. During the next few years such woods ought to be

managed so as to preserve density as far as possible, and the rabbits ought to be killed down.

At Airthrey I received the impression (which was afterwards strengthened) that the Scots fir is not adapted for general cultivation in Scotland to the extent that I had previously assumed. On poor soils overlying gneiss, and on sands, the Scots fir is undoubtedly the right tree to plant, but several other trees will give a better return on granite and basalt soils, as well as on diluvial ground and old moraines. Under these circumstances, the Scots fir should be regarded as a means to, rather than an object of forestry. At Grantown, where I had the opportunity of inspecting timber that was being converted in a saw-mill, I found that the timber furnished by the Scots fir in Scotland is of much poorer quality than similar wood grown in East Germany, being softer, broader in the ring, and containing more spring wood. The low quality of such timber is probably due to some extent to the lower summer temperature and the heavier rainfall of Scotland, though it is also a result of the too open character of the woods.

My impressions lead me to suppose that the oak should be more frequently planted on loams, and the ash, sycamore, and beech on calcareous soils. Satisfactory results may also be anticipated from the cultivation of certain American trees—*e.g.*, *Quercus rubra*, *Prunus serotina*, and *Betula lenta*. Amongst conifers, the larch is probably the best for soils that do not suit the Scots fir, but as the success of this tree is now very uncertain, the spruce may to some extent be substituted for it.

Although the growth of the last-named tree in pure woods cannot be relied upon to be always satisfactory, it will doubtless do well as a mixture with the larch, and the same is true with regard to certain exotic conifers, especially *Pseudotsuga Douglasii* or Douglas Fir and *Picea sitchensis* or Menzies Fir. The large parks which are so common in Scotland have proved an excellent experimental ground for testing the growth of such trees, and this is a subject to which I shall again refer.

2. In Scotland the afforestation of waste land is a matter of the utmost importance.

A stranger who visits the Highlands for the first time finds the long railway journey through districts which show but little vegetation except heather, not only monotonous, but positively depressing. This impression is intensified by the absence of

animal life, with the exception of mountain sheep, while means of communication by road are few and far between. The experience is still more intensified when the traveller is a forester or a political economist, for the remnants of forests (*e.g.*, on Rannoch Moor), and the presence of stumps in the bogs, remind him that this extensive area was once covered by wood.

At the present time such land gives a return only through its scanty pasturage and its sporting rights. The ground is not infrequently cleared of sheep in order to encourage the game, which consists for the most part of grouse and red deer; but the latter animal, judging from the antlers which I had the opportunity of inspecting, is of such diminutive proportions that a stag from the poor pine forests of Germany would appear like a giant beside it.

The annual grazing and sporting rent from such areas appears to fluctuate between sixpence and half-a-crown per acre. The question then comes to be whether forestry offers the opportunity of improving the revenue from such land.

The favourable climate of Scotland, and the comparatively easy slopes of its mountains, make it unnecessary to undertake forestry operations for the improvement of the climate or the fixation of the soil upon the hills. The ease with which coal may be got in that country, and the facilities which it enjoys—at least for the present—for the importation of timber from abroad, make it unnecessary that planting should be undertaken either for the purpose of providing a supply of fuel or of structural timber. The possibilities of the afforestation of the waste lands of Scotland must therefore be regarded entirely from the financial point of view. Whether forestry will be financially successful or not will to some extent depend upon whether the question is regarded from the national point of view, or from the standpoint of the owner of the woodlands for the time being.

Regarded from the point of view of the national weal, the question comes to be whether forestry offers the possibility of permanently increasing the nett revenue from the land. In my opinion this question must undoubtedly be answered in the affirmative, at least so far as the better classes of soil are concerned, and for the following reasons. Assuming that the Scots fir is employed, with a rotation of eighty years on soil of the third class, and, further, allowing $2\frac{1}{2}$ per cent. on the invested

capital, a percentage which for Britain errs on the side of being rather too high than too low, we have the following items of expenditure and revenue, so far as they refer to the first rotation :—

Expenditure per Acre.

1. Value of land worth 1s. 6d. per annum, at twenty-five years' purchase,	£1	17	6
2. Planting and beating up,	1	10	0
3. Annual outlay for supervision, protection, rates and taxes, and road-making,	0	2	0

By the methods of computation employed in forest valuations, the deferred value of these items of expenditure, with compound interest, at the end of eighty years amounts to about £49.

Revenue.

According to my investigations,[1] the final felling and the deferred value of the intermediate returns (thinnings)—allowing, however, only 2 per cent. interest on the latter—will amount at the end of eighty years on soil of the third class to £87. Distributed over eighty years, the balance of £38 gives an annual revenue of just over 3s. per acre, which compares with a former rental of 1s. 6d.

Although nothing has been allowed on account of game in the above calculations, it is not to be supposed that no revenue will be derived from this source during the whole period of the rotation. On the contrary, the game rent, during the second half of the rotation of a German forest, amounts to a very considerable sum.

Apart from the increase of revenue, the afforestation of land is of great national importance as a labour-employing industry. Land under wood can maintain a larger population than land under rough pasture. From the national point of view it is manifestly also an advantage to produce timber at home, and so dispense with its importation from abroad. This matter is of

[1] "Wachsthum und Ertrag normaler Kiefernbestände," Berlin, 1889, p. 66.

special importance in view of the fact that many countries which at present export timber must in the near future cease to do so. Many of these countries are exploiting their forests in such a reckless manner that their stock of timber will soon be exhausted. It was this consideration that mainly influenced the Swedish Government in its determination to send a delegate to the International Congress of Forestal Investigation Stations, which is this year to meet in Brunswick.

When the question of afforestation is viewed from the standpoint of the private owner, it assumes a materially different aspect from that which has just been indicated. When the private individual undertakes tree-planting, he does so with the knowledge that the small but certain rental which the ground has previously yielded will temporarily disappear. And not only so, but he has also to face a serious outlay on account of planting and management, and he can have no guarantee that the undertaking will be a success. He knows, moreover, that he himself will derive no financial benefits from his operations, or, at best, that these benefits will be very insignificant. Under these circumstances, the majority of owners will prefer to retain such small revenue as the land affords, rather than embark upon an undertaking which must be so absolutely unprofitable to themselves, and whose returns are so long deferred.

In Austria and Germany there are many landowners who possess extensive forests, but such forests have long been worked upon a definite rotation, and yield a constant and permanent revenue. They know that their forest land yields them a better return than tillage or pastoral land of a similar character. The consequence is that they are induced to forego a portion of the revenue from their woods in order that other suitable land on their estates may be afforested for the benefit of their successors. Their action, in fact, is precisely the same as that practised by the Countess of Seafield upon her Highland estate; and her example might, with manifest advantage, be followed by other proprietors.

From what I have been able to learn, however, I do not think that it is likely that any large proportion of the waste lands of Scotland will be afforested by private enterprise. Past experiences show that the extension of forestry on a large scale, such as is necessary in Scotland, must be undertaken by the State, or

other public body, such as corporations, county councils, etc. It is only such bodies that have the necessary means, and as there is no question of death in their case, they are in a position to wait patiently for the deferred returns of forestry. I trust that the efforts of the Royal Scottish Arboricultural Society in this important department of national economy may be crowned with success.

In connection with the question of afforestation, it is evident that all kinds of waste land are not alike suitable for tree-planting. High and exposed situations and precipitous declivities do not lend themselves to forestry operations. Then, again, there are wide areas of comparatively flat land of moderate elevation, which are covered with heather and peat to such an extent as to preclude much hope of success from tree-planting. The most suitable areas for planting are furnished by moderate declivities in sheltered situations, where peat is either absent or at least present to such a small extent as not to prevent the roots of the young trees getting at the mineral soil underneath. It is with such areas that one should begin, for it is these that will most rapidly give satisfactory results.

3. To me the most interesting part of my tour consisted in the opportunities I obtained of inspecting the exotic conifers that are so common in the parks and pleasure-grounds of Scotland. It is now fifteen years since the acclimatisation and forestal cultivation of the various species of exotic conifers was vigorously taken in hand in Germany, and large sums have been spent upon the work. Foresters are divided in their opinions of the results and the value of these operations in Germany, many maintaining that the splendid growth which many of the trees are at present making will not be continued for many years. Seeing that such trees have been cultivated in Scotland for upwards of forty years, we are able to draw conclusions as to the probable ultimate results of their cultivation in Germany, bearing in mind, of course, that the climate of the two countries differs to a very considerable extent. The parks which I visited differed in character and situation to some extent, but all of them were pictures of sylvan beauty. To a stranger accustomed to a Continental climate, the splendid collections of conifers came as a revelation, and it would be difficult to say which of them was the most interesting. To me, as a forester, Murthly appeared

as the pearl of them all. It was here that I found American conifers in the greatest abundance and of the largest size, and the trees had been treated here more as one is accustomed to meet with them in the forests. The magnificent development of the different species, and the picturesque and artistic manner in which they were grouped, with luxuriant specimens of rhododendrons, hollies, bay laurels, and other plants, combined with the beautiful velvety turf of the Scottish lawn, produced an impression never to be effaced. From the point of view of German forestry, the most interesting trees that I met with were,—*Pseudotsuga Douglasii*, or Douglas Fir; *Picea sitchensis*, or Menzies Fir; *Chamæcyparis Lawsoniana*, or Lawson's Cypress; *Tsuga Mertensiana*, or Prince Albert's Fir; *Abies grandis*, *concolor*, *amabilis*, and *nobilis;* and *Thuja gigantea*.

Seeing that the trees which I met with in the parks are all standing singly, one cannot with certainty infer from them what form of bole they will possess, or what diameter-growth they will make when grown in close woods. They do, however, give valuable information regarding their annual growth in height. Even the fine wood, about 8 acres in extent of Douglas fir, near Scone does not represent a satisfactory picture of the behaviour of this tree when cultivated under true forestal conditions. The trees had been originally planted too wide apart (about 10 feet square), and although they have been subjected to artificial pruning, their boles are not what the forester or timber merchant would consider satisfactory.

Height-growth, which is an excellent criterion for determining the suitability of a tree for its environment, was found in all cases to leave nothing to be desired. In spite of the fact that trees, when standing singly, are incapable of growing in height to the maximum extent—and especially is this the case in Scotland, where the wind has a powerful influence—the older specimens of the various species have attained a height of from 60 to 80 feet. The trees in the Douglas fir wood, near Scone, have reached an average height of about 85 feet. There is no doubt that the above-named species thrive well in Scotland, and grow quite as rapidly as in their native habitat.

Seeing that some of the more important European trees do not in all cases grow very satisfactorily in Scotland, I should recommend that the North American conifers should be planted

on a larger scale, as is now being done in Germany. The spruce, for instance, does not yield a satisfactory growth in many parts of Scotland, and this is also found to be the case near the sea-coast in other countries, as, for instance, in Schleswig-Holstein. Many parts of Scotland, also, do not offer what I would consider very suitable conditions for the growth of the Scots fir. True, rabbits will materially interfere with the success of the cultivation of exotic trees and with forestry operations in general, but there is no reason at all why this difficulty should not be overcome.

Not only do many of the exotic trees give a larger yield of timber than the indigenous species—compare, for instance, the yield of woods of Scots fir and Douglas fir of similar age at Scone—but they also furnish timber of superior quality. This point gains additional importance in view of the fact that the American supply of timber of many valuable species is within measurable distance of extinction. Scotland possesses the most favourable natural conditions for producing those high-class timbers which America will soon cease to supply. I regard the evidence of the successful growth of exotic trees in the parks of Scotland as of far greater national importance than the beautifying influence which these trees exert upon the landscape.

With regard to one species, however, namely, *Thuja gigantea*, I would utter a word of caution. In Germany this tree grew well in its earlier stages, but it has now been attacked and largely destroyed by a disease due to a fungus called *Pestalozzia funerea*. Unfortunately, I found that the specimens of this tree in the nursery at Dunkeld were attacked by the same disease, and at Murthly the Thujas were also suffering from this parasite. I am afraid that this disease will interfere with the extensive cultivation of *Thuja gigantea* in Scotland. Although the older specimens of this tree are proving resistant to attack, it is probable that the fungus will obtain the upper hand of the young plants. We find an analogous state of things in regard to the larch, old specimens of which are comparatively free from attack of the canker which is so destructive to the tree in its earlier stages.

During my visit to Murthly I often put the question to myself, whether the trees which are showing such luxuriant growth in

Scotland will succeed equally well in Germany. When I looked around me, and saw the luxuriant growth of *Araucaria imbricata*, *Cedrus Deodara*, rhododendrons, bay and Portugal laurels, and many other species, which cannot withstand the severity of our winters, I could not help doubting the ultimate success of our attempts to acclimatise exotic trees. But when I came to compare the meteorological conditions of the two countries, the matter appeared in a more favourable light. The average annual temperature and rainfall of Perth and Berlin are practically identical, nor is there any material difference between these two places as regards the minimum winter temperature (Perth, −17° F.; Eberswalde, −29° F.). That Scotland is subject to long-continued frost is sufficiently evident from the popularity of the game of curling.

Scotland certainly possesses a much milder climate than her latitude would lead one to expect. This is in a large measure due to the influence of the Gulf Stream. Her proximity to the sea has also the effect of securing for her a fairly equal seasonal distribution of the rainfall, while her humid atmosphere has the effect of modifying the force and duration of the sun's rays. The centre and east of Germany, on the other hand, are subject to much greater variations of temperature, and are liable to suffer from long-continued periods of drought. But climate notwithstanding, American conifers which have been planted for fifteen years and longer in Germany are growing very satisfactorily; and we may therefore conclude that, although our climate may prevent the growth of *Araucaria*, *Laurus*, *Cedrus*, etc., it will permit of the cultivation of the hardier exotics, although their growth may be somewhat slower than in Scotland. Such, at least, are the expectations which my trip to Scotland has encouraged.

In conclusion, I may shortly summarise the points that appeared to me to have the most important bearing on the future of forestry in Scotland:—

1. In selecting the trees to be cultivated, more regard should be paid to the character of the situation.
2. The stocking, whether artificial or natural, should be denser. In the latter case, gaps amongst the seedlings should be early and carefully filled up by artificial transplantation.

3. The woods should be managed on sylvicultural principles, and not in the park-like manner at present in vogue.

4. The operation of thinning should be conducted in a more rational manner, and with more regard to the future of the wood. (The more important principles of thinning are indicated in my paper on "The Importance of Density in Sylviculture," published in the present part of *Transactions*.)

5. A broader view should be taken of the whole financial aspects of forestry. The success of forestry operations cannot be judged from the æsthetic point of view, nor can it be gauged by the immediate returns; it can only be determined by the difference between the deferred or final sum of all the items of revenue and of expenditure.

6. Considerations of sport should be permissible only when they do not interfere with the production of timber, which is, of course, the main object of forestry.

IV. *The Genus* Pissodes *and its Importance in Forestry.* By R. Stewart MacDougall, M.A., B.Sc., Lecturer on Entomology, Royal Botanic Garden, Edinburgh.

During my insect-huntings of the last several year, I have repeatedly had opportunities of observing the species of the above genus at their destructive work in woods and forests. In my work amongst its members, more than once it has occurred to me that if the insects belonging to the genus *Pissodes* were better known to British foresters, it might chance that observation would prove that in Britain there are really more than the two, or at most three, species which our British coleopterists admit as found in this country. It is interesting to me to know that at least one other worker in entomology shares this suspicion. With a view, therefore, of familiarising the forester with the life-history, appearance, and habits of the *Pissodes*, I purpose giving an account of the species—British and Continental—which have proved themselves of forest importance.

In this account—keeping in view the hope that it may be the means of stimulating search among the members of the Arboricultural Society favourably situated for observation, so that if no species new to Britain be found, at least a better knowledge of the distribution of the admitted species may result—I will give minute descriptions of the form and appearance of the various insects, sufficient to enable any searcher to recognise a species when found.

Position of the Pissodes in the Insect World.

The *Pissodes* is a genus of insects belonging to the great order Coleoptera, or beetles. The beetles are divided up into four sections, according to the number of joints in the tarsus,[1] and the *Pissodes* are classed in the section pseudo-tetramera (falsely four-jointed), in which the tarsi are really five-jointed. The fourth joint, however, is so small—requiring a good hand-lens or a

[1] On examination, the leg of an insect is found to be attached to the thorax by a part called the coxa. The coxa is followed by a short joint, the trochanter, this by a strong femur, then a thinner tibia, and lastly comes the tarsus, with a varying number of joints. The tarsus generally ends in a claw.

microscope to reveal it—that for a time it was overlooked, and the members of this section were in consequence wrongly named tetramera (four-jointed), a name that is still often found in the books.

Allies of the Pissodes, and their Forest Importance.

The pseudo-tetramera section is divided into several sub-sections, one of which is termed the Rhyncophora, or weevils, whose characteristic is the possession of a rostrum or proboscis projecting from the front of the head. Of the families into which the weevils are broken up, one is termed the Curculionidæ, and to it the *Pissodes* and their allies belong.

The Curculionidæ (using the term in a sense which will exclude at the one end the Bruchidæ, whose well-known grubs are so often found in leguminous seeds, and at the other end the Scolytidæ, the mother-beetles of which bore in trees tunnels, along the sides of which eggs are laid) may be defined as rounded or oval beetles possessing a rostrum or beak, and distinctly elbowed antennæ; while the females do not bodily enter into the tree for the purpose of egg-laying like the Scolytidæ, but lay their eggs on the tree externally (rarely), or in a hole bored from the outside (commonly), or, it may be, lay them directly in the soil. The Curculionidæ larvæ may be recognised as fleshy rounded bent grubs, with no legs, with biting jaws, and with a scaly, chitinised head.

This family contains a very large number of genera, many of which are very important from the point of view of the economic entomologist, and some of them are very dangerous enemies of the forester. The harm may be done by the grubs, more rarely by the mature beetles, and rarest of all by both. Among the forms with destructive grubs is the genus *Otiorhynchus*, whose larvæ, hatching out from eggs laid in roots or in the ground in their neighbourhood, gnaw the external surface of these and cause decay; our genus *Pissodes;* the grub of *Cryptorhynchus lapathi*, so harmful to the alder; the leaf-mining larvæ of the lively *Orchestes fagi;* the grub of the long-nosed *Balaninus,* familiar in nuts; and the *Anthonomous* larvæ, so troublesome to the apple-grower.

Harmful in the mature stage as beetle is the pestiferous Pine Weevil (*Hylobius abietis*).

General Account of the Genus Pissodes.

The species belonging to this genus have a longish rostrum. Near the middle of the rostrum the elbowed antennæ are inserted, their long basal joint almost reaching the small, slightly projecting eyes. The prothorax[1] is narrowed in front, and its posterior margin, on examination with a lens, may show two slight excavations. The scutellum[2] is round and raised. The elytra[3] quite cover the abdomen. Femur untoothed, tibia straight, and with a strong curved hook at the point. The third joint of the tarsus is broad and two-lobed, and the terminal fifth joint ends in two simple claws.

Round of Life.

In round of life most of the *Pissodes* agree. The females lay their eggs in the bark of needle-leaved trees, a varying number of eggs being laid in each bore-hole. The hatched out grubs, starting from a common centre, gnaw long winding tunnels in the bark, the tunnels increasing in size with the growth of the larvæ, the whole, it may be, showing a ray-like pattern. This ray-like design is not so frequently met with in *Pissodes piniphilus* or in *Pissodes notatus*. The full-fed larvæ having reached the innermost layers of the bark, gnaw in the outermost layers of the wood a kind of little bed or cradle, oval in shape, and here, covered by a cushion of sawdust and chips, they pupate. The mature beetles, when ready to escape, bite a clean-cut circular hole through pupa-bedcover and bark.

The grubs living between the bark and the wood interfere with sap-circulation, and the infested plants or trees sicken and die.

The question, so often debated among forest entomologists, as to whether this species or that will attack a healthy tree is mentioned by Altum in relation to the *Pissodes*, which he writes of as preferring feeble and unhealthy trees to healthy and well-grown ones, his experience showing him that where old timber had been attacked the tree had certainly previously been weakly. At the

[1] Prothorax—the segment bearing the front pair of legs.

[2] Scutellum—the segment bearing the second pair of legs is called the mesothorax; what can be seen of its upper surface in these beetles is called the scutellum.

[3] Elytra—the horny covers underneath which are the wings used in flight.

same time he admits that *P. piniphilus* and *P. harcyniae* will attack the branches and crown of perfectly healthy trees. Authorities are much divided on the question of the "generation"[1] of the various *Pissodes* species, but I will leave this matter to be dealt with when mentioning each species in detail.

Generally it may be stated that the larvæ and not the imagos[2] do the harm.

Out of the twenty or so species known in entomology, five are well known in Britain or the Continent as pests on coniferous trees, viz., *Pissodes notatus*, *P. pini*, *P. piniphilus*, *P. harcyniae*, *P. piceae*. These five I will describe fully, at the same time mentioning at shorter length two additional species, *P. scabricollis* and *P. validirostris*.

Determination of the Species.

- Posterior corners of prothorax right-angled, or projecting somewhat sharply. The upper surface of the prothorax wrinkled, and covered with a number of closely arranged punctures.
  - Wing-covers with a narrow transverse band behind their middle—*P. pini*.
  - Wing-covers with a broad transverse band behind their middle.
    - Wing-covers have longitudinal rows of large dots varying in size—*P. piceae*.
    - Wing-covers have longitudinal rows of equally sized dots.
      - Dots medium sized—*P. notatus*.
      - Dots fine—*P. validirostris*.
- Posterior corners of the prothorax rounded, and the deep punctures not so close together.
  - Beetles black, in ground colour—*P. harcyniae*.
  - Beetles, in ground colour, rusty brown—*P. piniphilus*.
  - Beetles with a more or less prominent raised middle line on the prothorax, generally much smaller than *harcyniae*, and in colour not so black—*P. scabricollis*.

A glance through the above table, which, with slight modifications (I have added *scabricollis*) is Nitsche's, will show that the

[1] "Generation"—the time comprised between one egg-laying and the egg-laying of the next swarm. Generation is annual if only one brood is produced in a year; double, if two broods; biennial, if two years are required to complete a cycle, and so on.

[2] Imago—the adult insect.

species resemble each other closely. The resemblance is close in size, colour, and round of life. Besides, the characteristic spots and bands (these latter formed from the coalescence of individual scales) so helpful in the determination of fresh specimens, get rubbed off in course of time, making the determination of isolated not-fresh examples troublesome. Size and colour of species also fluctuate within limits. For example, while a normal-sized *P. piceae* is not to be confused with a normal-sized *P. notatus*, I have seen specimens of *piceae* as small as an ordinary *notatus*, and not to be distinguished from the latter save by its different food-plant.

It is possible to confuse *P. pini* with *Hylobius abietis*, but these two beetles are readily distinguished thus :—

Hylobius abietis.	*Pissodes pini.*
Femur of all six legs with a tooth.	No tooth on femur.
Antennæ inserted on the rostrum near its apex.	Antennæ inserted about the middle of the rostrum.
Darker in colour.	

As an aid to the forester in determining the work of the *Pissodes* (for he will have to do with the damage perhaps oftener than with the real insect), the following may be noted as characteristics :—

(*a*) *The Larval Tunnels arise from a common centre.*—There is just the chance of confusing the eating with that of the Scolytidæ, but in the case of the *Pissodes* no mother-tunnel is found, only larval ones.

Sometimes the eggs are laid singly. This occurs with *piniphilus*, and, as a great rarity, with *harcyniae*.

The resulting single tunnels are very difficult to determine, but if they are very long, one can pretty safely diagnose them as the work of a *Pissodes*.

(*b*) The tunnels are long, a considerable distance intervening between the place of egg-laying and the pupa-bed.

If the tunnels, for some reason or other, instead of winding on, form a sort of interlacing network confined to one place, then the work may be confused with the larval borings of some of the long-horned beetles. Several times I have found *Pissodes* larvæ and the larvæ of long-horned beetles working side by side. In

May 1894, in Bavaria, when examining an old felled silver fir, I found hundreds of the larvæ of *P. piceae*, and among them many larvæ of a species of *Rhagium*, a longicorn beetle; and it is just possible that in such a case the latter larvæ may be useful by destroying the *Pissodes* galleries.

(*c*) The beds of the pupæ, with their coverings of sawdust and chips. The pupa of *Hylobius abietis* also lies in such a bed, but only in stumps or roots.

(*d*) Typical host-plants—

P. notatus on Pinus (various species).
P. pini on Pinus, seldom on spruce (*Picea excelsa*).
P. piniphilus on Pinus.
P. piceae on silver fir (*Abies pectinata*).
P. harcyniae on spruce (*Picea excelsa*).
P. scabricollis on spruce (*Picea excelsa*).
P. validirostris in pine cones.

Pissodes notatus, the Small Brown or White Spotted Weevil.

Description.—This red-brown beetle measures, excluding the proboscis, from less than $\frac{1}{4}$ inch to a shade over $\frac{1}{4}$ inch. The posterior angles of the wrinkled prothorax project sharply, and its hinder edges show two sinuous excavations. Both the upper and under surfaces of the beetle are powdered with white scales. On the upper surface of the prothorax stand four well-marked white points and a fifth on the scutellum. The elytra have two transverse bands of scales, one in front and one behind their middle. The front one, which is non-continuous at the suture,[1] is yellowish on either side externally, whitish internally. The hinder band has almost the same coloration. It is broader externally than internally, and is continuous right across the wing-covers.

The larva is a fleshy somewhat wrinkled, curled, legless grub, with a brown scaly head and strong gnawing jaws. The only difference between larvæ of the *Pissodes* species is one of size. Away from their food-plants, they practically cannot be differentiated.

[1] Suture—the line down the back of the insect formed by the meeting of the elytra.

Distribution.—Common in Germany and France, *notatus* is said to be rare in Britain, but I feel sure it is far more plentiful than is suspected.

In the *Scottish Naturalist* for 1871-72 it is described as having "become common in Scotland within the last six or seven years." Fowler gives the following localities:—Chat Moss (between Liverpool and Manchester), Sunderland (introduced in ships). In Scotland, the Dee and Moray districts.

The question is sometimes asked about *notatus*, has it been introduced from the Continent? Examples of introduction and spread of insects from other countries in driftwood, timber cargoes, etc., are not uncommon, and no doubt our native *notatus* is sometimes reinforced by arrivals from the Continent.[1]

Life-History.—*P. notatus* is injurious, both in the imago state and as larva, but chiefly as the latter. The mature weevil in its feeding pierces the bark with its proboscis, making a number of tiny holes. Some of the young pines (four to six years old) which I have used in my breeding experiments with the beetle have been completely riddled from top to bottom by the feeding weevils, just as if a person had taken a needle and pierced all over with it the stem and branches.

The larva tunnels in the bark, and between the bark and wood, and sometimes does immense harm in pine nurseries, especially if the attacked plants are growing on poor soil.

The favourite breeding-places are young pines from four to eight years of age, but sickly "poles" are also frequented. In the world of timber-infesting beetles we meet with varied demands as regards quality of food. Some are dainty feeders, asking for better quality of material, some are easier to satisfy, while some, as regards quality, are not at all particular, *e.g.*—*Bostrychus typographus*, the eight-toothed spruce bark beetle, is dainty; *Hylesinus piniperda* will practically put up with anything; but *P. notatus*, while preferring weakly material, asks for a certain quality.

For breeding in, the small brown weevil chooses plants of the genus *Pinus*. *Pinus sylvestris* is the commonest host-plant, but there are records of attack on Weymouth pine, black pine, maritime pine. Spruce and larch have been known to be infested, but such instances are rare and exceptional.

[1] See a most interesting note by Mr Mitchell in *Trans. Roy. Scot. Arbor. Soc.*, 1895, on "Driftwood and Insect Attacks."

The female *notatus* after copulation bores a hole in the bark for the reception of her eggs by means of her mandibles situated at the end of the rostrum. The eggs are first laid, and then, taken up in the mouth, are introduced by means of the proboscis. Several eggs are laid in each bored place. If pine in the pole stage be chosen, then, owing to the sufficiency of room at the disposal of the larvæ, the tunnels show a star-like pattern. Most commonly, however, as young plants are chosen for egg-laying, the larvæ on hatching out tunnel upwards and downwards, and indeed it may only be downwards, as the female *notatus* is very fond of laying her eggs immediately below a whorl of branches, and there is thus a kind of natural barrier to the upward direction of the tunnelling. The tunnels wind in the bark and towards the outer layers of the wood, a trail of brown bore-dust remaining behind to map out the path of the larva. Arrived at the wood, the grown larva gnaws out a hole in the outer layers, and in this hollowed-out bed protected by a cover of sawdust and chips the pupation stage is passed. If one remove the chip cover ere the flight-time of the beetles, the pupa can be seen lying with the rostrum arranged along the under surface of the thorax. When the beetles are ready to escape, they bore a circular hole through cover and bark. On emergence they are light coloured, but they soon darken into their normal coloration.

The weevils are somewhat sluggish, and rather timid. In collecting them, when touched, they would drop to the ground, and lie on their backs for a considerable time without movement, as if dead. This is not the place to enter into the interesting psychological questions that underlie the dropping to the ground, and the death-feigning characteristic of so many insects, suffice it to say that *notatus* falls on being touched, not from any lack of power to grip, for if the weevils be made to crawl over the hand or fingers, one is conscious of their ability to hold on. Incidentally, I might remark here how perfectly the beetles are adapted in coloration to their surroundings, it being a very difficult matter to pick them out on a young pine if they are motionless.

The Generation of P. notatus.—Regarding the flight-times and the generation of our pest, there has been no little controversy; and as the question of the generation of a timber-infesting insect, from its close relation to extermination measures, and

when these should be proceeded with, is practically a very important one, I purpose to deal with it here in detail.

The information we possess as to the generation of *P. notatus* we owe to Continental observers, and in the records which I will give it must be held in mind that in our climate these may be subject to variations. I understand that Professor Somerville has been making a series of observations on the generation of *P. notatus* in Britain. It goes without saying that these will be thorough, and one looks forward with interest and pleasure to the publication of the details. Personally, I am engaged in some breeding experiments with *notatus*. These will not be completed for some time, but I will just say here what, so far as I know, has not yet been suspected, that possibly some of the difficulties may find their solution on the same lines as in the case of *Hylobius abietis*, and that *notatus* may have to be added to the not very large list of insects which possess the power of recopulation and repeated egg-laying.

The various statements as to the generation of the small brown weevil may be brought together thus:—

First, the generation is normally a double one—*i.e.*, there are two broods produced in the year.

Second, the generation is an annual or single one—*i.e.*, one brood in a year.

Third, there are, or may be, three broods produced in a space of two years.

First, the generation is a double one. Henschel champions this view, which needs for its fulfilment a very early appearance of the mature weevils in spring time, as early as March. From eggs laid then larvæ would be hatched, and after pupation a brood of beetles would appear in midsummer. These, in turn, would copulate and lay eggs, the beetles appearing to complete the cycle the same autumn. The autumn-appearing beetles would hibernate as such, starting to breed in the next March. My comment on this is that, while not impossible, for example, in exceptionally favourable weather conditions, it is little likely to be the normal condition. At any rate, one desires a little more evidence.

Second, the generation is single or annual. The great mass of evidence is in favour of this. There is some difference of opinion, however, as to the details, one set of authorities considering that the winter is passed in the imago stage,

the other writers standing out for hibernation in the larval stage.

Those who believe that the mature beetles hibernate, look upon swarming as taking place in May and June, the larval stage in June and July, pupation in August, with the beetles appearing in September, to pass the winter as such. Graphically, according to Nitsche's calendar, this might be represented thus :—

	Jan.	Feb.	Mar.	April	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1895				B	BBB E	BLL E Feed	LL ing	PP	BB	B Hib	B erna	B ting
1896	B	B	B	B	B	B E						
		Hib	erna	ting								

Note.—B=beetles; E=egg; L=larva; P=pupa.

That this calendar represents what is often the case there is little doubt. Altum and Nitsche both quote instances in proof of it; while Pauly experimentally has proved that three and a half to four months is an average time for development from egg to beetle in fair weather conditions. That the mature beetles often pass the winter as such is beyond question. They winter in crevices in the bark, in the litter covering the soil, even in the soil itself. In my experiments I was witness to their hibernation in moss which I had supplied to them for the purpose.

At the same time the evidence of trustworthy observers forces us to admit that sometimes hibernation takes place in the larval stage. Perris, working in South France, declares that hibernation is always in the larval state. According to him, the beetles start breeding at the end of June, July, and August; that the larvæ hatch in September, continue as such till the following April, when they pupate, the beetles appearing at the end of May and in June. We have seen that hibernation in the larval condition is *not* always the case; but yet it has been noticed by Ratzeburg, Perris, and others.

The truth is that the last two views under discussion, viz., the hibernation as beetle and the hibernation as larva, are not necessarily mutually exclusive. Both may be true. A common meeting ground for the holders of these two views is afforded by

the additional admission of our third proposition, viz., the possibility of three broods in the space of two years. Most believers in a one-year generation would, I think, be prepared to assent to this possibility. The females, it would appear, take a long time over their egg-laying. One can imagine that in very favourable weather conditions the first eggs might be laid early enough to allow of all the stages being passed through, so that beetles might emerge in time for copulation and egg-laying in the same season. The larvæ from the eggs of these early beetles would, of course, be overtaken by the winter, and when they did arrive at the beetle stage in the following year, the next generation from their eggs would emerge to hibernate as mature beetles.

Means of Prevention and Extermination.—It is pleasant to know that, troublesome as our pest often is, vigorous and timely measures are certain to prevail against it. The great principle is the rooting out of all weak trees.

As guides denoting attack may be mentioned the bead-like drops of resin that issue from the wounded bark, the drooping of the plants, and a reddening of the needles. Infested plants should, before the escape of the weevils, be uprooted and burned. In districts on the Continent which have at different times suffered from fire, it was noticed that *notatus* was attracted to the singed and weakened pines, hence the recommendation that, in the case of an onset, here and there in the nursery or plantation plants should be artificially weakened. These weakened plants, taken possession of by the beetles for breeding purposes, will later on be dug out and destroyed. Some help is given from parasites. More than once I have found *notatus* larvæ attacked by ichneumons.

Pissodes pini, the Larger Brown Pine Weevil.

Description.—This pest measures $\frac{3}{8}$ inch, and is red-brown to brown-black in colour, with sparse yellow scales on both upper and lower surfaces. The punctured thorax has a fine raised middle line. Its posterior corners are right-angled, and the hind edges show scarcely any sinuosity. In front of the elytra two yellow spots on each side. Below the middle of the elytra a small continuous transverse band, composed of yellow scales compacted together. There are rows of long deep pits down the wing-covers.

Distribution.—Fowler gives Northumberland, the Forth, Tay, Dee, and Moray districts.

Life-History.—The larger brown weevil lays her eggs on old stems of the genus *Pinus*, Scots pine and the Weymouth pine figuring most largely in notices of attack. The thinner parts of the tree are not neglected by the females; indeed Altum, generalising from his experience with *pini* and other *Pissodes*, proclaims that in the first instance it is the upper thinner parts, and later in the progress of the attack that the lower thicker parts are infested. Spruce is sometimes used for egg-laying.

A varying number of eggs are laid in a hole bored by the female in the bark. The larvæ start from their common hatching-place and bore out in all directions, the tunnels, however, running chiefly in the long axis of the stem. In one case Altum counted no fewer than thirty of these tunnels springing from one point. The tunnels are long (I have found specimens up to a foot in length) and winding, and they often cut one another. The pupa-beds, with their characteristic covering of chips, are always at least partly in the outermost layers, and sometimes, as, for example, where thin material has been attacked, altogether in the wood. We have no experimental information as to the generation of *pini*, but Nitsche suggests the following calendar for middle Europe, the generation being an annual one :—

	Jan.	Feb.	Mar.	April	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1895						BB E	BB EEE	LLL F	LLL eedin	LLL g	LL Hiber	LL nating
1896	LL Hiber	LL nating	LL Fee	LL ding	PPP	PBB E						

The mature beetles do some harm by piercing a number of holes in the bark. Such harm has also been noticed on twigs of larch, and to the tufts of needles.

Extermination Measures.—I can speak from observation of the great service against this pest of catch trees. So many trees are marked out and felled as brood material, and these are barked at the proper time. The bark containing the broods of larvæ is burned.

Pissodes piniphilus, the Pine-Pole Weevil.

Description.—The pine-pole weevil measures less than a quarter of an inch in size, and in colour is rusty brown, powdered all over with whitish scales. The posterior corners of the prothorax are rounded, being more round than in any of the other *Pissodes* species. Scutellum whitish. In place of the ordinary transverse band behind the middle of the elytra, there are two large rusty yellow spots, one on each side, between the suture and the outside edge. These spots are very characteristic, and, along with the absence of the band at the front of the elytra, are of great service in determination.

Distribution.—This bettle, widely spread over Europe from France in the south to Sweden in the north, is said by Fowler to be rare in Britain. Mention is made of it as found at Sunderland in imported timber, whence doubtless it has or will spread.

Life-History.—This troublesome and sometimes very harmful pest attacks, as its name indicates, chiefly pine forest in the pole stage. While trees from twenty to forty years old are the favourite breeding-places, yet *piniphilus* is not uncommon on old pines, its tunnels being found, not in the thick-barked underparts, but in the thin-barked upper parts of the branches of the crown.

While tunnels of a star-shaped pattern are not unknown, the female pine-pole weevil seems most usually to lay her eggs singly in the small needle-like prickings made by her rostrum. On peeling off the bark from an attacked stem, the larval tunnel is easily traced by the brown-black bore dust which fills it. The tunnels measure from 4 to 6 inches in length, but, as each tunnel winds in and traverses the bast at different levels, one is apt to think, from the comparatively small part presented at any one level, that the tunnels are much shorter. The pupal cradles gnawed in the wood by the grown larvæ are small, in keeping with the small-sized weevil, and the covering consists of very fine particles. Whilst weakly trees are preferred, *piniphilus* also besets healthy trees, which may soon succumb to this quickly-spreading pest. As *piniphilus* makes its onset on a tree high up, and not on lower, more easily seen and examined parts, the determination of attack is rendered difficult.

There is this, however, in favour of the forester, that *piniphilus* does not pass through its round of life rapidly, but that, as it takes two years from the time of egg-laying till the beetles are

mature and ready to escape, time is given for observation and procedure against it.

I must say that this two-yearly generation of the pine-pole weevil, when its small size is remembered, has often seemed to me hard to believe; and yet I am forced to admit that, so far, all the evidence forthcoming points to its correctness. At present I am engaged in some experiments with a view to determining beyond doubt the generation of *piniphilus*. On the Continent the weevils issue in June and the beginning of July, the eggs are laid in July, and the larvæ live as such for over twenty months. Nitsche's calendar is as follows:—

	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1894						BB E	L	L Fe	L edin	L g	L Hiber	L nating
1895	L Hiber	L nating	L	L	L	L Fee	L ding	L	L	L	L Hiber	L nating
1896	L Hiber	L nating	L Feed-ing	LPP	PP	BB E						

Prevention and Remedy.—Sickly poles with the needles of the crown discoloured should be felled about the spring of the second year's attack, *i.e.*, before the flight-time of the mature beetles. The felled poles should be barked, and the bark burned. Any pupa-beds in the alburnum must also be destroyed. Altum insists on the necessity of destroying the tops of the felled trees, as these tops are often left lying, and are used by *piniphilus* as breeding-places.

From some specimens of a twenty-year-old pine cut in the forest as attacked by the pine-pole weevil, I secured many examples of a parasitic ichneumon.

Pissodes harcyniae, the Harz Weevil.

The Harz weevil measures from $\frac{1}{4}$ inch to a little more in size. It is thin and black, and sparsely sprinkled over with white scales. Posterior corners of prothorax rounded, its upper surface scaled with white. Scutellum also whitish. Two interrupted transverse bands, one before and one behind the middle of the

elytra, yellowish-white. The elytra have rows of deep similarly-sized punctures, and the longitudinal lines alternating with the rows of pits are somewhat raised.

Life-History.—The Harz weevil, not a native of Britain, receives its name from the region where it is so plentiful and sometimes so havoc-working, as it also is to the spruce on the hill slopes of the Erzgebirge and the Riesengebirge.

Although the mature weevils may do some harm to bark and needles by pricking, it is the larva chiefly which is the pest. The females choose for egg-laying only spruce, and of an age varying from fifty up to one hundred years. The upper, thinner, smooth-barked parts of the tree are first used for egg-laying, the under thicker parts later. In each place bored by the female a small number of eggs is laid. The star-shaped pattern of tunnelling is well marked. As with the others, a bed is gnawed in the outer wood layers. Sound trees as well as sickly are attacked. In districts in Saxony where the smoke from factory chimneys had weakened spruce grown in the neighbourhood, the weakened trees were attacked by *harcyniae*, and soon succumbed. Indeed, in several such situations the growing of spruce has had to be discontinued and leaf trees grown instead.

The Harz weevil is also a pest, because it usually brings in its train several other injurious bark beetles. Such following beetles soon compass the death of a tree previously weakened by the onset of *harcyniae*.

Generation.—There is very little certainty as to the generation of the Harz weevil. Some consider the generation as annual, corresponding to *pini*, but the majority of forest entomologists hold by a two-yearly generation, that between two egg-laying periods twenty-four months elapse.

Preventive and Remedial Measures.—Careful and repeated revision of the areas planted with spruce, so that all weakly and suppressed stems may be felled and removed. The weevil will thus be deprived of favourite breeding-places, while the sound trees left behind are better fitted to resist attack. The attacked trees are marked, felled at the proper time, and the bark burned along with the inhabiting larvæ.

The helps in diagnosing attack correspond for the most part with those appearances discussed earlier in the paper.

(*a*) As in *notatus* and the others, an exudation of resin results from the wounds made by the rostrum of the attacking beetles.

From some recent observations on the Harz weevil, it seems that one cannot always be certain, from the presence of large resin outflow, that larvæ will be found on examination of the bark, for the outflow of resin may have been such as to stifle any hatched out larvæ. This, I think, is most probable, and likely to happen not infrequently with the Harz weevil, as it attacks sound trees. Miss Ormerod, in her "Manual of Injurious Insects," adduces examples of the grubs of the Elm Bark Beetle being drowned out by excessive flow of sap following the wounding of the tree; and I myself have been witness to an attack on a seventy-year-old spruce on the part of the adult beetle *Hylesinus micans* (not a British species), an attack which was quite beaten off owing to the great outflow of resin following the woundings of the beetles.

(*b*) The smooth bark where the eggs have been laid will be found to be ridged up somewhat over the larval tunnels.

(*c*) Discoloration of the needles.

Catch trees have proved successful with *harcyniae* as with *pini*. Ichneumons here, too, are serviceable. In one of the specimens which I have prepared to illustrate this paper, the cocoons of an ichneumon are seen, eloquent witnesses of a great tragedy. In the pupa-beds, dug so laboriously by the parasitised *harcyniae* larvæ, no *harcyniae* pupæ are to be found, but in their places useful ichneumons, descendants of the one,

> "Who for her embryon young
> Gored with sharp horn the caterpillar throng."

The voracious ichneumon maggots had accomplished their work so thoroughly, that of the *harcyniae* larvæ nought remained behind but their indigestible horny jaws and an empty skin or two.

Pissodes piceae, the Large Silver Fir Weevil.

This beetle measures up to $\frac{3}{8}$ inch in size, and is dark brown in colour. Wrinkled prothorax, with posterior corners projecting somewhat, and its hinder edges somewhat sinuous. Several white dots occur on the surface of the prothorax, which is traversed by a median longitudinal slightly raised line, Scutellum whitish. The whole upper surface of the beetle is covered with brownish-yellow scales. Below the middle of the wing-covers is a yellowish band, broader externally, and interrupted at the suture. The hollow pits arranged in longitudinal

rows down the elytra differ in size, some being distinctly larger. Not a native of Britain.

Pissodes piceae is found exclusively on silver fir. Its damage is done on old grown timber, and it never appears as a nursery or plantation pest. For egg-laying, sickly growing stems, freshly felled stems, blown down trees, stacked timber, are all made use of. Eggs may be laid in the thick bark of the under stem parts, several together. The wide coarse larval tunnels end in the usual pupa-bed, covered with very coarse chips.

The end of June and July, in middle Europe, seems to be the flight-time for the beetles.

From specimens of bark containing grown larvæ and pupæ, collected by me in the middle of May, I have bred out the beetles by the end of July. The generation is said to be an annual one. In absence of what we found to be a guide suggesting attack with the other *Pissodes* species, viz., needle-discoloration, the German forester suspects *piceae* attack when woodpeckers are found busy in their visits to the silver fir. The woodpeckers come for the enclosed larvæ.

Pissodes scabricollis.

This is the smallest of the *Pissodes* species, measuring without its rostrum sometimes less than $\frac{1}{8}$ inch. It is brownish-black, posterior corners of prothorax rounded. Upper surface of prothorax has a raised middle line not quite reaching the base. On each side of this middle line is a white dot, while round the edge are yellowish-white scales. Scutellum white. On the elytra we find a yellow spot on each side in front of their middle, and behind their middle a broad, somewhat interrupted, yellowish-white band. Pauly, who has more than once found it wrongly named in collections, insists on the following as characteristics :— Smallness, blackness, and the broad, white, and yellow band behind the middle of the elytra.

P. scabricollis is a form regarding whose life-history and work much remains to be investigated. The beetle has been taken in large numbers, but up till now its larvæ and pupæ are not certainly known in a state of nature. Dr Pauly, of Munich, by keeping a number of these weevils in captivity, and supplying them with spruce, has succeeded in breeding the beetles, obtaining all the stages from the egg onwards. It will be remembered

that *harcyniae* also breeds in spruce, and in an endeavour to distinguish the two in their work I will give Pauly's measurements:—

	harcyniae.	*scabricollis.*
Average length of the protective covering of chips over the pupa-bed,	11 –18½ mm.	11 –13 mm.
Average breadth of same,	4½ – 6 mm.	4 – 4½ mm.
Average length of hole gnawed in splint for bed,	8 –10 mm.	6½ – 9½ mm.
Average breadth of same,	2½ – 3¼ mm.	2 – 2½ mm.
Length of full-grown larvæ,	9½–11 mm.	7½ – 9 mm.
Larval tunnels,	...	Shorter and more delicate.

It is discouraging to find how little possible it is to distinguish their work, always, of course, in the absence of the beetles. Last summer I thought I had made a lucky find, as I procured at Kirchseon in Bavaria some spruce bark with larvæ and pupa-beds and pupæ. The beds were smaller than I had ever seen for *harcyniae.* I waited impatiently for my beetles to emerge, and when they did they proved to be only a small *harcyniae.*

Tar-Rings or Sticky Bands as a Possible Aid in Extermination of the Pissodes.—During the great devastation in the spruce forests of Bavaria in 1890-91, when the ravages of the caterpillars of the Nun Moth (*Liparis monacha*) cost the Bavarian Government £100,000, as a means to prevent the caterpillars from ascending the trees, a ring of tar (of a special preparation) was placed round each tree in the forest. Vast numbers of insects other than the one against which the rings had been primarily directed were met with under the rings. In the spring of 1891 Pauly noticed, among other insects, numbers of *Pissodes*, chiefly *P. scabricollis* and *P. harcyniae.* In one district alone, that of Sauerlach, it was estimated that over 1,000,000 *Pissodes* were collected from under the rings, where they had stationed themselves, with their proboscis buried deep into the bark, feeding and perhaps egg-laying.

Again, in the forest of Nuremberg, where thousands of pines had had a tar-ring put round them to prevent the ascent of the caterpillars of the Pine Moth (*Gastropacha pini*), many *piniphilus* were got in the spring time. In view of these facts, then, such ringing may prove of great value as a proceeding against an onset of *Pissodes.*

Pissodes validirostris.

This brown or red-brown weevil is very like *notatus*. The posterior corners of its prothorax are right angled, and the hinder edges slightly sinuous. Scutellum white, while white scales are dotted not very thickly over the beetle. Elytra with two transverse bands. The front one yellowish and interrupted at the suture. The hind one is somewhat irregular and yellowish externally, whitish internally. Rows of very fine dots along the elytra.

P. validirostris I have only seen as a museum specimen, and only include it here for the sake of completeness. Some hold there is no difference between it and *notatus*. The larvæ is found in pine cones.

In concluding this communication on the *Pissodes*, I wish to acknowledge my indebtedness to the works of Nitsche and Altum, and also to my old teacher, Professor Pauly, of Munich, who placed so many facilities in my way for studying the *Pissodes*.

V. *Is British Forestry Progressive?* [1] By Arthur C. Forbes, Wood Manager, Bowood, Calne, Wiltshire.

The not inconsiderable amount of attention paid to forestry by certain sections of the public during the last few years, and the various opinions which have been expressed in connection therewith, must be my only excuse for bringing the subject of this paper before the members of this Society. Since the Forestry Exhibition of 1884 many events have taken place which have had, or ought to have had, an important effect upon the condition of forestry in this country. I need not take up time by enumerating these events, as no doubt they are familiar to all present, but I may remind you that the only tangible and permanent effect of them hitherto has been the inauguration of instruction in scientific forestry. Since Professor Somerville delivered the first course of lectures in Edinburgh University, the subject has been and is being taught in other centres, and is gradually being recognised by various examining boards and educational institutions as one worthy of encouragement. Farther reaching in its effects, perhaps, than even this instruction, has been the publication, in the English language, of several well-known standard German works on forestry, the appearance of a Manual of Forestry from Cooper's Hill, and new editions of old works on British Forestry, all of which have brought a knowledge of the subject within reach of all classes.

With all these aids to advancement, it might reasonably be expected that British forestry would show some signs of awakening from its torpid condition, and although sufficient time has not yet elapsed to permit of any great improvement in the actual condition of British woods, yet some signs of activity ought to be observable. The landowner, for instance, should be fully alive to the advantage of having his woods properly managed; while the practical forester, on his side, should be well up in the most approved methods of planting and rearing crops of timber, and the general management of a woodland area. No doubt, if things were as they appear to be at first sight, such would have been the case by this time, and British forestry would now be seen slowly but surely emerging from its old state, and taking its proper place in the rural economy of the United Kingdom.

[1] Read at a General Meeting held on 3rd August 1896.

But unfortunately for the realisation of such expectations, many factors operate upon British forestry which cannot be allowed for in any abstract reasoning or theorising upon the subject. In the first place, British woods have no distinct individuality. They are not represented by so many thousands of acres devoted to the production of timber, but are part and parcel of so many separate estates, of which they form by no means the most important part. They possess a relative rather than an absolute value, and the purpose they serve in estate economy is merely a subordinate one. In the second place, they are in the hands of private owners, and their condition and treatment are determined, not by the merits of a particular sylvicultural system, but by the individual tastes, interests, and objects of their respective owners. To clearly understand the effect of these several existing conditions, one must have filled the position of forester on a private estate, as no outsider, however intimate his acquaintance with the subject of forestry in general, can have anything but a faint idea of the numerous influences which are continually at work upon an estate.

It may be possible, however, to give a faint idea of what I mean by glancing at the influence an estate owner exercises on his woods in his threefold capacity of individual, property or landowner, and the head of a noble family. As an individual, his inclinations may run in the direction of sport, arboriculture, or landscape effect, and according as one or other of these inclinations preponderates, so will he wish his woods treated. As a landowner, the return he derives from his property is what chiefly concerns him; and a present rent of two or three shillings per acre is of more value to him personally than a prospective one of three or four times that amount in sixty or eighty years time. As the head of the house, tradition and sentiment enter largely into his actions, and any wide departure from the course adopted by his predecessors is not readily taken. The proprietor of a fine old family estate has a natural repugnance to treat his woods as a financial concern, and to consider them as so many cubic feet of timber to be disposed of at a certain period in their growth. They have been before his eyes as long as his memory can go back, and it is only natural that he should wish to hand them over to his successors with their most distinctive features still unimpaired.

The above are only a few of the numerous obstacles to the

introduction of economic forestry on private estates. Another, and probably the one most readily recognised, is the financial side of the question. It is very rarely that a proprietor derives any pecuniary benefit from tree-planting during his own lifetime. If he is a natural forester—like so many Scottish landowners—it must always be to him a source of gratification to see young woods clothing what was once a bare hill-side or a bleak moor; but it is only wealthy estate owners who are able to indulge in this form of recreation. When we consider what has been done on many Scottish estates during the last two centuries in the way of tree-planting, we might be tempted to be equally hopeful as regards the future; but we must remember that the financial condition and prosperity of landed estates are by no means so good as they once were. For a millionaire or capitalist with a taste for estate improvement, the afforestation of land is a healthy and highly commendable means of employing spare capital. Such gentlemen might well follow the example of Mr Vanderbilt, who, upon his estate of Biltmore, in Carolina, has laid the foundation of a scientifically organised forest on the Continental principle, a feat which the Government of the United States, as well as other Governments, appear unable to accomplish as yet. But go to an average landed proprietor, whose broad acres include a good many barren ones, and explain, as forcibly as you can, the economic, philanthropic, hygienic, and æsthetic importance of planting waste land, and wait for results. If the waste land in question is adapted for conversion into a game-preserve, planting of a kind (but not your ideal) may be indulged in to a slight extent; but you need not look for extensive forest-planting where farms are lying derelict, buildings are out of repair, and rents are little more than nominal. Any money invested in planting by a private estate owner is money for which he has no immediate need, and on which he expects no interest during the next twenty-five years. Such investments are not characterised by a close observance of those economic principles which guide the ordinary investor, and are regarded more as additions to the amenity of an estate than as interest-bearing speculations. Consequently such plantations are more frequently used for the preservation of game, and the supply of material for estate purposes, than regarded as timber-producing crops.

But I may be reminded that the prospects of future planting do not comprise the whole question of British forestry, and that

there exist some two to three millions of acres of woods and plantations in Great Britain, the improvement of which deserves attention. Unfortunately for the discussion of this subject, the returns published by the Board of Agriculture do not show the purpose for which British woods are maintained, and no distinction is made between game-preserves, ornamental woodland, and plantations ostensibly formed and tended for the production of timber. Indeed, the distinction between these three classes is probably so obscured by the points of view of individual proprietors, that, as regards the majority of them, it would be extremely difficult to decide under which heading they should be placed, although they are usually utilised for all three purposes. Many woods again owe their designation to the fact that a few old or stunted trees still remain scattered over the ground, the actual quantity of timber present being very small. Consequently a return of the nominal woodland area of Great Britain affords little indication of the extent of *bonâ-fide* plantations of timber trees. Generally speaking, however, while English woods are chiefly used and maintained as game-cover, plantations in Scotland have been formed with a partial view to timber production, and are considered as of some economic importance. But here again there is a difficulty in discriminating between those which are managed with a definite view to profit, and those which are valued quite as much for the shelter they afford and the effect they produce on the landscape as for their timber-yielding capabilities. By far the larger proportion comes into the latter category. I believe that forestry pure and simple has but a very limited existence in British woods. Planting, thinning, and felling may go on with comparative regularity, and some system, more or less complete, may be apparent in the management of most estate woodlands; but the general idea which permeates the whole management of a state forest—namely, that of keeping the growing stock of the forest in as nearly as possible a normal or well defined ideal condition—is lacking in this country. No provision is made for maintaining a continuous and uniform yield, and where we find one estate on which the annual fall of timber over a series of years represents a comparatively constant sum, there are ninety-nine on which that sum fluctuates between wide limits. It is probably owing to this absence of uniformity that proprietors take so little interest in the financial aspect of their woods. They are more apt to regard the revenue they

derive from them as a reduction of capital than as interest upon it, and forget Mr Gladstone's somewhat ambiguous axiom, that "the best way to preserve timber is to cut it down."

It is probably to this indifference on the part of the owner that the existing condition of British forestry is due. The most enthusiastic reformer may expatiate without success on the deplorable condition of a proprietor's woods, and the enormous advantages of economic forestry, and its influence upon our industrial welfare. The proprietor listens, thanks him for the information, believes he is quite right, and before parting asks his advice regarding the planting of a bit of game-cover, or the preservation of an old tree—*Sic itur ad astra.* Old customs and ideas die hard, and the promotion of forestry in this country not only involves the teaching of new systems but the abolition or modification of old and deeply-rooted prejudices. This is the task which this Society presumably set itself at the outset, and we are justified in inquiring—"With what result has British—or if you like—Scottish forestry shown any improvement of late on that of fifteen or twenty years ago? Are proprietors taking a greater interest in tree-planting, and the production of first-class timber? Are they more eager than of old to get the best advice on the management of their woods?" These are questions of vital importance to British forestry, which is entirely in the hands of private estate proprietors. What is the all-absorbing topic in rural life in this country but agricultural depression, and what is its effect upon landed estates? So far as can be seen at present, the general tendency is in the direction of a reduction all round in acreage, in working expenses, and in outlay of capital, and all this is hardly conducive to the advancement of scientific forestry on private estates, which demands, if not a greatly increased expenditure, at least a certain sacrifice of the pecuniary interests of the present to those of the future. One of the first indications of an embarrassed estate is generally an excessive felling of timber, which is seldom followed by commensurate planting operations, and when this is the case woods soon fall into a neglected state. It is only on large estates, again, where the acreage of woodlands is proportionately large, that an efficient staff of workmen can be maintained for the various operations necessary to keep the condition of woods up to a proper standard. On a small estate the woods are attended to when time and opportunity permit, and this often means that

next to nothing is done to them. Theoretically, there is no reason why the woods on a small estate should not be as well cared for as those on large properties. Facts and experience prove, however, that the smaller the acreage the more likely are they to be neglected, or simply treated as game-cover or ornamental woodland.

With these facts before us, it cannot be said that the prospects of British estate forestry are particularly promising. We have had several remedies suggested of late, it is true, but none of them is, in my opinion, of great efficacy. The most likely are, perhaps, "education for the forester," and "pecuniary loans to the planter." It is a fondly cherished idea in some quarters that proprietors have hitherto been retarded in their efforts to improve their woods, and to inaugurate a better system of forestry, by the inefficiency of their foresters. The latter are said to be thoroughly practical, but lacking in scientific knowledge, and owners are accordingly handicapped in their efforts to improve their woods by the want of better trained men. This is a beautiful theory, but one which unfortunately vanishes when it comes to be analysed. That mistakes have been made in the past I am quite ready to admit, but it is hardly fair to put the whole responsibility for them upon the forester. How often are thousands of young trees destroyed in a few weeks by ground-game? How often is the forester obliged to cut into immature woods in order to satisfy estate requirements? And last, but not least, how often are his own ideas and wishes overruled by the powers that be in the matter of planting, thinning, and felling. Perhaps in all the operations of practical forestry over-thinning has been the great blot which has disfigured British forestry in the past. But the day has scarcely disappeared when a forester who thinned a Scots pine or spruce wood on what are now generally admitted to be correct principles, was regarded as totally incompetent, and as having ruined the plantation.

After all, however, from whom comes this complaint of a lack of properly trained foresters? In all the correspondence and discussions which have appeared in print or taken place on the subject of forestry education, the names of really representative woodland proprietors or their representatives are rarely seen. Scientists, economists, nurserymen, gardeners, and foresters themselves have all raised their voices in support of the various schemes that have been suggested, but the party for whose benefit this praiseworthy movement has been set on foot, whose income from

his woods is to be so greatly increased by it, and who is expected to welcome the "new" forester with open arms—where is he?

How is it that in a House of Commons, the majority of which consists of landowners, any debates on the question of a school of forestry, or the recommendations of the select committee, have been dismissed in a few words, and with apparent indifference? If anything like unanimity prevailed on this point, surely landowners as a body would have both the will and the power to carry through such a comparatively small undertaking. Only within the last few weeks, while the Agricultural Land Rating Bill was passing through committee, woodlands were excluded from the provisions of the Act with but one dissentient voice. This does not look as if proprietors were so very anxious regarding their woods after all, although there are doubtless exceptions to this state of indifference. Everyone who read or heard the eminently practical address of the esteemed President of the Society, Mr Munro Ferguson of Novar, which was delivered at last year's annual meeting, must feel that in him we have a friend and powerful ally in the cause of scientific forestry. But even that gentleman, in spite of the brilliant example he sets to his brother landowners, appears to have little faith in the advance of estate forestry nowadays.

The best means we have of testing the truth of these assertions is by the demand which exists for men with the amount of technical knowledge supposed to be necessary or desirable. If proprietors really wanted their woods managed on sound sylvicultural principles, there would be a strong inducement held out to the practical forester to qualify himself for such work, for in men, as in other commodities, the class of article most in demand will always rule the market. But, so far as I am able to judge, so long as a man has sufficient experience of the practical working operations of woods, and has proved himself thoroughly trustworthy and capable of managing men, his knowledge of scientific forestry is rarely called into question. Of course, it must be admitted that it has hitherto been impossible to get men with anything but practical experience, and consequently the demands of the past afford no criterion of those of the future. But it must also be remembered that the average Briton, whatever position he may occupy, has not yet adopted the motto, "Practice with Science," with anything like enthusiasm. Science pure and simple he has a great respect for, but when he finds anyone who

has practical work to do with a smattering of it, he shakes his head, and remarks that "theory" is all very well, but give him experience. On estates the purely practical man is favoured, for several reasons. The principal one, however, is apparent when we consider what the duties of an estate forester are. Theoretically, they are the management of woods and the superintendence of the staff employed therein. Practically, they are just what the proprietor considers most expedient for the economical working of the estate. If the woods are of small extent, other duties are often entrusted to the forester, such as attending to roads, fences, draining, and sundry other work peculiar to an estate, according as its character and other circumstances render a grouping together of certain duties advisable. A knowledge of scientific forestry is consequently considered by most proprietors a superfluity, and although I should not like to say that the possession of it was a disadvantage to a candidate for an appointment, I don't think it would be likely to help him very much. The class of men wanted on the majority of estates nowadays are not specialists, but jacks-of-all-trades, who can turn their hands to anything and turn up their noses at nothing. If a young forester, after studying forestry and the allied sciences, is willing to begin work on this understanding, and put his science in his pocket till it is asked for, all well and good. But if, on the contrary, he puts on an air of superiority, substitutes scientific language for his mother-tongue, and falls into that lamentable condition peculiar to the immortal Jack Jones, it would have been better for him to have remained as Nature intended him to be. Anyone acquainted with the average estate labourer in the south of England will know that any attempt to alter his methods of taking that gentle exercise which he euphemistically terms "work," or to introduce new tools, is simply labour in vain, and a little tact and judgment are of more use than a great deal of science.

Under present conditions, it is only the young forester, who has a genuine affection for his profession, and to whom the receipt of so much per annum is not the sum total of his ambition, that can benefit by a scientific education. Every *bonâ-fide* forester is more or less a naturalist, and beyond the mere stock of facts furnished by a study of such subjects as botany, chemistry, zoology, etc., it will enable him to make accurate observations—an advantage which needs no recommendation.

But in the present condition of British forestry, the number of

landowners with appointments to fill who are desirous of securing the services of scientifically-trained men is limited, and therefore our young foresters of the new school must not give way to despondency if, on finishing their science course, they do not at once find the opportunity of putting modern sylvicultural methods into practice. Nor need they, under any circumstances, expect to have a perfectly free hand in the management of their employer's property. But even if they have frequently to act in a manner which is not in conformity with good sylvicultural practice, it cannot be doubted that the knowledge which education has given them must, on the whole, have a beneficial influence on the woods placed under their charge.

As for the prospect of estate forestry being encouraged by loans to planters, I cannot put much faith in it. As already pointed out, the planter derives no actual benefit from his work, and in most cases suffers personal loss, and I do not see how this loss would be obviated (although it would doubtless be diminished) by a loan. Interest would have to be paid upon it in any case, and a proprietor who planted a deer forest or grouse moor would simply change his position from that of a rent-receiver into that of a rent-payer for someone else's benefit. Some assert that the private ownership of land forms no great obstacle in the way of economic forestry, and point to the Continental forests owned by private individuals. But I am afraid they forget that the traditions and conditions are totally different in the two cases. In the first place, these forests are regarded as such, and game is not the only objective consideration. In the second place, they exist, and have existed for centuries, and the owners have come to regard them as constituent elements of the estate. In the third place, forestry is a recognised institution, and Governments and legislation keep an eye upon it in a fatherly spirit. With us, no such advantages are present. To begin with, we have no forests on an extensive scale, our woods are valued according to their game-producing powers, and whenever a landowner converts a barren waste into a productive property, he is promptly taxed for it. Forestry and the utilisation of waste land concern the nation at large, and not merely an individual or a particular class, and I see no reason why a proprietor should sacrifice his own interests for the good of a public who are quite able to carry on work of this kind for their own benefit if they choose. Unfortunately, the British public wants a good deal of education on

this point, and I noticed that the Minister of Agriculture himself expressed an opinion, when replying to the Scottish deputation on Forestry last year, that State forests might possibly do estate owners an injury, by adding an element of competition into the growing of timber in this country. The facts, in my opinion, rather lead to an opposite conclusion, viz., that an increased production of timber would tend to enhance its value by placing the home-timber trade on a sounder basis, and inspiring greater confidence in the minds of merchants regarding a steady supply. At any rate, action by the State or other public body is the only means by which a rational system of forestry can ever be properly established in this country, and the only way to bring this about is by united action on the part of all interested in the matter. There ought to be no great difficulty in enlisting the sympathies of all societies which have the welfare of the land at heart, and in this connection it is gratifying to note what has been done by the Highland and Agricultural Society to promote forestry. But considering the intimate connection between agriculture and forestry in any part of the country, I do not understand why a national society like the Royal Agricultural Society of England should pay little or no attention to this subject. State forestry would do far more for rural England, Scotland, or Wales than many minor industries encouraged by that Society; and although the latter may have no power in itself to carry on such work, yet its sympathy and support in such a cause would carry great weight. That we are likely to see State forestry established on a large scale is hardly to be expected for many years to come at least, but when once a beginning has been made, the most elaborate dreams and aspirations may ultimately be realised.

In conclusion, I only wish to say that if my opinions and views on British forestry and its future prospects are regarded as too pessimistic, no one will be better pleased to be assured of this than myself. That an improvement in the detailed management of woods (in Scotland, at least) will result from the educational work so ably carried on by Professor Somerville, Colonel Bailey, Professor Bayley Balfour, etc., during the last few years, I cannot but believe, and the only question is, "Will proprietors of woodlands do their share in promoting economic forestry?" for upon them depends everything, not so much as regards actual operations, as the principles and motives which underlie them. How this aspect of the case affects the question, I have already tried to make clear.

VI. *On the Rearing of Natural and Artificial Undercover for Game.* By Alexander M'Rae, Forester, Castlecomer, Kilkenny Co., Ireland.

Practical forestry of the present day embraces a field of operations which is at once wide and varied. In the main the forester is expected to raise and manage plantations so as to produce the best possible quality of timber at the least possible expense; but at the same time, on the great majority of our estates, he must also provide ample facilities for sport and the preservation of game.

On large estates, where the plantations are extensive, and of all ages, and in all stages of growth, the task of providing cover is not very difficult, especially if the older plantations are well stocked with underwood, which is well managed on the rotation system. By this method the supply of cover is continuous, and if the locality is a good one, and the underwood produced is of good quality, the revenue will also be continuous, a phase of the question which is somewhat important in these times of depression.

But if good sport is required on small estates, where the plantations consist of mere slangs and long narrow strips, with here and there a wood containing several acres, it becomes absolutely necessary to preserve and encourage all natural undercover, and also to introduce covert plants suitable to the soil and situation. The reason for this is obvious. On small estates it is very difficult to keep game, and especially pheasants, from straying into the enemy's camp unless good, comfortable covers are provided for them.

By way of following the subject up from the beginning, we shall suppose ourselves on an estate where the renovation of the game covers is an item of importance. The first step will be to examine the condition and position of the covers, and the next to decide—after consultation between the proprietor, the gamekeeper, and the forester—which of the covers is first to be operated on. We shall suppose the plantation chosen consists chiefly of hardwoods of timber size, with a fair sprinkling of overgrown underwood. It will be necessary to commence operations by making a careful examination of the trees forming the standard crop. If they are moderately thin, and distributed pretty equally over the ground, little need be done; but where the standards stand thick it is advisable to thin them out, care being taken to regulate them so as

to leave the best specimen trees, by cutting out all the poor trees and everything that is crushed up. All the tall, lanky underwood should also be cut out, so as to get a fresh growth from the stools. By these means an additional supply of light and air will be obtained, and the conditions will be much more favourable for all sorts of undergrowth. If any of the underwood is of a thick, bushy habit of growth, it is advisable to cut it off from 3 to 4 feet above the level of the ground, thereby forming nice compact bushes at once.

Elder bushes, if not too lanky, can be made into splendid cover by cutting them about half through near the ground, and afterwards bending them down. They will then throw up a mass of young shoots from the root and all along the stem; while fern, bracken, briers, and other rubbish will grow up through them, forming a good hide for game. Hazel, birch, alder, oak, thorn, beech, elm, etc., can all be treated in the same way, provided rabbits are not very numerous.

When the felling has been completed, the standard trees ought to be pruned. If this operation is properly carried out, and all the dead, broken, and superfluous branches neatly cut off, it will greatly improve the appearance of the job. If, after having removed the timber and all the useful brushwood, planting is decided on, all the remaining rubbish ought to be burned up so as to effect a clearance. It must be kept in mind, however, that a good many gamekeepers prefer to have some rubbish littered about the bottom, and there is no doubt it is useful for nesting, etc.; but if any rubbish is left where planting is to be carried on, it should be piled round the stems of the standing trees, so as to leave all the open ground available for planting. At this stage all drains in the cover should be put into proper working order, and the fences repaired where necessary.

The foregoing operations should be completed, if possible, between the months of November and March, because if done then the underwood will throw up a much stronger growth from the stools than it would do if cut during the growing season.

If there should be a fair quantity of oak to fell during the thinning, it would likely be advisable to clear out all the underwood and other trees first. The oak could then be felled during the peeling season—for a few tons of bark are a consideration—and the clearing up could be done afterwards, in readiness for planting next season. Rabbits should be kept well down for a

year or two after cutting up, so as to give the underwood a fair start.

If a piece of cover, such as a heading corner, or a portion of a wood that seems well adapted as a preserve for pheasants, is required to be specially good, it is advisable to enclose it with wire netting for a few years, so as to exclude rabbits and hares. A greater variety of plants can then be used in the composition of the undercover, and the stuff gets a chance to settle and make a fair growth before being molested.

Planting.

Having completed the preliminary operations, we shall now proceed with the planting, which may be carried on any time from November to March, according to circumstances.

The more open spaces which show a good bit of headroom should be planted with evergreens of an upright habit of growth, such as spruce, Douglas fir, or common yew, and a few Scots fir or other varieties of pine. These should stand from 8 to 10 yards apart, and if given sufficient headroom they will soon develop and form splendid roost and shelter. If grown close they will run up too quick, and lose their lower branches at too early an age.

Common spruce is really the best tree for the purpose, because it can be obtained cheap, and generally does pretty well when transplanted into an old plantation, while pheasants are very fond of it for roosting.

Well furnished young plants, about 6 feet high, are the most suitable for this purpose, if they can be obtained from young plantations on the estate, or from the home-nursery. They ought to be lifted, and conveyed carefully to the place of planting, so as to have the balls as large as possible. The pits should always be dug large enough, in fact, a good deal too large for the present requirements of the plants. Large stones and old roots can then be disposed of, and the soil will in consequence be rendered more favourable for the reception of the rootlets. This rule should be insisted on in all cases of underplanting, because it is impossible to trench the ground, and large pits are therefore the only alternative. When the standards have been planted, the ground should be filled up, to about 6 feet apart, with such a mixture of covert plants as may be considered most suitable for the position and circumstances.

The common rhododendron can nearly always be used in underplanting, and is a splendid plant for the purpose. It is not particular as regards soil, and soon forms a good, thick, dark cover; one great point in its favour being that rabbits and hares do not interfere much with it.

The following would be a good mixture for ordinary cases, viz., one-third *Rhododendron ponticum*, one-third hazel, and one-third common evergreen privet. For ordinary cover these plants recommend themselves, because they can be obtained cheap, and when once settled, they soon make considerable growth. I have found it quite customary to plant masses of rhododendron alone for cover, the plants being so close together, that in about five or six years they are all growing into each other, and three or four plants are then occupying the ground which ought to be filled by one.

When rhododendrons are so thick together, it is very difficult to get game out of them, and as a rule pheasants do not seem to like them. A mixture of other stuff, such as hazel and privet, helps to keep them open and dry.

In regard to rhododendrons, a good deal of money could be saved on many estates by making use of the hundreds of seedlings which come up around the old bushes. In fact, I have seen estates where, with a little care and management, rhododendrons for cover purposes need never have formed an item on the nurseryman's bill. Privet could soon be grown in any quantity from cuttings, while hazel might be bought as seedlings, and afterwards grown in the home-nursery, strong and bushy, just to the mind of the planter. *Mahonia* is also a very good cover plant, and can be obtained very cheap; it is a valuable addition to covers of a semi-ornamental nature.

In damp places alder should be used pretty extensively, as it stands a good deal of cutting, and grows freely. A whole host of other plants might be used, such as *Rosa rugosa*, yew, laurel, holly, box, etc., but as a rule they are far too expensive for general cover purposes. I would only just mention, that for covers in exposed situations on the sea-coast, nothing succeeds better than the sea buckthorn and the tamarisk.

For successful cover planting the plants used should not be too large; while in the nursery they should be transplanted rather frequently, so as to ensure their being well furnished with fibrous roots, and encourage them to assume a compact bushy habit of growth. Long lanky stuff, such as we often see used,

whether bought or home grown, is not worth the trouble of planting.

Management.

For the first two or three years after planting it may be necessary to clear the young plants a little, because after the thinning and pruning there is sure to be a much thicker growth of grass, bracken, briers, nettles, or other rubbish, which would be apt to choke the young plants, or at least retard their growth.

Undergrowth for game cover should never be allowed to get too tall and lanky. As soon, therefore, as the tops begin to run up, it is advisable to go round and switch them off about 3 to 4 feet high; this encourages a thick bottom-growth, and saves the standard evergreens from being lashed and weakened. It also gives the beaters a better chance of working the game out, while the guns have more uniform sport, because the birds rise gradually, instead of all running forward under a mass of top-growth, and rising in flocks at the heading corner.

In regard to switching the underwood, it would be advisable to divide it into sections, and do a part every year, each section being gone through about once in four or five years, according to growth, etc. It is best to do the switching in winter, and especially during hard weather, because the branches and young shoots thus cut off take up the attention of the rabbits, and help to keep them from gnawing the roots and stems of the trees and plants. Covers so treated, if started on while young, may be kept in good condition for many years.

If there are any young plantations, or portions of plantations, on the estate composed chiefly of spruce, say from six to twelve years old, they can be converted into splendid covers in the following manner:—The best trees should be picked out and left standing from 8 to 10 yards apart for standards. The leaders should then be cut out of all the intermediate plants, about 3 feet above the ground, and the rubbish trampled down underneath. The standards will then have plenty of room to develop, and will form nice specimen trees. They will also help to retain the unbroken appearance of the plantation when viewed from a distance. The topping should be done while the plants are still clothed to the bottom with fresh green branches. The plants so treated will throw up several leaders, and an occasional switching is all that

will be required to make them spread and keep them from running up too high.

This forms an excellent cover for pheasants and foxes, as it is always so dry and comfortable; with a little care and patience it can be produced on any estate at a merely nominal cost, and if properly looked after, will last for a long time. Where rabbits and foxes are the main objects in view, the very best cover for preserving them is, without doubt, gorse or whin. Of course, if there is a good supply of natural grown whins, little need be done, except an occasional cutting or burning, just to keep them in good condition, and this should be done on the rotation system—say a patch every year, so as to keep up a regular supply of cover. The burning or cutting should always be done before the plants get too old and weak, because if left too long, the roots are apt to die out.

On a good many estates, and especially in the principal hunting districts in the midlands of England, good patches of natural gorse are rather rare, consequently it is quite a common practice to raise them from seed.

In connection with the selection of a site for an artificial gorse cover, the following points might be observed:—

The site should be of a hilly nature, composed of light sandy soil —say the worst piece of ground in the district.

It should not be in too close proximity to arable land, because a large number of rabbits can soon do enormous damage to grain or root crops, and they prove a constant source of annoyance to the farmer.

An ideal site for a gorse cover would be in the middle of a large park adjoining the mansion-house. There is then plenty of food for rabbits, and it is handy for shooting, while in the hunting season it is rather interesting to watch the "draw" from the windows or pleasure-grounds.

If the soil is light and sandy, gorse-growing is almost a certain success, provided the seed is of good quality. If the proposed site is old turf, it is advisable to plough it a fair depth in the autumn, and let it lie all winter, so as to let the turf rot as much as possible. In the spring, the ground should be worked pretty well, so as to kill as many of the weeds as possible, and then the seed may be put in early in April, just like an ordinary cereal crop. If the ground is very dirty, the seed should be sown in drills, say 20 to 24 inches apart. Cleaning can then be attended to during the summer months, thereby giving the crop a fair start for the first season. If

the seed is good, about 20 lbs. per acre is sufficient for cover purposes. The patch should be fenced so as to exclude cattle and sheep. If the gorse occupies a rather prominent position, the effect on the landscape might be rendered more pleasing by planting some nice specimen spruces, or other conifers, at intervals of 12 to 15 yards apart. These plants would, however, require to be encl sed with wire netting, so as to protect them from the rabbits. If properly managed, the gorse will form splendid rabbit cover in two years from time of sowing.

Artificial gorse, as a rule, is very apt to run up tall, instead of assuming the compact, bushy habit peculiar to the natural growth, and especially if it is grown thick on a pretty good soil. In this condition it is very liable to be blown down, or crushed with snow, and the one-half smothers the other in a very short time. This might be prevented by going over it when about two years old, and switching off all the long leaders with a sharp hedge-bill, repeating the operation every year, which would tend to encourage a thick growth, and allow the gorse to come up very gradually.

Of course it will be apt to run out in course of time, so that cutting or burning will have to be attended to, as in the natural growth, but if kept comparatively low, it may last for many years.

If a patch of gorse is grown on one side of a plantation, it forms a valuable addition to the game cover. It makes a splendid heading corner, the birds being forced gradually out of it, and there is generally capital sport among the rabbits. Heather and bracken are both good natural undercover, but they are generally qualified to look after themselves.

All masses of game cover should always be well intersected with shooting tracks, so as to give the guns every opportunity of reaching the game; and sometimes, in very thick places, it is necessary to cut little zig-zag paths for the beaters, so as to enable them to work the game out properly.

REPORTS BY THE HONORARY OFFICIALS.

1. *Report on the Meteorology of Scotland for the Year ending September* 1896. By R. C. Mossman, F.R.S.E., Honorary Consulting Meteorologist.

The following remarks are deduced from the bi-diurnal observations made at sixty-seven stations of the Scottish Meteorological Society, the data being already reduced by Dr Buchan, and published quarterly as an appendix to the Registrar-General's returns. Other sources of information, such as the monthly abstracts issued by the London Meteorological Office, have also been utilised. It is hoped that some scheme will be inaugurated during the coming year whereby the relations of climate to forestry will be shown in their more immediate and practical bearings. In the meantime, the following statement, summarising the more salient features of the weather experienced over Scotland during the twelve months under review, is submitted.

October 1895.—The weather of October was very changeable. The month opened with a continuation of the phenomenal warmth of September, the temperature at many places exceeding 70° in the shade on the first two days of the month. Cold, arctic conditions, however, set in about the end of the first week, with the result that the mean temperature of the month was nearly 4° below the average. The depression of temperature was relatively greater in the south than in the north of the country, being greatest in Galloway. Rainfall was a little over the average, but was distributed throughout the country in a capricious manner. In the counties of Roxburgh and Berwick more than double the average precipitation was recorded, while the deficit was considerable over nearly the whole of the western districts. Bright sunshine was in excess of the average.

November 1895.—The weather throughout the greater part of the month was very unsettled, gales and heavy rains being

frequent. The mean temperature was above the average over the southern counties, and also in the Hebrides; but a deficit was recorded in the vicinity of the Caledonian Canal, and at some places situated on the coast from Dunrobin to Banff. The rainfall was 15 per cent. below the normal, the deficiency being greatest to the north of the Grampians, especially at those places to the westward. On the other hand, the precipitation exceeded the average by 50 per cent. at places on the east coast, as well as in one or two widely scattered districts. Bright sunshine was in excess of the average at northern and western stations.

December 1895.—The weather of December was extremely unsettled. Gales were frequent, and were accompanied in many cases by snow and hail showers; while thunderstorms were a very usual concomitant, especially on the western seaboard. The temperature was just the average, there being a slight defect at some south-western stations, but over the greater part of the country the values were quite normal. The rainfall was above the average over the eastern districts, the excess being most marked in the counties of Aberdeen and Banff. Over the west of Scotland, on the other hand, there was a considerable deficiency, which was most noticeable in Sutherland. Sunshine was scanty, few places having more than 10 per cent. of the possible duration.

January 1896 was characterised by a temperature nearly 3° above the average, the mild weather being accompanied by a remarkably high barometer, which in some places reached the phenomenal elevation of 31·10 inches on the 9th of the month. Rainfall was very deficient, save in the counties of Ross, Sutherland, and Caithness, where it exceeded the average by from 40 to 50 per cent. The smallest rainfall was recorded at stations to the south of the Moray Firth. Slight falls of snow were experienced between the 21st and 23rd, which soon melted. Sunshine was very prevalent in the north-east, Aberdeen being the sunniest station in the British Isles.

February 1896 was dry and mild, in marked contrast to the corresponding month of 1895. The mean temperature was 3° above the average, the excess being much the same over the greater portion of Scotland. The mean rainfall, taking the country as a whole, was two-thirds of the normal, but was above the average in the north-west, the wettest station being Fort-William, with over 8 inches. Bright sunshine was considerably

less than the mean, the defect being greatest at Aberdeen, which had only one-third of the average.

March 1896.—Very unsettled weather prevailed throughout the greater part of the month, falls of rain, sleet, or snow being of frequent occurrence. The temperature was high, a result of the predominance of winds from the west and south-west. Rainfall was much in excess of the average at places on the west coast open to the prevailing winds, but in the north-eastern counties there was a marked deficit. Bright sunshine was slightly below the normal, the maximum amount being recorded in Aberdeenshire.

April 1896.—Changeable showery weather characterised the first half of the month, during which time showers of snow, sleet, and hail were of frequent occurrence, whilst thunderstorms were often observed. The mean temperature was 3° above the average, the excess being greatest at places in the east, situated some little distance from the sea. Rainfall exceeded the average in the west and north, but was below the normal in the east. Sunshine was fairly abundant, except in the northern districts.

May 1896.—The weather of May was exceedingly dry and warm, a severe drought being experienced over nearly the whole country, while abnormally high temperatures were of common occurrence. The mean temperature was 4° above the average, the greatest excess being 6° at Ochtertyre, and the least, 2°·5, in the Shetland Isles. Rainfall was less than half the normal, taking the country as a whole, while in many places the downfall amounted to only one-quarter of the average. There was a slight excess in the north of Sutherland and in Orkney and Caithness. Bright sunshine was very abundant.

June 1896.—The weather of June was characterised by great variability, being on the whole changeable, with an excess of rainfall, a deficiency of sunshine, and, rather curiously, a high temperature. The mean rainfall exceeded the normal by 37 per cent., and, as frequently happens, was distributed over the country in a capricious manner. The temperature was 3° above the normal in the south-western districts, but cool weather prevailed in the north. Bright sunshine was below the average.

July 1896.—The weather during this month was in an unsettled state generally, and particularly so from the 25th to the 27th, when gales were experienced. Fine and warm conditions prevailed about the middle of the month. The temperature was above the mean at stations on the east coast, but in

other districts there was a small deficit. The mean rainfall was in excess of the average, but was rather under it in the northern counties generally. Sunshine was deficient in all the districts.

August 1896 was characterised by dry, cool, and sunless weather. The mean temperature was a degree and a half under the average, the deficiency being greatest in the northern and least in the western districts. The unequal distribution of the rainfall over the country was a striking feature, Stornoway and Scourie having double the average precipitation, while only one-third of the normal quantity fell to the south-east of the Cheviots.

September 1896.—The mean temperature this month was slightly under the average, the rainfall nearly 33 per cent. above the average, and the sunshine deficient to an unwonted extent. The temperature was slightly below the average at eastern, but above the normal at western stations. The mean rainfall was nearly 40 per cent. above the average, the greatest excess being on the east coast of Scotland.

The year ending September 1896.—The year under review was characterised by a temperature about 1° above the normal, by a rainfall just the average, but falling on thirteen days more than the average, and by a great deficiency of sunshine, equivalent to 23 per cent. of the average. The first half of 1896 was exceptionally warm and dry, although bright sunshine was less than the mean in most districts, owing to the prevalence of polar winds. The summer of 1896 was cool and wet, with little sunshine, although August was decidedly better than for many years past.

Abstract of Observations of Temperature, Rainfall, and Sunshine as recorded at Sixty-seven Stations of the Scottish Meteorological Society during the Year ending September 1896, *and compared with the Averages of the previous Forty Years.*

	Mean Temperature.				Mean Rainfall.				Hours of Sunshine.	
	Mean.	Difference from Average.	Mean Daily Range.	Difference from Average.	Total Rainfall.	Difference from Average.	Number of Rainy Days.	Difference from Average.	Hours of Sunshine.	Difference from Average.
	°	°	°	°	Ins.	Ins.			Hrs.	Hrs.
October 1895,	42·8	−3·6	13·2	+1·3	4·61	−0·56	18	+1	104	− 1
November ,,	41·8	+1·2	10·5	+0·1	4·44	+0·62	18	+2	54	−19
December ,,	37·4	−0·4	8·9	−0·7	4·38	+0·41	19	+3	31	−26
January 1896,	39·7	+2·6	10·2	+1·0	2·53	−1·37	15	−2	48	−13
February ,,	41·4	+3·0	9·9	−0·2	2·00	−1·06	12	−3	51	−34
March ,,	41·2	+1·8	13·5	+1·5	4·12	+1·32	21	+6	111	−13
April ,,	47·0	+2·9	14·3	−0·0	2·03	−0·11	15	+3	137	−24
May ,,	53·0	+4·0	19·6	+4·2	0·98	−1·30	7	−7	226	+30
June ,,	56·2	+1·4	14·8	−1·0	3·39	+0·91	17	+4	140	−75
July ,,	56·6	−0·5	14·9	0·0	3·89	+0·72	16	+1	144	−58
August ,,	55·0	−1·6	14·5	0·0	2·75	−0·90	16	0	136	−40
September ,,	52·4	−0·4	12·1	−1·7	4·87	+1·33	21	+5	76	−66
Means and Totals,	47·0	+0·8	13·0	+0·4	39·99	+0·01	195	+13	1258	−339

2. *Report by* R. Stewart MacDougall, M.A., B.Sc., Honorary Consulting Entomologist.

Since the declaration of my appointment as Honorary Consulting Entomologist to the Society a few months ago, I have received queries relating to the Pine Beetle (*Hylesinus piniperda*), and also an interesting communication regarding the Squirrel (*Sciurus vulgaris*).

The Pine Beetle.

This is one of our very worst pests in Scotland—one that every forester has opportunity of becoming acquainted with, and as, in order to cope successfully with it or to proceed against it at all intelligently, a knowledge of its round of life is quite necessary, I purpose giving a general account of its life-history, and means of prevention and remedy.

The mature beetles always come out of their winter-quarters at

the end of March and the beginning of April, and after pairing, the female, under cover of the bark scales, begins to excavate her tunnel in some sickly standing pine, or in a stump, or in felled or fallen timber—preferably of the genus *Pinus*. As a rule, the place chosen has thick bark, although I have repeatedly found the tunnels where the bark was quite thin. The tunnel crooked to begin with, but throughout the greater part of its length vertical (Somerville has well compared its shape to a golf-club), is completed in from four to five weeks, and along its sides, in little excavated niches, the hundred or more eggs are laid. The tunnels average 3 to 4 inches, although they are often longer, one I cut from a tree two summers ago having a length of $11\frac{1}{2}$ inches. From the eggs hatch out grubs, which begin to gnaw tunnels in the cambial region. These grub-tunnels are at right angles to the mother-tunnel, and ultimately become winding, increasing in size with the growth of the larvæ. When full-fed, each grub pupates (passes into a resting stage) in a little cell formed in the bark at the end of its tunnel. The perfect beetles appear in June and July, according to the order of egg-laying, in some seventy-five to eighty-five days from the laying of the eggs. The earliest issuing beetles start breeding at once, with the result that a second brood of beetles appears in September. In unfavourable weather conditions there may be only one brood in a year, but with the weather conditions favourable, Somerville has proved beyond dispute that in Scotland two generations appear in the year.

Taking the favourable weather conditions, the following may stand as the Calendar for the Pine Beetle :—

Nov. 1895-March1896.	End of March.	April and May.	June.	July.	August.	September	October.
Beetles in winter quarters.	Beetle and eggs.	Larvæ.	Pupa Beetle.	Eggs. Larvæ.	Larvæ.	Larvæ. Pupa Beetle.	Beetles.

The second generation of beetles, which emerges in September and October by boring their way through the bark from their pupal cell (the flight-holes giving the bark an appearance as if riddled with small shot), make their way to the young shoots of the pine, and bore into these—not for egg-laying, but for feeding purposes—a little ring of resin marking the entrance hole. These bored shoots can be found in large quantities below the trees after a gale. Repeated attacks of the Pine Beetles, and loss of these shoots, soon

alter the shape of the tree, and result in the scraggy straggling tops so familiar to those acquainted with *piniperda* attack, which appearance has earned for the beetle the name of Wood-gardener or Forester.

It is only exceptionally that the beetles winter in the shoots, their winter-quarters as a rule being in moss or in cracks in the bark, or in holes bored into the bark at the base of the tree. Without going more into detail, I have said enough to show the application of certain general principles with a view to protection.

There must be careful oversight of the wood on the part of the forester, who should make it an axiom to remove from the wood as quickly as possible all felled or blown pine timber. It is not always convenient, or perhaps possible, to remove quickly, but it cannot be too strongly insisted on that such felled logs, stumps, etc., if left unbarked, are favourite places for egg-laying, and every such unbarked stem is a direct invitation to the beetle on the part of the forester, and an encouragement to a future plague. A glance at the Beetle Calendar will suggest the dates before which removal of timber had better take place, or when barking should be done.

A cutting out of sickly trees and their removal is also advisable.

As a remedial measure once the pests have got to work, no means can compare in efficiency with the system of "catch-trees." From February or March onwards till the autumn let there be a series of such traps, to be examined at regular intervals, and peeled, and the bark burned. These "catch-trees" may be sickly pines standing in the forest and marked, or else trees felled here and there at intervals for the purpose. In such trap-trees or logs the pine beetles will breed, and in the peeled and burnt bark eggs and larvæ will be destroyed. There must be careful and systematic revision of the traps, else the remedy may prove worse than the disease. The traps must not be left too long, a new series being prepared say every month. How fruitful in destruction to the pests this method of "catch-trees" is, I can testify from much experience of their use. I have in my collection a piece of bark of Scots pine which I stripped from one such "catch-tree." It measures 28 inches long by 12 broad, and in it I count 30 mother-tunnels, and allowing 100 eggs for each, no fewer than 3000 beetles might have escaped from this piece alone.

Description of the Beetle.—A little over $\frac{1}{6}$ inch in length. Glossy black in colour, although red-brown on first emerging.

Antennæ and legs reddish-brown. On examination with a lens, the wing-covers show longitudinal finely punctured stripes. The spaces between these stripes have a number of little knobs carrying bristly hairs. These little knobs, however, are absent at the hinder end of the second space on each side of the middle line.

The grub or larvæ is about a quarter of an inch long, with a fleshy, bent, legless body, whitish in colour, and a yellow-brown head.

The Squirrel (*Sciurus vulgaris*).

In the month of August I received an interesting communication relating to the habits of the Squirrel from Mr D. Robertson, forester, Dunrobin. From Mr Robertson's letter I quote the following:—"Some days ago I noticed that large numbers of blown Scots fir trees, full of the grub of the Pine Beetle (*Hylesinus piniperda*), were being peeled, and the grubs eaten by some bird or mammal. At first I was inclined to think it the work of birds; but to-day, having a few hours to spare, I went on a tour of discovery, and to my surprise I found that the peeling and the destruction of the grubs was being done by squirrels. I watched six of the squirrels at work, and got quite near to several, and saw them quite clearly. They ran along the fallen trees, passing over those which were quite old, and in which there were no grubs; but when they came to a tree in which grubs were numerous they began operations, pulling off the bark immediately above the grub-galleries and eating the grubs. The squirrels were always followed by three kinds of small birds, the wren, the bluebonnet, and I think a chaffinch. The squirrels usually began operations near the top of the trees, and worked towards the base, until the bark got too strong for them to break. Since seeing the above, I am beginning to think there is some good in Mr Squirrel after all." Mr Robertson then goes on to ask if this is a common occurrence.

I replied at the time that this was quite a new observation, not that the squirrel should eat insects (I know of his taking cock-chafers), but that of set design he should strip only those trees which were grub infested, and at the places of infestation. In diet the squirrel is both vegetarian and carnivorous; indeed, it may be described as omnivorous, as will appear below.

Perhaps the chief food of the squirrel may be said to be the "seeds" of trees—acorns, beech-seeds, hazel-nuts, and filberts. The seeds of conifers are specially liked, the cones of pines,

larches, spruces, etc., being robbed of their seeds. My own observations would lead me to think that spruce seed is a favourite. I have picked up scores of spruce (*Picea excelsa*) cones pulled off and destroyed by squirrels, and now and again have come on a spruce stump on whose cut surface lay several cones that had afforded a repast for the squirrel. The cones are damaged in a characteristic way, as all the scales are pulled off bodily except a few at the top. Cones damaged by Crossbills (*Loxia curvirostra*) show quite a different appearance.

Buds of trees and also young shoots are destroyed, and much harm may be done by the squirrel barking pines and larches. The bark may be removed here and there in patches, or the tree may be quite "ringed," the squirrel hanging on to the wounded bark by its sharp claws, and licking the sap on the exposed places.

Galls are also taken by the squirrel, the oak gall (*Cynips Kollari*) for example. In Roslin Glen this summer I found some of the galls of the spruce gall aphis (*Chermes abietis*), which had been picked to pieces by squirrels.

When the squirrel comes to the ground, he may do harm by scratching up sowed seeds or very young plants. Truffles are hunted for by scent, and Mr J. E. Harting has noticed squirrels breaking up and eating the large white fungus (*Boletus edulis*).

Now and again the squirrel takes eggs and young birds. Abroad it has been noticed that in places much frequented by squirrels, the song birds show a marked decrease in a few years, and I have in my notebook authenticated records of birds (sparrows and starlings) being killed and eaten by them.

In view of this very bad record, the economic zoologist's verdict in the case of *Sciurus vulgaris* must be "Guilty"; and even if the taking of a few galls and insects, and his beauty (and the squirrel's grace and liveliness in the wood will never fail to cover a multitude of his sins), are pled as extenuating circumstances, should squirrels be very numerous the forester must forget the æsthetic and use his gun.

NOTES AND QUERIES.

Leaf-Mould.

The leaf has been called the laboratory of the plant. It is in it that the great process of reduction goes on by which wood is made, and it is there that a host of other vegetable matters are elaborated under the action of sunlight. The raw material for this manufacture is chiefly carbonic acid, got from the air, and water brought up to the leaf from the soil; but the process of wood-making could not advance one step if this water did not contain, dissolved in it, inorganic substances which had been dissolved out of the soil by the root, or found by it already in a state of solution. The destination of these inorganic substances is, in the first place, the leaf, where they take part in the formation of complex organic matters which are required for the flower and fruit, and in the latter they are for the most part stored up to serve as nourishment for its young—the embryos wrapped up in the seed.

Although the final destination of these inorganic matters is not the leaf itself, yet a very considerable proportion is unavoidably retained there, having been unable to find its way back into the stem or into the root, where the surplus store of material is usually preserved for future use. Thus it happens that when the dead leaves fall in autumn, they convey to the earth a very notable amount of the materials which plants require as food. These, in the living leaf, are in the form of organic salts chiefly; but as the organic matter of the leaf decays, they are left in the form of inorganic salts, viz., phosphates, sulphates, carbonates, etc., of potash, soda, lime, magnesia, and other bases. These are sometimes described as the mineral constituents of the leaf, and sometimes the ash constituents, for they are found in the ash when the leaf is burned. A very important constituent of leaf-mould that is not found in the ash is the nitrogenous matter. It exists in the leaf as albuminoid matter, but during the process of conversion into leaf-mould, it is more or less completely converted into ammonium salts and into nitrates. The process of conversion into leaf-mould is a slow and complicated one, and the products

vary according to many circumstances, and notably according to the greater or less exposure of the mass to the air. The outside of a heap of leaves has a brown colour, and is undergoing a somewhat simple process of slow combustion or decay under the action of the oxygen of the air. In the deeper layers the colour of the vegetable matter is dark brown or black, and therein changes of a more complicated kind, called putrefaction, are proceeding. In all these changes the action of living micro-organisms takes an important part. The conversion of the dead leaf, whose form we can recognise in the dark-coloured formless mould, is one in which the organic matter of the leaf is chiefly concerned. It is partly oxidised; the carbon being converted into carbonic acid, and the hydrogen being converted into water. These volatilise and escape into the air, and as they do so the layer becomes gradually more and more consolidated. The mineral matter remains behind, and becomes relatively more abundant as the volatilisation of organic matter proceeds. Much interest attaches to the nitrogenous matter of the leaf, whose fate varies much according to circumstances. Some of it decomposes in such a way as to give off its nitrogen as free nitrogen gas. Some of it escapes as carbonate of ammonia, while the greater part of it remains behind as nitric acid, in combination with lime or other base.

The composition of leaf-mould is thus very variable, but some notion of its value can be had from knowing the composition of the dead leaves from whose decay it is produced. As regards nitrogen, the dry dead leaves of some of the more common forest trees have on an average about one per cent., viz.:—

	Per cent. Nitrogen.
Beech leaves,	0·8
Oak leaves,	1·0
Spruce Fir,	1·3
Scots Fir,	1·9
Larch,	0·9

That is a large amount of nitrogen, averaging twice as much as is contained in ordinary well-made farmyard manure. That it is not so active as farmyard manure is due to its not being sufficiently rotted to enable any of the nitrogenous matter to be converted into soluble substances, such as ammonia salts or nitrates, but

these substances are gradually formed as the processes of conversion into mould proceed.

As regards the mineral constituents of leaves and forest litter generally, it will be seen from the following table that the leaf is very rich in manurial constituents :—

Average Composition of Forest Litter in parts per 1000 *of Dry Matter.*

Leaves of	Pure Ash.	Potash	Soda.	Lime.	Magnesia.	Peroxide of Iron.	Phosphoric Acid.	Sulphuric Acid.	Silica.
Beech, . .	56	3·0	·6	25·0	3·6	1·5	3·0	1·0	18
Oak, . .	49	1·6	·3	24·0	2·0	·3	4·0	2·2	15
Larch, . .	40	1·8	·5	8·8	2·8	1·0	1·5	·6	23
Scots Fir, .	15	1·5	·6	6·0	1·5	·5	1·2	·5	2
Red Spruce, .	45	1·6	·6	20·0	2·3	1·0	2·1	·7	16
White Spruce, .	38	2·6	·5	24·0	2·5	1·0	2·8	1·0	2·3
Mosses, . .	31	7·6	1·4	5·5	2·5	1·8	4·8	1·6	5
Ferns, . .	67	24·0	2·7	8·3	4·7	1·1	5·5	2·3	14
Heather, . .	21	2·7	1·4	4·5	2·0	1·0	1·5	1·0	6
Wheat Straw, .	54	7·0	·7	3·0	1·3	·3	2·6	1·3	36
Barley ,, .	48	11·0	2·0	4·0	1·2	·3	2·1	1·8	25
Oat ,, .	47	10·4	1·4	4·0	2·0	·7	2·0	1·5	23

Along with the leaves, there is given in the table the composition of mosses, ferns, and heather, which form a large proportion of forest litter; and there is also given, for the sake of comparison, the composition of the straw commonly used as farm litter.

It will be seen that the litter produced by the leaves of forest trees is distinguished by the large amount of lime, and the comparatively small amount of potash it contains, thus differing from the straw of cereals, which is rich in potash and poor in lime. Poorest of all in ash constituents is the leaf of the Scots fir. The leaves of the oak and the beech are relatively rich in manurial constituents, and it is to the large amount of phosphoric acid and nitrogen that the former owes its reputation as a source of good leaf-mould.

It is evident from the above analysis that the removal of forest litter, for the purpose of making leaf-mould, which is now a considerable industry here as well as on the Continent, must result

in the gradual deterioration of the forest land. Doubtless forest trees have the power of extracting nourishment from a larger area and a greater depth of the earth than have agricultural plants, but the nourishment so obtained is small in comparison with that which they get superficially from the mould formed by the accumulation of their own leaves. This leaf-mould is the natural manure of forest trees, and should not be removed. It is not alone the manurial constituents of leaf-mould that make it of value; the physical effects it produces are of perhaps even more importance, and chief among these is its power of absorbing and retaining water, and of regulating the temperature of the soil, whereby the trees are sheltered from extremes of heat and cold and of wetness and drought.

Below the moist covering of leaf-mould, in all stages of formation, there is a mild, moist atmosphere, rich in carbonic acid, whose effect is to hasten the disintegration of the subjacent rock, whereby it is caused to yield up its mineral matter, and contribute to the formation of a soil whose fertility is slowly but steadily increasing.

A. P. Aitken, M.A., D.Sc.,
Honorary Consulting Chemist to the Society.

The Connection between Geology and Forestry.

In the practice of forestry it is inevitable that questions should arise in which an acquaintance with geological science should prove a valuable assistance. The forester, like the farmer, applies his labour to the soil, and only if that soil be suitable will his labour be repaid. It is important, then, for him to understand the methods by which the soil is formed, and the geological agents which effect the decomposition of the solid rocks. And as the soil depends on the rock which underlies it, different rocks yielding different soils, the forester must often require to know on what formations his land is situated, a point which only a geologist can satisfactorily settle. Of rocks, as of soils, a chemical analysis is often of the greatest value; but without a geological examination much of its value is lost, and it may even prove misleading. The same chemical substances, in very much the same proportions, may exist in two rocks which yet are entirely different for all practical purposes. It is only by a very gradual

and complex series of changes that the minerals of the rocks become transformed into soluble matters which are adapted for plant-food and the insoluble matters which form the basis of the soil. The farmer, by the process of tillage, can facilitate those changes, and modify in some measure the natural processes. But the growth of the forest is slow, and the forester must rely in a far greater degree on the slow operations of nature for the nourishment and growth of his trees. A knowledge also of the conditions which favour the preservation of the soil when formed, and prevent its removal by running water and other agencies, will in many cases be of value. The growth of the forest in itself greatly promotes the accumulation and preservation of the soil, while the rapid deforesting of a district may result in such injury that the subsequent growth of trees may be rendered almost impossible.

In another way, also, the nature of the underlying rocks affects the forester, for some are loose and open, others, such as boulder clay, are compact and almost impenetrable. Such rocks prevent the downward passage of the surplus water from the soil. They are damp, cold, and stiff, and require artificial drainage. They offer such resistance to the progress of the roots as greatly to hamper the growth of trees after a certain size has been attained. This influences also the holding power of a tree, and the ease with which it will withstand a storm.

The geologist, by his study of a district, is often in a position to offer useful advice on questions of water supply. The drainage of water from the soil depends on the nature and structure of the underlying rocks, and this determines also the possibility of obtaining water supplies by boring. The underground circulation of water depends on circumstances which only a careful geological examination can bring to light.

Other questions, to which I shall only briefly refer, as influencing opinion as to the geological forces at work in any area, are situation and exposure, prevalent winds and rainfall, exposure to frost, to floods, and to storms; and the importance to the forester of the accurate knowledge of such conditions as these can hardly be overestimated.

JOHN S. FLETT, M.A., B.Sc., M.B., C.M.,
Honorary Consulting Geologist to the Society.

Season and the Growth of Trees.

The year 1893 and 1896 will long be remembered in the south of England on account of their remarkably dry summers. In 1893 drought set in at the beginning of March, and continued practically without a break until the early part of July, when a few days showery weather revived vegetation wonderfully, although it again suffered from the intense heat of the following August. In the present year (1896) the dry weather commenced about the end of March, and continued until August 19th, although thunder showers and occasional sprinklings totalled up to about an inch of rain throughout that period. These remarks only apply to the locality in which they are written, as the great feature of the 1896 drought was its extremely partial character, neighbouring counties, and in some instances neighbouring parishes, receiving widely different amounts of rain. Taking the rainfall for the whole of the two seasons, however, an important difference may be noted. The drought of 1893 succeeded one of the wettest Februarys on record, and the ground at the commencement of the dry weather was fully saturated. That of 1896, on the contrary, followed an exceptionally dry autumn and winter, and although the month of March was rather wetter than the average, the rainfall for the ten months, commencing November 1895, was greatly below the average. These two years were separated by a damp and growing season in 1894, and one with a dry spring and wet July and August in 1895.

With the idea of ascertaining, if possible, what effect these four seasons have had upon the growth of trees, so far as the breadth of the annual ring is concerned, a number of trees belonging to four different species—oak, beech, Scots pine, and larch—were tested by means of Pressler's "growth borer." The maximum and minimum ring breadths in each section are alone given, while the ring showing the maximum or minimum zone of summer wood is indicated by a thick or thin line respectively. The trees were bored about four feet from the ground, and on the north side. The results are given in the following table :—

Species.	Age.	Year. 1893.	1894.	1895.	1896.	Remarks.
I. Scots Pine, 1	120		max.	min.		Crowns free. Soil sandy. Shaded by undergrowth of Elder, Sycamore, etc. Moderate humus layer.
,, 2		max.			min.	
,, 3		max.	min.			
,, 4		min.		max.		
,, 5			max.	min.		
,, 6				min.	max.	
,, 7		max.		min.		
,, 8		min.		max.		
,, 9		min.			max.	
,, 10		max.		min.		
II. Scots Pine, 1	120		max.		min.	Crowns free. Soil sandy. Surface grass covered. No humus layer. Separated from preceding 10 by fence, and grass fed by sheep and deer.
,, 2		max.	min.			
,, 3		max.			min.	
,, 4		max.		min.		
,, 5		max.		min.		
,, 6		max.			min.	
,, 7			max.	min.		
,, 8			max.		min.	
,, 9		max.			min.	
,, 10			max.		min.	
III. Larch, . 1	100	min.	max.			Crowns free. Soil thin loam, overlying rock on side of hollow. Shaded by underwood, brambles, etc. Little humus.
,, 2		max.			min.	
,, 3				max.	min.	
,, 4				max.	min.	
,, 5			max.		min.	
,, 6			max.		min.	
,, 7			max.		min.	
,, 8			max.		min.	
,, 9			min.	max.		
,, 10			min.	max.		
IV. Larch, . 1	20	max.		min.		Sandy soil. Plantation thinned in spring of 1895.
,, 2				max.	min.	
,, 3		max.		min.		
,, 4			max.		min.	
,, 5			max.		min.	
V. Scots Pine, 1	20	min.		max.		Sandy soil. Plantation thinned in spring of 1895.
,, 2		min.		max.		
,, 3		min.		max.		
,, 4		max.		min.		
,, 5		max.			min.	

Species.	Age.	Year.				Remarks.
		1893.	1894.	1895.	1896.	
IVa. Larch, . 1	20	max.			min.	Sandy soil. Not thinned for some years.
,, 2		min.		max.		
,, 3		max.			min.	
,, 4			max.		min.	
,, 5				max.	min.	
Va. Scots Pine, 1	20	min.	max.			Sandy soil. Not thinned for some years.
,, 2			max.		min.	
,, 3			max.		min.	
,, 4		max.			min.	
,, 5		max.		min.		
VI. Oak, . 1			min.	max.		Standards in coppice. Soil stiff loam. Crowns full. North aspect. Coppice cut in 1894-95.
,, 2			min.		max.	
,, 3			min.	max.		
,, 4			min.	max.		
,, 5			min.	max.		
,, 6		max.	min.			
,, 7		min.		max.		
,, 8			min.		max.	
,, 9				max.	min.	
,, 10			min.	max.		
VII. Oak, . 1	120		min.	max.		Sandy soil. Trees drawn up among Beech. Thick humus layer.
,, 2		max.		min.		
,, 3			min.	max.		
,, 4		max.	min.			
,, 5		max.		min.		
VIIa. Oak, . 1	110			max.	min.	Standards in coppice, on sandy soil. Coppice cut in winter of 1895-96. Crowns full, and exposed to south.
,, 2				max.	min.	
,, 3				max.	min.	
,, 4			min.	max.		
,, 5				max.	min.	
VIII. Beech, 1	120	min.	max.			Sandy soil. Stems clean and close, with perfect leaf canopy, and thick humus layer.
,, 2[1]			min.	max.		
,, 3				max.	min.	
,, 4			min.	max.		
,, 5			min.	max.		
VIIIa. Beech, 1	110	max.	min.			Sandy soil. Standing in narrow belt. Stem fairly clean. Surface grassy.
,, 2			min.	max.		
,, 3			min.	max.		
,, 4			min.	max.		
,, 5		max.			min.	

From the above it will be seen that the season has had a decided effect on the growth of the majority of those tested. Lots I. and II.

[1] No summer wood.

are of especial interest, as showing what is evidently the influence of the humus layer in counteracting or modifying the effect of variations of season. While no particular year, for instance, is especially marked as promoting or retarding the growth of those where this layer exists (Lot I.), the years '93 and '96 are particularly conspicuous by the maximum growth of the majority taking place in the former, and the minimum in the latter year in Lot II., where the surface is grassy and exposed to sun and wind. In the larch (Lot III.) the year '96 also exercised considerable influence, with a similar result to that noticed in Lot II., but the maximum chiefly occurs in the damp season of '94. In the unthinned larch (Lot IVA.) the minimum is found in four trees out of five in '96. The remaining lots call for no special comment.

The most striking fact in connection with these trees, however, is the almost invariable decrease in the production of summer wood in '96, while the dry summer of '93 rather favoured the formation of this zone than otherwise. In eighteen trees out of twenty larch and Scots pine of twenty years of age, the minimum breadth of this zone occurred in '96; while in fourteen out of the same number the year '93 produced the greatest bulk of summer wood. As with the total breadth of the ring, so with the summer wood zone, season had no predominant influence in the case of the ten Scots pine, the roots of which were protected by a humus layer; while with those not so protected the majority attained the maximum breadth in '93 and the minimum in '96. In the larch (Lot III.) the maximum and minimum ring breadths and summer zones coincide.

Coming to the hardwoods—beech and oak—it is apparent that the same climatic influences produce different results in these trees to those noticed in the conifers. In the trees examined of both these species, the (popularly termed) growing season of 1894 is conspicuous by reason of the small amount of wood produced in that year in eight out of the ten oaks in Lot VI. growing on stiff soil, and in three out of the five growing among beech on light soil. The maximum breadth occurred in seven trees in the former lot in 1895, and in that year in the whole of Lot VIIA., while in those standing among beech '93 shows the best result. It must be noted, however, that the oaks in '93 were visited in spring by a strong attack of the oak-leaf roller moth, and it is very likely that those in question suffered from this attack, and the natural course of growth would be disturbed. This is the more probable

when the growth of those standing among beech, which undoubtedly escaped the attack, is seen to be an exception to the remainder in regard to ring breadth in that year.

With the beech somewhat similar results are seen, the minima prevailing in '94, and the maxima in '95. While the breadth of the summer zone increases with the breadth of the ring in the oak, the wood rings in the beech show little relation between breadth and summer wood zone, and resemble the conifers a good deal in this respect. In those trees (beech) growing with a thick humus layer, '93 appears to have produced the greatest quantity of summer wood; but in no tree in this lot does it coincide with the maximum ring breadth. In three out of these five the maximum was produced in '93, and the minimum occurred in Lot VIIIA. in four trees in '96.

Although the limited number of trees examined precludes any definite conclusions being arrived at from the above facts, yet they enable us to gain some insight into the effect of different seasons upon the same and different species of tree. In Scots pine and larch the fact is pretty clearly demonstrated that the effect of any one season upon the breadth of the wood-ring and the development of summer wood is greatly determined by the nature and condition of the soil. Comparing the two dry seasons '93 and '96, it is seen that the former produced the maximum growth in ten out of twenty Scots pines on deep sandy soil, while the minimum occurred in exactly the same number in '96. In the larch on the loam, '94 gave the majority of maxima in breadth and summer wood, and '96 the majority of minima. In the larch on sandy soil, '93 again comes out favourably, '96 unfavourably. The great difference in the results of these two seasons can only be accounted for by the fact that soil moisture was sufficient in '93 (on all but the thin soil in which Lot III. grows) and deficient in '96, owing to the rainfall of the previous winter.

With the hardwoods the dry spring of '95 appears most conducive to growth, and the damp summer of '94 least so, probably owing to increased power of assimilation and higher soil temperature in the former, and the reverse of these conditions in the latter year.

A. C. Forbes, Wood Manager, Bowood, Calne, Wiltshire.

TRANSACTIONS

OF THE

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ROBERT GALLOWAY.

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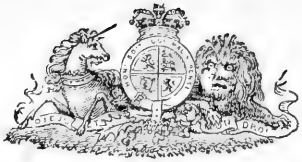
BY SPECIAL  APPOINTMENT.

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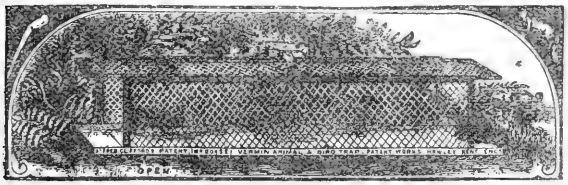

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Special Notices to Members.

HONORARY SCIENTISTS.

The Council desires to direct special attention to the appointment of Honorary Scientists of the Society recently made, with the object of affording to Members the opportunity of obtaining gratuitously scientific information upon subjects connected with Forestry.

The names and addresses of the present Honorary Scientists will be found on page 5 of the *Proceedings* appended to this Part.

Members wishing for information should write direct to the Honorary Scientists they desire to consult, sending full particulars regarding the subject of inquiry, and also, if possible, any Specimens, such as pieces of stem, twigs and leaves, fruits and seeds, fungi, insects (in all stages of transformation) and their food-plants, etc., that bear upon and would help to elucidate it. The replies sent to Members by the Honorary Scientists will, if of sufficient interest, be published in the *Transactions* of the Society.

FORESTRY NOTES AND QUERIES.

The Council begs to remind the Members that a few pages of the *Transactions* have been set apart for suitable Notes on subjects of interest connected with Forestry, which have come under the personal observation of Members, and that they are invited to send contributions. Notes should be short and duly authenticated.

It is hoped that advantage will be taken of this invitation by a large number of Members, and that much valuable information will thus be preserved and made available to every Member of the Society.

The Council also invites Members to submit Queries on Forestry Subjects, which, if suitable, will be inserted in the *Transactions*.

Notes and Queries may be sent to the Secretary at any time; but unless they reach him before the end of October, they cannot be inserted in the next issue of the *Transactions*.

THE SOCIETY'S CABINET OF LANTERN SLIDES.

The Council has resolved that the Society's Cabinet of 100 Micro-Photographic Slides—illustrative of the Structure of Timber, and suitable for the purpose of Lectures with Lantern Exhibitions—may be lent to any applicant who is willing to comply with the printed Conditions, copies of which can be obtained from the Secretary.

NEW MEMBERS.

The Council has prepared and printed a Memorandum containing particulars regarding the past and present work of the Society, which, it is hoped, may lead to the introduction of New Members. The Secretary will send copies of this document to any of the Members who may ask for them, and will forward a copy to any person likely to join the Society whose address may be sent to him by a Member.

The Secretary will receive applications for Membership at any time. See Form of Proposal and Conditions of Membership on opposite page.

ROBERT GALLOWAY,
Secretary.

5 ST ANDREW SQUARE,
EDINBURGH.

Royal Scottish Arboricultural Society.

FORM OF PROPOSAL FOR MEMBERSHIP.

To be signed by the Candidate and his Proposer, and returned to

THE SECRETARY,
Royal Scottish Arboricultural Society,
5 St Andrew Square, EDINBURGH.

Candidate for Membership.		Annual or Life Subscription.	Proposed by.	
Full Name.	Designation and Address.		Name.	Address.

For Conditions of Membership see next page.

Royal Scottish Arboricultural Society.

Conditions of Membership (excerpted from the Laws).

III. Any person interested in Forestry, and desirous of promoting the objects of the Society, is eligible for election as an *Ordinary* Member in one of the following Classes:—

1. Proprietors the valuation of whose land *exceeds* £500 per annum, and others, subscribing annually . . One Guinea.
2. Proprietors the valuation of whose land *does not exceed* £500 per annum, Factors, Nurserymen, and others, subscribing annually . . . . . Half-a-Guinea.
3. Foresters, Gardeners, Land-Stewards, and others, subscribing annually . . . . . Six Shillings.
4. Assistant-Foresters, Assistant-Gardeners, and others, subscribing annually . . . . . Four Shillings.

IV. **Subscriptions are due on the 1st of January in each year, and shall be payable in advance.** A new Member's subscription is due on the day of election.

V. Members in arrear shall not receive the *Transactions*. Any Member whose Annual Subscription remains unpaid for three years shall cease to be a Member of the Society, and no such Member shall be eligible for re-election till all his arrears are paid up.

VI. Any eligible person may become a *Life* Member of the Society, on payment, according to class, of the following sums:—

1. Large Proprietors of land, and others, . . . £10 10 0
2. Small Proprietors, Factors, Nurserymen, and others, . 5 5 0
3. Foresters, Gardeners, Land-Stewards, and others, . . 3 3 0

VII. Any *Ordinary* Member of Classes 1, 2, and 3, who has paid *Five* Annual Subscriptions, may become a *Life* Member on payment of *Two-thirds* of the sum payable by *new* Life Members.

XII. A Candidate for admission into the Society must be proposed by at least one Member, and shall, *on payment of the Annual Subscription* or *Life Composition*, be immediately admitted a Member of the Society, subject to the confirmation of the first General Meeting thereafter. Any Member of the Society proposing a new Member *shall be held to be responsible* for his first year's Subscription.

TRANSACTIONS.

CONTENTS.

The Society, as a body, is not to be considered responsible for any statements or opinions advanced in the several papers, which must rest entirely on the authority of the respective authors.

TRANSACTIONS

OF THE

ROYAL SCOTTISH ARBORICULTURAL SOCIETY.

VII. *Address delivered at a General Meeting held on 16th August 1897.* By R. Munro Ferguson, M.P., President of the Society.

I find myself called upon once more to rise like some hardy perennial which owes something like an apology for continued reappearance in exactly the same place. It is therefore some consolation to find so many giants of the forest about me, and to be able to report to the general meeting that the Royal Scottish Arboricultural Society is growing well.

Our printed *Transactions* maintain their high excellence, to which we are recently and largely indebted to Professor Schlich, who gave us so admirable an address. Our next volume should include a portion of the "Essays on Forestry Education," plus a criticism on them by Professor Somerville. Then, to look farther ahead, as it is understood that a working plan has been drafted recently for the Forest of Dean by an eminent member of H.M. Indian Forest Department, and that it is likely to be put into immediate operation, I would suggest that we invite its author to give us an account of these proposals at our winter meeting. Many of the scientific foresters who have lately come to Scotland have observed the absence of working plans in estate management. An address therefore from this officer, whom I had the pleasure to meet, upon the first regular plan of the kind made in this island, would be of great value for our publications, as well as a pleasure to those who hear it.

It must be the desire of us all to maintain our printed *Transactions* at a high level, since it is through them that we appeal

to a much wider public than that of our membership; and as the organisation that has most effectively sought to promote good forestry, we ought to appeal to a wide circle: from that point of view the papers or essays which we print are the chief part of our work, and I sometimes wonder whether the account of our home excursions might not be limited to a critique, of which that of Professor Schwappach was so brilliant an example, or else that it should be printed separately. For if an excursion to Germany is worth a full record, that of a trip to the South of England might be dealt with in less than a hundred of our pages. The mere details of a home trip scarcely earn immortality; and while these domestic incidents, no doubt, interest many members of the Society, they would be read by few of those whom we include, or hope to include, amongst our general readers. *They* will want to know what the Society has to tell or to do in the direction of securing a firm basis for the profession of British Forestry.

Another item of our affairs might be reconsidered. It is whether Edinburgh is always the best centre for annual or general meetings? Mr Dewar of Beaufort, and other Highland foresters have spoken to me strongly in favour of Perth; they would engage to attend at Perth, they say, when they could not come to Edinburgh. I know that this point has been discussed, but with the aid of the Forth Bridge, Perth has become very accessible to all Scotland. It is for us a natural centre, and without expressing any opinion of my own, let me suggest that, in the interests of Highland Forestry (which is no mean part of the whole), the matter is worth attention.

There has been a correspondence regarding Sir Robert Menzies's proposal that another Forestry Exhibition should be held, but the feeling of your General Purposes Committee was that this suggestion should be reserved until the approach of the jubilee of the Royal Scottish Arboricultural Society in 1904.

Various subjects lying before the Society have been in abeyance pending the Essay Competition, which was arranged to try to collect the widest range of opinion regarding the provision of forestry education. The competition has not been so successful as could have been wished; but upon the essays, and the judges' report drafted by Professor Somerville, considerable discussion should arise. Out of all this must come the definite recommendations of the Society upon the provisions it deems necessary for the instruction of foresters, which will, no doubt, in due course

be thoroughly prepared and finally adopted. For this purpose it will be necessary to reappoint a strong committee. When we have definitely adopted our scheme, we shall have to put forth our whole effort to secure for it the greatest possible amount of support.

Some disappointment may be felt that nothing has as yet resulted from our interview with the President of the Board of Agriculture. I cannot, however, share in that disappointment, and I can say so without being reasonably suspected of entertaining any undue regard or respect whether for the Department or for the Government. Because no Government can give without some pressure, and in these days Government seems to give in proportion to the pressure which is brought to bear upon it, apparently on much the same principle as the people who bestow their alms upon the sturdiest of the sturdy beggars on the street. No one can accuse the present Board or Government of being niggardly with the public purse, and if none of the golden shower has descended on us, it is because we are unable to make enough noise or to command sufficient support. This Society has been enthusiastic over a Forest School and an Experimental Area, but as we are only a limited number of more or less trained men, an army fashioned on the long-service system, we shall find that we have to add to the ranks and create our reserves.

Suppose we now review our forces, and weigh the feeling which prevails amongst the various classes interested in forestry education :—

1. Working foresters have shown their bent of mind by availing themselves liberally of such instruction as Edinburgh can provide, and of their zeal there can be no question.

2. Some rising factors also, despite the one-legged condition of the Chair of Forestry, have not neglected the University lectures; but since factors flourish wherever thistle-down blows, it may be rash to assume too much from their moderate attendance upon Colonel Bailey.

3. Timber merchants are well aware of what a steady supply of home-grown timber would mean for their trade. They could get much of what they need lying at hand instead of having to seek it abroad. It is by no means certain, moreover, that they still get the quality of foreign fir to which we have been for a while accustomed, and ere long there may also be a more serious question of scarcity.

4. There are the plant-growers. It has been often and eloquently declared when agriculturists are gathered together, especially after dinner, that the interests of owner and tenant have been, by the wise dispensation of Providence or otherwise, so wonderfully made and luxuriantly intertwined as to be indistinguishable the one from the other. However that may be, the interests of nurseryman and forester are, if more independent, even less likely to clash. Their common interest lies in the maintenance and extension of the forest area and of arboriculture generally, in the making of it popular and therefore profitable. It is said that nurserymen regard the practice of natural reproduction in forests as repellant. Experience, however, does not show that natural reproduction diminishes the need for plants, but rather that anything which adds to the value of the forests, or to their area, will add proportionately to that of the nurseries. The better plantations pay, the more of them will be planted. Some foresters may grow their own plants as a matter of convenience rather than of cost, but the shrinkage of nursery area of late years gave cause for general concern, and we note the more recent extensions of it with satisfaction. Nurserymen are amongst the best supporters of advanced forestry, and theirs is probably the best-managed department of our business.

These, then, are some of those upon whom we can rely in support of the work of this Society, and through whom we may expect to awaken some measure of public interest in the growth of trees, whether for beauty or for commerce, sufficient to prepare the way for a successful foray upon the Treasury. But these are not all, nor does everything depend upon Government grants.

5. There is another important class to be considered, for of those interested in forestry, the Landowners can, if they like, do most of all. It is on them that we are entirely dependent for capital, whether in land or in money, though capital is with them less nowadays than it used to be. Forestry is far more dependent upon the lairds than is agriculture, yet it is the last which has been first in their favour. The proprietors of Scotland who have done so much to stimulate practical scientific agriculture have done practically nothing for commercial forestry. They have distinguished themselves in forming the most beautiful pleasure-grounds in the world; that, however, is rather landscape gardening than forestry. Almost every proprietor who emerges from the hunting age is an hereditary—often a leading—agriculturist,

but we have yet to find the estate having as a policy the treatment of timber lands with the same methodical care which is being bestowed upon similar lands under crop, and too often if a real planter arises in one generation, his projects and his plantations do not long survive him in the next.

The Laird of Dumbiedykes, ere he soughed awa' to a tune which boded ill for his future, made one effort to escape punishment in the dying behest to Jock which has become our motto. Sir Walter, who gained immortality with spade as with pen, does not, however, record that Jock ever "stuck in a tree," while Dumbiedykes had to confess that "his father tauld him sae forty years sin', but he'd ne'er fand time to mind him." The industry which needs the higher training and the more elaborate treatment has been treated, whether in the estate office or in the Board of Agriculture, as a matter appertaining to æstheticism, to enjoyment, to ancestral homes, rather than to business or to the working-men—as a question of private whim, rather than of public importance.

Still, if proprietors have not been so keen to advance scientific forestry as they have been to ensure scientific farming, they need not be too seriously blamed. They have not had the same advantage of trained assistance in the one as in the other. Scottish agriculture has not been the creation of one class, else Scotland would not be farmed as she is to-day.

The proprietor who hands over the management of agricultural lands to factor or tenant may occasionally come to regret his selection, still, with the most ordinary care, he need seldom find himself in harness with any man who would not be taken to be a fair good manager or farmer all the world over. But while we could boldly say so much before the whole world, we should be a good deal more diffident in expressing the same view regarding the management of our woodlands. When the Scottish proprietor has no knowledge of how to make his plantations pay, he may often find it hard to discover his instructor; and though of good foresters there are not a few, too many of them have been obliged to buy their knowledge at their employers' expense, for lack of opportunity to acquire it at school or college in a manner at once more rational and economical.

Then, besides the question of management, the proprietor suffers further difficulties and discouragements which have been frequently acknowledged before the Society. The planter must feel that if he should be privileged to enjoy the fruits of

his labour it will not be in this world, where the delay in collecting his returns is so considerable. There is the uncertainty as to whether his schemes will not end in every kind of way save that which he intended, supposing that they survive the dangers which greatly beset trees of tender years. He may feel uncertain as to whether his successor will get a footing in the timber market which has been handed over with so rare a thoroughness to the foreign grower. There are the tolls on transport which the wisdom of Parliament has so largely left to the discretion of railway corporations. There is the conservatism which has been so slow to apply machinery to the manufacturing and transport of grown timber. Further, there is the modern tendency to think more of oneself and less of ancestor or posterity, which results in increased observance of the precept that "ilka herring should hing by its ain head." The depression in landward rents has probably strengthened the respect accorded to this homely testimony to the expediency of rational selfishness. There are the claims of sport, and so forth. With all this, it will not be easy to stimulate owners to make larger outlays. I adhere, therefore, to the theory that any considerable extensions of woods is not possible in our time unless undertaken by the State. Still, even without pressing men to plant more, we can at least impress upon them the advantage of planting and selling well.

There is, indeed, no occasion to throw stones at either proprietors or foresters; both have had to work under methods almost wholly empirical, so, rather giving all credit for active, if desultory effort, let us draw the necessary conclusions from the results before us, and then let us drive these conclusions home.

It is clear that whilst Scottish land management has been conspicuously successful in extracting returns from agricultural land, it has less to show to its credit in the forest area. If it has sufficed for agricultural production, it is proved to be unable to grapple effectively with timber growing. And this is not surprising, for a crop which takes one or two centuries to gather is not managed like a field of turnips. The farmer reaps many a crop during his tack, the forest survives many a master before it is brought low. Think what a farm would be like if it had a fresh tenant once a month, each taking his own line without giving much thought to what had been done, to what he was doing himself, or to what was to be done after him—yet such a system would hardly be a caricature of much of our timber

management as it is carried on without records or working plans. At Raith we have a Plantation Book begun by one of my forbears in 1724; it was elaborately kept until 1828, but having been then abandoned, the information it contains becomes curious rather than of practical utility. It makes me, however, the more confident in believing that forestry, to have a chance under private management, must have its records and working plans kept like title-deeds and posted up like ledgers. Then our forestry will be level with agriculture in so far as details of management are concerned.

Meanwhile we have no encouragement from the State. I need not recapitulate what has been done to train foresters in lands where forestry pays, nor the success of foreign Governments and communities in setting up a practical standard of forestry in national or communal forests,—a standard which I believe to be invaluable.

I once wrote a review article to maintain that communal ownership of land established side by side with private property was best calculated to develop national resources and social amelioration. The two systems being then in competition, the best would prevail in whatever direction its results would show it to be the best. I should be inclined to believe, for example, that communal farming would not be a practical success in our time, while, on the other hand, I believe that private forestry, as left to itself, will be generally a failure until the State takes in hand both instruction in forestry and the ownership of forests. Once State forests were started there should be an immediate improvement in the timber management of private estates. But to pursue the subject further would be going too far ahead. Our present and special business, outside of our ordinary routine, is the establishment of a Forest School coupled with an Experimental Area. This we advocate wholly apart from the policy of State forestry, as to which there may be divergence of opinion, whilst as to education and experiments there can be none.

Now, to gain the requisite provision for forestry education, I pin my faith upon this Society as the best available instrument. There may be more power in the little finger of the Government than in all our loins, but then that little finger is not likely to be lifted. There may be more science in the head of any professor amongst those who have so readily and effectively aided us than in all the laymen of this Society, yet we are the medium through

which their learning and science can best pass to invigorate the movement towards a higher standard of training.

This Society is thoroughly representative, harmonious, and flourishing; we are a travelled body with recent Germanic experience and with other transmaritime undertakings both east and west either in our immediate or prospective consideration. We should be able to command public confidence.

I have keenly watched the growth of our Society, because, once it became clear that no Government would move upon the report of the select committee on forestry alone, it seemed to me on looking round that the most likely if not the only remaining lever was the Royal Scottish Arboricultural Society. I believe that the whole immediate future of forestry lies with the success of our efforts now. We are the living organisation through which the support of followers of the noble art of forestry can best be centred to promote the cause. I certainly do not despair of the future, for the advance of technical and secondary education, if slow, is sure. Meanwhile we have to keep our lamp burning, its light will be needed ere long when we have educated a sufficient body of opinion to realise that we ourselves must be educated if a great national industry is to flourish, an industry which the exhaustion of forests abroad may render ere long one of supreme importance at home.

The process of educating people up to the point of giving us education may be irksome, but to spend time in vain regrets would be unworthy. I for one am confident that none of us will relax in our efforts nor cease in our demands until we have secured some provision for training foresters, so that we may overcome the waste and vacillation and ignorance that so beset an industry which, in its scope, may yet rank in Scotland alongside of agriculture itself.

VIII. *Forestry Education.*[1] By Dr William Schlich, C.I.E., Professor of Forestry in the Engineering College for India, Coopers Hill.

About eight years ago this Society paid me the compliment of electing me an honorary member. While most cordially appreciating the honour, I have for some time past felt very uncomfortable, because I have up to date not been able to show in a tangible way to what extent I consider myself under an obligation to you. Hence, when our worthy President invited me to address you to-day, I seized the opportunity most eagerly, trusting that the remarks which I shall be able to offer to-day may in some small degree contribute to the furtherance of the aims and objects of the Society; and I further trust that the present occasion may be only the beginning of my becoming more closely connected with the work of the Society, than has been the case in the past.

Our President left it entirely to me to choose a subject upon which to address you. I considered the matter, and I arrived at the conclusion that I could not do better than to offer a few remarks upon the question which, I know, has of late been uppermost in your mind, namely, "Forestry Education." This subject is all the more congenial to me, as I have for many years past been associated with the education of foresters, and if I know anything at all, I ought to know something about the requirements of forestry education.

Is Better Forestry Education Wanted?

The first point which demands our attention is—Whether a case for better forestry education, than has hitherto been obtainable in this country, has been made out?

Gentlemen, forestry is an "industry," and, like all other industries, it is subject to the law of demand and supply. Until a recent time the demand was for arboriculturists and not sylviculturists. That demand was admirably met by the corps of gentlemen who attend to the arboriculture on the various estates of this country. To expect that these gentlemen should suddenly

[1] An address delivered at the forty-fourth Annual Meeting, held on 27th January 1897.

turn into experienced sylviculturists, to suit a demand which only lately has sprung up, is hardly fair. Until recent times the economic question was, as far as the bulk of British woodlands is concerned, of minor importance, since these woodlands were maintained chiefly for other objects, such as beauty of landscape, or the production of fine specimens of trees grouped in picturesque fashion over the estates, or for game coverts. I am sure I may safely say that these requirements were admirably met by Scottish wood managers. But of late, however, a change has come. Agriculture has fallen low, and the rent-roll of many proprietors has been seriously affected. The economic or financial importance of woodlands, and the profitable utilisation of waste lands, have come more into the foreground. Hence the increased demand for skilled sylviculturists as wood managers who are fully acquainted with the economic aspect of the industry. This is all very well, but forests which have hitherto been managed for other objects cannot suddenly be converted into what I call "economic forests." The change takes time, and if proprietors are beginning to get impatient, they have clearly only themselves to blame. The transition from the one condition to the other takes a considerable space of time, and it demands the greatest skill of the sylviculturist to effect it without loss to the proprietor; in fact, it means in only too many cases the gradual utilisation of the woods now existing to the best advantage, and the production of new woods which will meet the requirements of modern economic forestry, and not of arboriculture. The thing can be done, but the operation requires the training of wood managers on lines somewhat different from those hitherto followed in this country.

To understand the difference between the two things more fully, it will be well if I touch for a few minutes on the principal causes why the timber now produced in Britain cannot compete with that imported from abroad. On this subject so much has been written and said of late that I can compress what I have to say into a few sentences. Indeed, the *Transactions* of this Society during the last two years are a very storehouse of information on the subject.

You are aware that the general drawback, from which forestry in this country labours, is the absence of a regular demand for home-grown timber. You also know that, until a comparatively recent date at any rate, most Government contracts for works of construction contained a clause to the effect that no home-grown

timber would be allowed to be used. If we take these broad facts into consideration, it is easy to perceive that the explanation may be condensed into the following two statements:—(1) The home-grown timber is, generally speaking, inferior in quality to that imported from abroad; (2) it comes into the market at irregular intervals and in fluctuating quantities. Exceptions exist, but here only the average conditions can be considered. These drawbacks can be removed only by improved sylvicultural methods, and a systematic management of the forests. You all know now that the plantations in this country have been too heavily thinned during the first half of their life. By such a procedure you can, perhaps, secure an increased average production per year and acre, but at the cost of quality. Here I mean the quality of timber now produced does not fetch the same price as that imported from abroad. However much we may demonstrate that the timber grown in this country is of as good or even better lasting quality, still the eating of the pudding is the proof thereof. The fact remains as stated above.

I need hardly remind you that, in the case of most estates in this country, cuttings are made at irregular intervals. Sometimes a proprietor prefers his woods to the cash which he can realise from them; in others, exceptionally large quantities are cut all at once to meet a special demand for money; and last, but not least, frequently enormous quantities of timber are thrown down by an exceptionally strong gale.

All these things are detrimental to a profitable utilisation of the material. Under such conditions a regular market cannot be developed, nor rational and cheap methods of converting the material be employed. The whole thing is haphazard, and neither the proprietors nor the timber merchants derive the full benefit which the industry is capable of yielding. This state of things can be remedied only by a systematic working of the forests, so that annually the same, or approximately the same, quantity of timber is offered for sale. Timber merchants, knowing this, will make their arrangements accordingly. A regular demand for the produce, and a well-organised trade in home-grown timber, will be developed. Improved means of extracting the timber, better means of communication, and high-class saw-mills will make their appearance, leading to a considerable reduction in the cost of extraction and conversion. In the same degree, an increased surplus is realised, the greater part of which will,

following the law of gravitation, find its way into the pockets of the proprietors of the forests.

In order to bring this about, the first and foremost requirements of our forest estates is, then, that they should be managed according to well-considered plans of operations, technically called working plans, which lay down the cuttings to be made for a series of years, thus leading to the method of a sustained yield. But working plans do more than this, they provide for the systematic and orderly performance of all other work to be attended to, such as the general method of treatment, the execution of regeneration, thinnings, construction of roads, etc., in short, for the whole business connected with forest management.

And this brings me to the next point, namely, the interference caused to an orderly systematic management by violent gales. No doubt this is a great source of annoyance in a country situated like Scotland. Although the forester cannot altogether prevent such disasters, he can do much to reduce their extent, partly by grouping the woods of different ages in a reasonable manner, and partly by mixing shallow-rooted species with deep-rooted ones.

Most strong gales come from a fairly fixed direction; in this country generally from a direction oscillating between north-west and south-west, in so far as deviations are not caused by the configuration of the locality, such as mountain ranges, deep valleys, etc. It is also well known that gales do special damage if they rush into the open front of the wood, or one which has suddenly been too heavily thinned. If, therefore, a cutting has been made by which the western front of an adjoining wood standing on the lea side is exposed, it is as likely as not that the next heavy gale will throw it down. If, on the other hand, we arrange the cuttings so that they begin in the east, and proceed gradually towards the west, we avoid offering to the wind specially favourable conditions for causing havoc. The wood at the western edge having grown up gradually under constant exposure to the western gales, will have developed strong edge trees, especially if they have been somewhat heavily thinned during early youth, and they will, in the majority of cases, resist gales. Hence they should not fall under the axe until all the woods behind them have been cut over.

Mixed Woods.—Again, it is highly desirable that shallow-rooted species, like spruce, should be mixed with species which have a

firmer hold on the soil. In this respect I remember a remarkable instance. When I was a forest student I joined an excursion to the Thüringian forest under the guidance of my old teacher, Dr Gustav Heyer. There we were one day shown an old wood of spruce and silver fir, about 140 years old. On examining the wood we found all the trees in rows running from west to east, and every edge tree on the west was a silver fir. It is well known that nobody thought of planting or sowing in rows 180 years ago in those out-of-the-way places, so that the wood was evidently the result of natural regeneration. Hence the only possible explanation was, that the silver firs along the western edge stood as well as the trees behind them; where the edge trees were spruces, they had in the course of time been blown down, carrying the trees behind with them. Thus the whole wood appeared as if it had been planted or sown in lines. As already stated, the forester cannot prevent all accidents of this class, because sometimes woods are blown down, even if all possible precautions have been taken, especially as gales are occasionally perverse, and blow from the east; but anyone who cares to visit, for instance, the kingdom of Saxony, will be astonished to see what the skill of the forester can do in this respect. The Saxon State forests have, for many years past, been managed on the financial principle, and they yield a revenue far higher than those in any other State known to me. Now, the best paying tree in Saxony is the common spruce, as it yields heavy crops, of which up to 80 per cent. are classed as timber, and which is used for a variety of purposes in construction, and also for the manufacture of paper pulp, an article becoming more and more important to the forester and forest proprietor.

Spruce, as you know, is very liable to be thrown by wind, in fact, more so than almost any other of our forest trees, and yet in Saxony spruce woods flourish. Indeed, the damage done by gales is wonderfully small. This is achieved by managing each forest charge according to a well-considered working plan, which lays down the general grouping of the different age classes, so that no cutting causes an open front to be exposed in the direction from which the strong winds generally blow.

I cannot follow up this subject on the present occasion, but I desire to add that, in my opinion, there are, for British wood managers, no more interesting forests and forest management to be seen than in the hilly parts of Saxony; and if any of you

should again go to Germany, do not return without having paid a visit to the forests in the vicinity of Schwarzenberg in the kingdom of Saxony.

Natural versus Artificial Regeneration.

And now there is one more point on which I should like to offer a few remarks before I proceed to forestry education proper, and that is the question of natural *versus* artificial regeneration. You have been told on various occasions, and by various authorities, that you must study natural regeneration, so that you may regenerate your woods without expense, and without exposing your soil to the effects of sun and air currents. Indeed, some people have gone so far as to declare that the salvation of the forest industry in this country depends on the introduction of the system of natural regeneration. The question which I should like to ask is, "Have the advocates of this theory not gone a little too far?" In answering the question, I shall begin by telling you that the cleared areas in the splendid spruce woods of Saxony, of which I have just spoken, are nearly all restocked by planting, and not by natural regeneration, although it is well known that spruce is one of those trees which is easy to regenerate naturally. And you must have seen numerous instances on your visit to North Germany where planting, especially in coniferous woods, has been practised. The fact is that each of the two methods has its advantages and disadvantages, and it depends entirely on the local and special conditions with which you have to deal whether the one or other is preferable. The principal points for consideration in this respect are the species to be grown, and the conditions of the locality. Where a tender species, like the beech or silver fir, is to be regenerated, which may suffer from frost or drought while young, a shelter-wood over the young crop is indicated. In these cases regeneration is generally effected naturally by the seed shed by the shelter-trees. But even this is not a necessity. The same, and in many cases even better results can be obtained by planting, and especially by sowing under and between the shelter-trees. For it is evident that the seed can be better cared for if placed by the hand of man, and the regeneration is likely to be more even, than if the distribution of the seed is left to the accidents of nature. In the latter case sometimes two, three, and more seed-years must be awaited before a full new crop is secured,

thus involving a serious loss of time. No doubt this is in some cases compensated for by a rapid increase of the volume and value of the shelter-trees, but this does not occur in all cases. In not a few cases, after having waited for a number of years without obtaining a new crop, or only a partial one, artificial regeneration has, after all, to step in and complete the crop, or even do the whole work. There can be no doubt that the successful conduct of natural regeneration under a shelter-wood requires the highest skill of the forester; and if the regeneration of a mixed wood is in question, the process may justly be called an "art," which only the greatest attention and skill can lead to a successful issue.

In the case of hardy species, especially if they are light-demanding from early youth onward, artificial regeneration is generally indicated, and leads to more satisfactory results than natural regeneration. Amongst this class of trees may be mentioned the larch, birch, Scots pine, and even the Weymouth pine, and in many cases also the spruce.

Then the soil, and especially the climate of a particular locality, have a decided influence upon the choice of method. Where the quality of the soil and the nature of the climate are unfavourable, a shelter-wood is indicated, so as to prevent a deterioration of the productive factors of the locality, or the springing up of a noxious growth of weeds. Where the climate is favourable, and especially where a too rapid drying up of the soil is not to be feared, as in most parts of this country, artificial regeneration may safely be resorted to. In this respect you will, no doubt, have found a decided difference between North Germany and Scotland. In this country I should not hesitate for a single moment to regenerate larch, Scots pine, Weymouth, and even spruce by artificial means.

As to the comparative cost, it is generally asserted that sowing or planting requires a certain outlay, which is not necessary under natural regeneration, but it is only too frequently overlooked that under the latter process much time may be lost, and after all "time is money." Hence it cannot be said off-hand that the one method is cheaper than the other. Do not let me, however, be misunderstood. There are many cases in which I should adopt natural regeneration; all I mean to say is, that there are others, in which artificial regeneration is just as good, and not a few where it is better.

From the above remarks we are justified in concluding that there is no reason why just as good timber as that now imported

from abroad should not be grown in this country, provided improved sylvicultural treatment and a systematic working of the forests are introduced.

Our Timber Imports.

The next subject, then, before me is to inquire whether there is a sufficiently large field open to us for extended action. An examination of the tables of imports and exports which are issued annually show that the nett imports represent a sum of money by no means to be despised. Taking, for instance, the returns for the years 1890–94, it will be seen that the average annual imports, including wood-pulp timber, came to 7,600,000 tons, representing a value of £19,000,000, of which sum about four millions went to the colonies and fifteen millions to foreign countries. By going back some years, it will also be seen that the average imports have increased by about £2,000,000 during the last eight years. Here, then, are facts which claim our attention, and we may well ask ourselves, whether, if not the whole, at any rate a considerable portion of that timber could not be produced, at paying rates, in this country? A detailed examination of the returns shows that, as far as the climate is concerned, about seventeen millions worth of the timber could be grown at home, leaving about two millions for timber which comes from species which have no chance of thriving in these islands. Of the 17 millions, no less than $14\frac{1}{2}$ millions represent coniferous timber, while the other $2\frac{1}{2}$ millions are made up by oak and other hardwoods. And what are these conifers? They are—(1) Baltic red pine, or our own Scots pine; (2) Baltic white pine, or the common spruce; (3) American white pine, the bulk of which consists of Weymouth, a tree which, introduced into this country about one hundred years ago, has been proved to be quite at home with us, yielding heavy crops of timber.

All this timber could be grown in these islands, and, as far as Scotland is concerned, the conifers would require special attention.

But have we the land for the purpose? To produce all the timber mentioned above, we should require at least five million acres. Are they available? A definite answer to this question could only be given after a detailed investigation, taking one county after another. But a general idea may be obtained by looking at the official Agricultural Returns. There we find that there are in

the three kingdoms—(1) Waste land not used, about 13½ million acres; (2) mountains and heath lands used for rough grazing, 12½ million acres, making a total of 26 million acres. Of this area about one-half is situated in Scotland. No doubt a fair proportion of the waste lands could be used for afforestation, but it must not be overlooked that the greater part of it is unfit for the purpose. Taking both kinds of land together, I do not hesitate in saying that much more than five million acres are fit for afforestation. At the same time, we must remember that, apart from rough grazing, by far the greater portion of the area is used for shooting, at any rate all that part which is fit for planting, and that shooting rents are high. I am told that they run from 6d. to 2s. 6d. and 3s. an acre. Hence these lands cannot be dealt with wholesale up here in the north. The income derived from shooting, including deer forests, is so considerable, that the proprietors are very touchy and suspicious in respect of anything that might affect this important source of income. Still, I am satisfied that, under proper arrangements, a considerable portion of the lands in question could be planted without interfering to an appreciable degree with shooting rents. In the case of deer forests especially, I believe that afforestation of the lower portions of the area would be likely to increase their value in this respect, while gradually an increasing revenue from the planted areas would be secured.

But I go a step further, by saying that in all cases where a proprietor is the owner of both land under wood and of waste land fit for planting, he can put a certain portion of the latter under forest without sacrificing a single shilling of his present income, while building up a higher rental in the future. I think it is worth my while explaining this by an example:—

Supposing a proprietor has 100 acres of woods, with a regular distribution of age gradations from 1 year up to 100 years old. In the ordinary way he would cut every year 1 acre of 100 years old wood, which would give him, say, £75 income. Supposing he has now another 100 acres of waste land, which brings him 3s. an acre a year from grazing or shooting, or £15 a year, and he proposed to put it under wood in the course of 25 years; he would have to spend £3 an acre for planting, or £12 a year. Let us also assume he had to sacrifice his grazing and shooting income at once over the whole area, so that he would have to find £27 every year. This he would find by cutting every year about

$1\frac{1}{3}$ acre of mature wood; in other words he would, during the 25 years, cut about 9 acres more than the ordinary area. In this way he would gradually press down his rotation from 100 to 91 years. On the other hand, he would have another 100 acres planted with young woods ranging from 1 to 25 years old. Then, as the thinnings begin to yield some return, he would gradually reduce his cuttings of mature wood until he has raised the rotation again to 100 years, and from that moment he would enjoy a considerably enhanced income, because he would then cut over 2 acres every year, thus realising £135 a year instead of the previous £75. You will observe that I have based my example upon unfavourable conditions, because the owner need not lose the grazing or shooting rents all at once over the whole 100 acres. In this way a scheme could be worked out for every estate, according to its proper conditions.

Does it Pay to Plant?

But we must not forget to ask the question—Would it pay to plant? Great difficulty is experienced in getting hold of reliable data regarding the receipts and expenses of British woodlands. I have succeeded in securing these in a few instances, and they, coupled with my personal experience as a practical wood manager, have enabled me to show that, here in the north, land which is capable of producing on an average $1\frac{1}{2}$ ton of coniferous timber per acre annually, can be profitably afforested if it does not yield an annual soil rental of more than 7s. 6d. per acre. The calculation is made with $2\frac{1}{2}$ per cent. compound interest throughout, and on the supposition that the thinnings are sold for pit props, and the final crop for construction, both at current rates. I shall, of course, not weary you with further details of this question, but assure you that the calculation has been based on moderate expectations.

In this connection I should like to give you a few figures regarding the Saxon forests which I have already mentioned to you. The forests of Schwarzenberg have an area of 46,000 acres, and are situated from 1000 to 2500 feet above sea-level. The annual yield from them is 3,640,000 cubic feet of wood of all kinds. Of this 3,045,000 cubic feet are timber, equivalent to 51 cubic feet English measure, by the quarter girth, per acre over the 46,000 acres of their area. The total receipts are £70,488,

and the expenses are £24,239, leaving a nett revenue of 20s. 1d. per acre. If you calculate out the price, you will find that it is not a high price they received for their timber. The woods are mostly of spruce, the trees having beautiful clean, cylindrical stems, 60 to 75 feet in height; but you will find that they only realise 4½d. per cubic foot. In Marienburg the price was a little better—the nett revenue being 27s. per acre.

It seems to me that, taking all these matters into consideration, as well as the fact that large and suitable areas are available for planting in Britain, a large sum of money might be kept in this country which is at present sent out of it for the commoner kinds of timber, and that a strong case can be made out for extended action as regards the afforestation of waste lands in the country.

Who is to Provide Forestry Education?

Supposing now that we are all at one as to the need of improved forestry education, the first question is—Who is to provide it, whereby a staff of wood managers would gradually be educated, who are well versed in modern economic forest management?

The efforts of this Society and others interested in the matter have, up to date, been only partially successful, and the demand has gone forth of late that the State should do something to further the business. A deputation of this Society had, as you are aware, an interview some time ago with Mr Long, the President of the Board of Agriculture, and the latter promised to see what he could do. This opens a question about which I should like to say a few words.

The State as such has, no doubt, duties to perform in respect of forestry, but its action must be limited by what is wanted in the interests and for the welfare of the nation as a whole. The nature and extent of the measures which the State should take in this respect depend chiefly on (1) the special requirements of the country; and (2) the nature of the proprietorship of the forests.

Where forests are required for their indirect effects, or where the means of import and of distribution over the country are deficient, the State might be called upon to interfere. But these cases do not apply to Great Britain and Ireland, at any rate, not at present. Generally speaking, these islands do not require forests for climatic or similar reasons, and, owing to their rich-

ness of coal, their sea-bound condition and extensive railway system, all parts of the country can be easily supplied from abroad. In this respect, then, State action could hardly be justified, especially in a country like this, where free trade and private enterprise are the very foundations of national life.

Referring now to the second point, I must mention that, apart from about 100,000 acres of Crown forest lands, situated almost entirely in the southern half of England, there are no State forests. On the other hand, we have about 2,700,000 acres of private forests, and almost the whole of the 26,000,000 acres of land of which I spoke a few minutes ago belong to private parties and not to the State. Hence it is to the proprietors that we must look for assistance in the first place, though the State should give a helping hand.

In this respect the action of Continental countries has sometimes been misunderstood. We have often seen it stated that France has two forest schools, and Germany some ten; but then the former country possesses upwards of 2,000,000 acres of State forests, and upwards of 4,000,000 acres of forests belonging to communes, which are, by law, under the management of Government forest officers. Germany has some 11,000,000 acres of State forests, and about 6,000,000 acres of communal forests, managed by State forest officers. These forests represent a capital value of several hundred million pounds, and the revenue derived from them forms an important item in the State budget. It is, therefore, but natural that in these countries the Government should take care to give their forest employés the highest possible training in their profession, it having been recognised for a long time past that a high-class training of the forest managers means a high return from the forests.

The Government of India, as you are aware, has for the last thirty years acted on the same principle, thanks to the enlightened views pressed upon that Government by Sir D. Brandis. That Government is the proprietor of more than 100,000,000 acres of State forests; and it has established two forest schools, one at Coopers Hill for the training of the European part of the staff, and another at Dehra Dùn, chiefly for the training of natives of India.

And yet instances are not wanting where private enterprise has done as well, and I cannot do better than refer you to the measures taken by the private forest proprietors of Bohemia and

Moravia in Austria, who established the following forest schools :—

(1) Weissmasser, in 1855, by the Bohemian Forestry Society, and taken over in 1862 by an Association of Landed Proprietors.

Graf Waldstein, Wartenberg, attached an area of 3000 acres of forest to the School for the practical instruction of the students.

(2) Eulenburg, in 1852, by the Moravian-Silesian Forestry Society.

(3) Lemberg, a similar institution, existing since 1874.

All three train forest managers for private woodlands.

(1) and (2) are entirely self-supporting; (3) has an annual grant from the State.

The above facts indicate that, as far as this country is concerned, we can expect only limited assistance from the State. Considering the large imports of timber, and a certain amount of uncertainty regarding future supplies, the State's action might reasonably be expected in the following four directions :—

(1) Assistance in the equipment of forest schools and training grounds.

(2) Management of, at any rate, a number of Crown forests on systematic economic principles.

(3) Advances at moderate interest ($2\frac{1}{2}$ per cent.) to landed proprietors who are desirous of planting.

(4) In some cases—for instance, where additional work is wanted in congested districts—surplus areas might be acquired and put under forest.

At the same time, we cannot close our eyes to the fact that, as the proprietors of forests are the people most interested in the systematic management of their woodlands, it rests, in the first place, with them to afford the means for a proper education of their agents, if they really want it, though, of course, the State will do well to help.

Assuming this to be the case, why should we not be able to do as much as has been done, for instance, in Bohemia and Moravia? I do not expect any landed proprietor in this country to make a present of a large tract of forest land, nor is this necessary; but would it be too much to expect that the proprietors

should, between them, provide the means towards the cost of forestry education in this country? Supposing, for the sake of argument, they determined to take up the matter in real earnest, and to contribute *one* penny per acre of actual woodland annually, say for the next ten years, we should have for Scotland alone a sum of £3600 a year, as there are some 900,000 acres of woods. And if only one-half of the proprietors joined such an association, it would still have about £1800 annually at its disposal, a sum quite sufficient to pay for the desired forestry education, apart from any help which the State may be willing to afford. Or if they only gave ¼d. per acre, it would still be £900 a year. I am sure there is nothing so very startling in these proposals, which, after all, run on the same lines as those adopted in many other cases in this country. At any rate, they are thoroughly in accordance with the foundations of national life in Britain.

How is Forestry Education to be Arranged?

Assuming, then, that the necessary funds for a proper start became available, the next question would be—How the course of education should be arranged? Perhaps the best way of explaining my views on this point will be to tell you shortly what we have done and are now doing at Coopers Hill College, and then to indicate my views as to what course should, in my opinion, be followed to suit the requirements of this country.

More than thirty years ago, when Sir D. Brandis arranged for the education of candidates for the Indian Forest Department, he informed the home authorities that, as there were no forests in Britain managed on systematic economic principles, the training must be done on the Continent. He arranged, accordingly, that one-half of the candidates should be sent to France, and the other half to Germany. At the same time he suggested that some of the English Crown forests should be taken under systematic management, so that they might, in course of time, become available as training grounds for British forest students. Of the latter suggestion no notice was taken.

In the year 1883, when the Secretary of State for India had decided to start forestry education at Coopers Hill College, I induced the Government of India, in my capacity as Inspector-General of Forests to that Government, to point out to the home authorities that, if forestry education in Britain were to become

a living thing, the first step to be taken should be to place the principal Crown forests under systematic economic management. In making this proposal, both Sir D. Brandis and myself had in our minds' eye the idea that such a step would be beneficial, not only for the candidates of the Indian Forest Department, but also for students who wished to devote themselves to the management of forests in this country and in the colonies. However, for the second time, no notice was taken of the proposal, and a start was ordered to be made at Coopers Hill without proper training grounds in this country. When I was subsequently deputed to organise the forestry branch at Coopers Hill College, I had no choice but to propose that our students should go to the Continent for the principal part of their practical training. Gradually the arrangements were perfected, and they are now as follows:—

Arrangements at Coopers Hill.

1. The students join the College in September, and remain under tuition for three years, divided into nine terms.

2. During the first seven terms they study at the College, being instructed in the auxiliary sciences, including Botany, and in the theory of forestry. During this time they visit all interesting forests in the vicinity of the College, one day a week being set aside for this purpose, and at the close of the first year they are taken for a fortnight to Brittany, principally to study the treatment of beech and oak woods, partly pure, but chiefly mixed with each other. In this way we enable the students to follow and understand the study of the theory of forestry. At the end of seven terms, the students are sent to Germany and placed, in batches of two, with specially selected Prussian forest officers, under whom they work for five months, so as to see and learn to understand all the operations carried on in a well-arranged and well-managed forest district. Then they are all brought together, and under the guidance, until lately of Sir D. Brandis, and now of myself, they visit a selected number of specially interesting forest districts in South Germany. After that they are considered fit to be sent to India, and to enter the forest service of that country.

In arranging this course of study, we were guided by the following considerations:—(1) Theoretical and practical training

in forestry must go hand in hand; (2) the student must become thoroughly acquainted with the work in a systematically managed forest district; (3) the student must study varying conditions, over and above those found in any one district, so as to acquire a sufficiently ripe judgment, which will enable him to decide on the correct measures to be taken in any conditions which he may meet with subsequently in his work.

Before applying what I have said to the case of Scotland, I must clear the ground a little more. The demand for better forestry education has gone forth, but I have nowhere seen it clearly stated what is really wanted. There are a large number of foresters in Scotland who look after the woods on estates of varying extent. Some proprietors have only a few hundred acres, or even less, while others own areas up to many thousands of acres. The former employ a forester or woodman, whom they pay hardly more than any untrained industrious labourer can earn; and even in the case of the latter the emoluments of their wood managers reach only a very moderate figure. Now, every labourer is worthy of his hire, and before a young man makes up his mind to devote several years of his life, and a not inconsiderable amount of cash, in acquiring a thorough knowledge of a profession, he must see his way towards obtaining afterwards a position and emoluments which make it worth his while to proceed. No man in his senses would go through a systematic course of study if all he could look forward to at the end of it were a salary of say £70 a year. But then a proprietor will say—How can I afford to give more, if I have only a small area of woods to be looked after? The fact is that we require two distinct classes of foresters, the ordinary working forester, and the wood manager, or forest expert if you like the term better. The former would be in charge of the ordinary current works, while the latter lays down the method of treatment, and supervises the execution of the work. Every proprietor would have one or a number of working foresters, according to the size of his woods, and a wood manager or a share of one. If his estate is of sufficient extent he will engage his own wood manager, and if he owns only a small area, he will secure the occasional services of one. There are endless examples where a land agent manages a number of estates, and there is no reason, as far as I can see, why the same should not be the case as regards wood managers. In that case they would

secure an income commensurate with the sacrifices which they have made in educating themselves.

The working forester would be a practically trained man, who need not necessarily, at any rate not at present, visit a forest school, unless he desires to work himself up to the position of a wood manager. The future employés of the latter class require superior training. Unless you keep this distinction clearly in view, all your attempts are likely to lead to disappointment.

On looking over what has been done up to date, I find that there are three distinct means of acquiring a theoretical knowledge of forestry—(1) The training of working foresters at the Royal Botanic Garden, Edinburgh; (2) the lectures given in connection with the Department of Agriculture of the University of Edinburgh; and (3) those given in the Edinburgh School of Rural Economy. Over and above, I see it stated that it is intended to start forestry instruction at various other places.

Although I have considerable hesitation in expressing an opinion, owing to my incomplete knowledge of the local conditions, still, as an outsider, I cannot help thinking that energy and money are likely to be wasted by running on too many lines all at once. For some time to come your chief energies should, in my humble opinion, be directed to the education of the future wood managers, while the working foresters will, for the present at any rate, do well to seek their training in well-managed forests.

In my opinion, you would do better if you, at the start, were to concentrate operations, so as to make *one* definite scheme a reality, and that scheme should be to perfect the education of your future wood managers, or under whatever title they appear upon the scene. In other words, I should advocate *one* centre of instruction, consisting of (1) theoretical instruction in connection with a university or agricultural college, where instruction in the auxiliary sciences is already provided; (2) woodlands where the practical instruction can be imparted, because in forestry theory and practice must go hand in hand.

As regards the first point,—theoretical instruction,—a beginning has been made in this very city, where my friend Colonel Bailey is delivering lectures on forestry. The arrangement needs only further development, and to be put on a proper footing, so as to bring the subject of forestry, as regards its importance, on a par with other branches of learning.

The difficulties are much greater in coming to the practical

training, viz., the provision of forest districts in which the practical part of the instruction can be conducted. To meet this difficulty, some members of this Society have proposed to start a model forest under the auspices of a joint-stock company. Now this is a novel idea, which at first sight may recommend itself to some people, but for myself, I confess I do not think much of it, for several reasons. For one thing, the buying of a tract of land and planting it up would be equivalent to postponing progress for about another generation, during which time not much more could be learned in it, except what can be seen in hundreds of the forest estates existing in this country. For I need hardly point out to you that, as far as planting operations are concerned, our Scottish foresters may proudly enter the arena, never minding whom they meet therein. Indeed, in this respect, Continental foresters may learn a good deal by coming to Scotland.

For immediate use we require something more, and that is a considerable area of actually existing forests, which can at once be placed under systematic management and regular sustained working. There is no necessity that these should at once be put into apple-pie order. All that is wanted is that a plan of operations, or a so-called working plan, should be drawn up for each, under which the forest (while safeguarding the interests of the proprietor) is gradually, and in the course of a number of years, led over into a model forest. There would be an annual return at once, which would gradually increase to the highest possible yield which could reasonably be expected from the area. Operations like those involved in such a conversion would be the very thing for the instruction of students, and this all the more, as they would, when entering upon independent activity, in all probability have to introduce and conduct similar operations. Any forest area which is fairly stocked would therefore do for our purpose, provided it offers a sufficient variety of conditions. For the latter reason it would be best to have several forests, situated in different parts of the country. Nowadays all parts are easily accessible, so that those estates could be conveniently reached, but it would be a distinct advantage if one of them was sufficiently close to the place where the theoretical instruction is given, so that it can be visited by the students in the course of a day, while at the others the students would pass through a regular apprenticeship.

Where are these Forest Estates to be Found?

As continuity of action, extending over a long period of time, is required, nothing would be more proper than that the State should take up the matter; Crown forests should be used for the purpose. There are something like 100,000 acres of forests under the management of Her Majesty's Commissioners of Woods and Forests, who act under the control of the Lords of the Treasury. These forests are the property of the Crown, and they are leased to the State during Her Majesty's life. Whatever arrangements may be made hereafter, they represent areas in which the temporary wishes or necessities of the owner are not likely to interfere with the management, and they are therefore eminently fitted for continued systematic management. Unfortunately, none of these forests are situated in Scotland, but if we look at Great Britain as a whole, I think a renewed effort should be made to bring the principal Crown forests, in so far as they do not serve as Royal shooting grounds, under systematic economic management. I am inclined to think that the Commissioners of Woods and Forests would not be unwilling to consider any proposals in this respect, if it is made clear to them that systematic economic management does not mean cutting the woods down, but, on the contrary, leading them over into a condition in which they will give an increased yield and revenue.

There being no State forests in Scotland, I think the Government would not go out of its way if it were to buy an estate, a considerable proportion of which is already under wood, and to affiliate it with the Forestry School at the University of Edinburgh, with a duly qualified wood manager in residence on the spot. This wood manager, under the advice of the Lecturer on Forestry and a duly constituted committee of control, would have to draw up a working plan of the area, giving full details of the objects to be aimed at, and the manner in which they will be utilised. This area could at once be utilised for the practical illustration of many of the theories set forth in the lecture-room, and it would also afford opportunity for the training of working foresters. Proposals for the establishment of such a training ground are, I understand, now before the President of the Board of Agriculture, and I trust he will see his way towards providing the means for its utilisation.

But can we not achieve something more? Could we not

persuade a few, or even one, of the great landed proprietors of this country to make the experiment of placing their forests under systematic economic management? Let me assure them they need not fear for the æsthetic beauty of the estates. True forestry is not barbarous; on the contrary, the proprietors would soon find that their estates would be just as beautiful as before, besides improving in yield capacity and additional cash in their pockets. Nor need forestry interfere with the income from shooting, at least not more than what would be fully covered by additional receipts derived from the sale of forest produce. Of course, we must not forget that this is a century which marches ahead at a quick pace, while forestry is an industry which proceeds but slowly. Haste has no place in forestry. Still, there is no reason whatever to doubt, as I have already shown, that an estate can be subjected to systematic forest management without curtailing the revenue hitherto derived from it, while giving promise of a considerably higher revenue in the future. At the outset, occasional visits to suitable Continental districts would probably be necessary, but they may be reduced in the same degree as the systematic management of the home estates improves, until they would become unnecessary. The sooner the latter stage is arrived at the better, because, apart from political considerations, these visits are a source of great inconvenience and expense.

And now, gentlemen, I fear I have kept you long enough. The subject of forestry education is one in which I take a great interest, and I only trust that the realisation of your aims in this respect may be accomplished at an early date. National and private interests of considerable magnitude are involved in their realisation, which I hope will not be put back for another generation.

IX. *Forestry in Scotland in the Reign of Her Most Gracious Majesty Queen Victoria.* By MALCOLM DUNN, The Palace Gardens, Dalkeith.

In taking a survey of the progress of forestry in Scotland during the sixty years which have passed of the reign of Her Majesty Queen Victoria, it cannot but be evident to every close observer that a very substantial advance has been made within the period. Not only have numerous new species and varieties of trees and shrubs been introduced, many of which are of the greatest value to the arborist, and many improved methods and appliances adopted in the management and working of our woodlands; but a much deeper interest has been taken by the public in forestry questions during the past twenty years, and especially in the improvement of the education and training of foresters, with the view to a greater and more profitable development of our forests. Considering the condition of Forestry in this country in the first quarter of the present century, it may be safely asserted that it has made much greater progress within the period of Her Majesty's reign than either of the sister arts—Agriculture and Horticulture, much as they have undoubtedly advanced during the same period. It may also be noted that Forestry, as it is known and practised in Britain at the present time, is almost entirely a creation of the Victorian era.

It is true that the trees chiefly employed in the formation of plantations when Her Majesty ascended the throne sixty years ago were of the same species as those now in vogue, and which will probably remain popular with planters for ages to come, notwithstanding many fine newer introductions. Plantations formed in Scotland in the early part of this century, before the Queen began to reign, were as a rule wholly composed of three species of the Coniferæ—Larch, *Larix europæa*; Scots Fir, *Pinus sylvestris*; and Norway Spruce, *Picea excelsa*; and five species of broad-leaved trees—Ash, *Fraxinus excelsior*; Beech, *Fagus sylvatica*; Scots Elm, *Ulmus montana*; Oak, *Quercus Robur*; and Plane or Sycamore, *Acer Pseudo-platanus*. All other species of trees cultivated in Britain at that period were seldom planted as forest trees, but were almost entirely confined to the embellishment of parks, pleasure-grounds, and gardens, where their value as decorative objects in the landscape was the first consideration.

British and Early Introduced Exotic Trees.

The primeval forests of Britain are believed to have been mainly composed of Oak, *Quercus Robur*, and Scots Fir, *Pinus sylvestris*; the former predominating on the rich lands of the low country, and the latter on the poorer soils of the moors and exposed uplands. The remains of both are found in abundance, and often in a wonderful state of preservation, after the lapse of many ages, at the bottom of peat-bogs, which have grown up over them to a depth of many feet in the course of centuries. About a dozen other species of large trees, 30 or more feet in height, and with a stem of a foot or more in diameter at 5 feet up,—including Alder, *Alnus glutinosa*; Ash, *Fraxinus excelsior*; Beech, *Fagus sylvatica*; Birch, *Betula alba*; English Elm, *Ulmus campestris*; Scots Elm, *Ulmus montana*; Hornbeam, *Carpinus Betulus*; Lime, *Tilia europœa*; Poplar, *Populus alba* and others; Spanish Chestnut, *Castanea vesca*; Sycamore, *Acer Pseudo-platanus*; Willow, *Salix alba* and others,—are considered to be indigenous, or have been introduced at such an early period that all record is lost of the date, and they are now as much naturalised in Britain as any native tree.

Of smaller British trees, indigenous or naturalised in far back ages, there is a greater number, and some of them produce timber of considerable value, beside being among the most useful and effective of ornamental and fruit-bearing trees. In this section are the Apple or Crab, *Pyrus Malus*; Aspen, *Populus tremula*; Bird Cherry, *Cerasus Padus*; Box, *Buxus sempervirens*; Buckthorn, *Rhamnus catharticus*; Bullace, *Prunus insititia*; Elder, *Sambucus nigra*; Gean, *Cerasus Avium*; Goat Willow, *Salix caprea*; Guelder Rose, *Viburnum Opulus*; Hazel, *Corylus Avellana*; Hawthorn, *Cratœgus Oxycantha*; Holly, *Ilex Aquifolium*; Maple, *Acer campestre*; Medlar, *Mespilus germanica*; Pear, *Pyrus communis*; Plum, *Prunus communis*; Rowan, *Pyrus aucuparia*; Sea-Buckthorn, *Hippophæ Rhamnoides*; Service-tree, *Pyrus Sorbus*; Sloe, *Prunus spinosa*; Spindle-tree, *Euonymus europœus*; Strawberry-tree, *Arbutus Unedo*; White Beam, *Pyrus Aria*; Wild Service, *Pyrus torminalis*; and Yew, *Taxus baccata.*

Among the more notable indigenous or naturalised shrubs, the following may be mentioned:—Barberry, *Berberis vulgaris*; Black Currant, *Ribes nigrum*; Bladdernut, *Staphylea pinnata*; Bog Myrtle, *Myrica gale*; Broom, *Cytisus Scoparius*; Butchers'

Broom, *Ruscus aculeatus*; Dogwood, *Cornus sanguinea*; Gooseberry, *Ribes Grossularia*; Heath, *Erica cinerea* and others; Juniper, *Juniperus communis*; Mezereon, *Daphne Mezereum*; Mistletoe, *Viscum album*; Osier, *Salix viminalis*; Privet, *Ligustrum vulgare*; Raspberry, *Rubus Idæus*; Red Currant, *Ribes rubrum*; Rose, *Rosa canina* and others; Tamarisk, *Tamarix Anglica*; Spurge Laurel, *Daphne Laureola*; Wayfaring-tree, *Viburnum Lantana*; and the Whin, *Ulex europæa*.

The chief of the ligneous climbers and trailers that are natives of Britain are the Bramble, *Rubus fruticosus*; Brier, *Rosa arvensis* and others; Honeysuckle, *Lonicera Periclymenum*; Ivy, *Hedera Helix*; and Traveller's Joy, *Clematis vitalba*. These lists comprise all the ligneous British plants that are of any economic value, or which are of service to the forester, and previous to the fifteenth century they probably were the sole occupants of their kind—trees and shrubs—of our forests and woodlands.

With the advent of the sixteenth century a taste for tree-planting appears to have sprung up. In the reigns of James V. and Mary Queen of Scots, 1513–1567, we find royalty and the nobility beginning to display an interest in arboriculture, by planting the domains around their castles and mansions with the best of the trees and shrubs at their command. Trees are still extant, and in vigorous health, which are historically, or traditionally, closely connected with these Scottish sovereigns, and around old Scottish family seats are seen many venerable trees that were undoubtedly planted in those early days by the arborists of the period. The resources of the native trees and shrubs, as given in the above lists, would appear soon to have failed to satisfy the tastes or wants of our arboricultural ancestors, and then exotics began to be introduced from European countries and other accessible parts of the world. From about the middle of the sixteenth century we possess tolerably authentic records of the introduction of the hosts of exotic trees and shrubs that so beautifully adorn our gardens and pleasure-grounds, and form a large and important part of our planted woodlands. The earliest of these, Turner's *Herbal* appeared in 1548, and in it is recorded that on or before that date the Norway Spruce, *Abies excelsa*; Stone Pine, *Pinus pinea*; Cypress, *Cupressus sempervirens*; Oriental Plane, *Platanus orientalis*; Savin, *Juniperus Sabina*; Sweet Bay, *Laurus nobilis*; and Spanish Broom, *Spartium junceum*, were among the plants introduced from Europe. The

Walnut tree, *Juglans regia*, was introduced about 1562; the Holm, or Evergreen Oak, in 1581; and before the end of the century the following trees and shrubs had been added to the introductions, as recorded in Gerard's *Herbal*,—Silver Fir, *Abies pectinata*; Maritime or Cluster Pine, *Pinus Pinaster*; Arborvitæ, *Thuja occidentalis*; Laburnum, *Laburnum vulgare*; Laurestine, *Viburnum Tinus*; Lilac, *Syringa vulgaris*; Mock Orange, *Philadelphus coronarius*; Judas Tree, *Cercis Siliquastrum*; Phillyrea, *Phillyrea latifolia*; and about sixty other ligneous plants of lesser growth.

Some of the most interesting to the arborist of the trees and shrubs introduced in the seventeenth century need only be here noted, the first and perhaps the most important being the European Larch, *Larix europœa*, which, according to Parkinson, in his *Parnasus*, was introduced before 1629, but by whom is not recorded. The same authority also records that about that time the Horse Chestnut, *Æsculus Hippocastanum*; Hickory, *Carya alba*; Black Walnut, *Juglans nigra*; Persimmon, *Diospyros virginiana*; Common or Cherry Laurel, *Cerasus Laurocerasus*; Alaternus, *Rhamnus Alaternus*; Pyracantha, *Cratægus Pyracantha*; American Bird Cherry, *Cerasus serotina*; and Virginian Creeper, *Ampelopsis hederacea*, were introduced; and by the middle of the century the Occidental Plane, *Platanus occidentalis*; Deciduous Cypress, *Taxodium distichum*; False Acacia, *Robinia Pseudo-Acacia*; Portugal Laurel, *Cerasus lusitanica*; and Poison Oak, *Rhus Toxicodendron*, had appeared in Britain. The last half of the century saw the introduction of about eighty species of ligneous plants, many of them being obtained from the eastern States of North America, then British colonies, and long a fertile source of new trees and shrubs. A few of those most useful to the arborist are the Scarlet Maple, *Acer rubrum*; American Nettle Tree, *Celtis occidentalis*; and Butternut or White Walnut, *Juglans cinerea*, in 1656; the Tulip Tree, *Liriodendron tulipiferum*, in 1663; Red Cedar, *Juniperus virginiana*, in 1664; the Constantinople Nut, *Corylus Colurna*, in 1665; Cedar of Lebanon, *Cedrus Libani*, in 1676; the Aleppo Pine, *Pinus halepensis*, Phœnician Juniper, *Juniperus phœnicea*, Scarlet Thorn, *Cratægus coccinea*, Dwarf Almond, *Amygdalus nana*, in 1683; *Magnolia glauca*, *M. longifolia*, and *Aralia spinosa*, in 1688; Scarlet Oak, *Quercus coccinea*, and Cockspur Thorn, *Cratægus crus-galli*, in 1691; Balsam Poplar, or Tacamahac of North America, *Populus*

balsamifera, and Babylonian Willow, *Salix babylonica*, in 1692; Cork Oak, *Quercus Suber*, Dwarf Chestnut, *Castanea pumila*, and Candleberry Myrtle, *Myrica cerifera*, in 1699; and the Honey Locust, *Gleditschia triacanthos*, White Spruce, *Picea alba*, and Black Spruce, *P. nigra*, in 1700.

The eighteenth century saw about five hundred species of ligneous plants introduced to Britain, of which North America contributed about three-fifths, Europe one-fifth, Asia about eighty, including half-a-dozen species from Japan, a country which in later times has been so fertile in fine trees and shrubs, Africa about a dozen, and South America three species. Of that large number of trees and shrubs, only a few of the most useful call for mention, beginning with the Weymouth Pine, introduced by Peter Collinson from North America in 1705. The White Ash, *Fraxinus americana*, in 1723; *Catalpa syringæfolia*, 1726; *Azalea nudiflora*, *A. viscosa*, and others, *Rhododendron maximum*, *Andromeda racemosa*, *Kalmia latifolia*, and *Magnolia grandiflora*, all from North America, in 1734; Turkey Oak, *Quercus Cerris*, Sugar Maple, *Acer saccharinum*, 1735; Hemlock Spruce, *Abies* (*Tsuga*) *canadensis*, White Cedar, *Cupressus thyoides*, and the American Larch, *Larix microcarpa*, in 1736; Red or Champion Oak, *Quercus rubra*, Black Jack Oak, *Q. nigra*, and Live Oak, *Q. virens*, in 1739; *Pinus Cembra* in 1740; Kentucky Coffee Tree, *Gymnocladus canadensis*, in 1748; *Ailanthus glandulosa*, 1751; American Lime or Basswood, *Tilia americana*, *Biota orientalis*, and *Juniperus thurifera*, in 1752; Maidenhair Tree, *Ginkgo biloba*, 1754; the Striped-bark Maple, *Acer pennsylvanicum*, and other Maples, 1756; Lombardy Poplar, *Populus fastigiata*, 1758; Corsican Pine, *Pinus Laricio*, 1759; *Rhododendron ponticum*, 1763; Red Beech, *Fagus ferruginea*, 1766; Cottonwood of America, *Populus canadensis*, 1769; Black Italian Poplar, *Populus monilifera*, 1772; *Pyrus spectabilis*, 1780; *Aucuba japonica fœmina*, 1784; *Pinus montana*, 1789; *Pinus Pallasiana*, 1790; and the Chilian Pine, *Araucaria imbricata*, and *Thuja plicata*, 1796. The last two fitly close the list of the best of the ligneous introductions of the eighteenth century. A new era was commencing, in which the farthest corners of the world would be ultimately ransacked by intrepid travellers and explorers in search of useful trees and shrubs. With a few important exceptions, the trees which had been introduced hitherto had not proved valuable to the planters of timber-

producing forests, however useful many of them were to the ornamental planter and the landscape gardener.

Towards the end of the century, travellers and collectors of plants began to push their way into most of the accessible parts of the world, and to freely ransack them of their treasures in the way of trees and shrubs that promised to thrive in the British climate. Among those fearless and enterprising travellers, Scotsmen hold a prominent place, as the introducers to the British Isles of many of the finest of hardy exotic trees and shrubs. Without going farther back than the period we are now dealing with, a few of those intrepid countrymen of ours may be mentioned. Archibald Menzies, a native of Perthshire, was born in 1754, at Weem, in Strathtay, and accompanied, as naturalist, the famous Captain Vancouver on his voyage round the world in the years 1790-96, bringing home with him, in the latter year, *Araucaria imbricata* from Chili, and *Thuja plicata* from British Columbia. John Fraser, a native of Inverness, who travelled widely over the Eastern United States and the West Indies in search of new and useful plants, and, between 1784 and 1811, introduced many trees and shrubs from those regions to this country, including *Abies Fraseri* in 1811, which was named after him. John Lyon, a native of Forfarshire, also travelled much in the Eastern States of America between 1802 and 1812, and collected many new and rare species of trees and shrubs, which he introduced to Britain chiefly through Loddiges & Sons, then eminent nurserymen at Hackney, London. And last of the noted band, but most indefatigable of all the pre-Victorian travellers and plant-collectors, David Douglas, who was born at Scone, near Perth, in 1799, and travelled in various parts of America for the Royal Horticultural Society of London from 1823 to 1833. He sent home to Britain within that period more hardy trees, suitable for forest culture for commercial purposes, than all the plant-collectors who had gone before him, or any one that has come after him. Beside the now popular Douglas Fir, *Abies Douglasii*, which was one of his first introductions from the north-west coast of America, and most worthily commemorates his name, he introduced upwards of fifty hardy trees and shrubs, many of which have proved to be of special value in forestry, and all are exceedingly useful in gardens and pleasure-grounds. Amongst Douglas's introductions were such fine stately trees as *Abies amabilis, A. Douglasii, A. grandis, A. Menziesii*, and *A. nobilis*; *Pinus insignis, P. Lambertiana,*

P. macrocarpa, *P. monticola*, *P. ponderosa*, and *P. Sabiniana*; *Acer circinatum* and *A. macrophyllum*. Of the smaller trees and shrubs, mention may be made of the Mahonia, *Berberis Aquifolium*, *Garrya elliptica*, *Gaultheria Shallon*, *Arbutus procera*, *Amelanchier florida*, *Ribes aureum*, *R. niveum*, *R. sanguineum*, *Caprifolium Douglasii*, *Clematis Douglasii*, *Spiræa ariæfolia*, and many others more or less noteworthy and useful to the ornamental planter.

Through these and other channels, about eight hundred species of exotic trees and shrubs were introduced to Britain in the early years of the present century, before the Queen's reign began in 1837, all of which were supposed to be sufficiently hardy to grow in the open air in some part of the British Isles. A few only of the most notable trees may be mentioned beside the introductions from America by Douglas, Fraser, and Lyon already referred to. The Himalayan Spruce, *Abies Morinda*, was introduced from India in 1818, by Dr Govan of Cupar, Fife; and the first plants of it were raised from seed at Hopetoun, by Mr James Smith, gardener to the Earl of Hopetoun, after whom it was called *Abies Smithiana*, by Dr Wallich, who himself introduced from the same regions, between 1822 and 1829, the beautiful Silver Fir, *Abies Webbiana*, *Cupressus torolosa*, *Juniperus recurva*, *Pinus excelsa*, and *P. Gerardiana*, all very beautiful conifers, requiring a warm and sheltered position, however, to thrive well in Britain. The Indian Cedar, *Cedrus Deodara*, was introduced by the Hon. W. Leslie Melville in 1831; the Pyrenean Pine, *Pinus pyrenaica*, by Captain Widdrington, in 1834; the Austrian Pine, *Pinus austriaca*, by Lawson & Son, Edinburgh, in 1835; and the Indian Silver Fir, *Abies Pindrow*, by Dr Royle, early in 1837.

Forest-Tree Nurseries.

Early in the eighteenth century, public nurseries for the rearing of young forest trees to meet the increasing demands of planters, and for the propagation and distribution of the newly introduced trees and shrubs, began to be established in Scotland. The first nursery formed in Scotland was started in the year 1729, by Robert Dickson, at Hassendeanburn, near Hawick, Roxburghshire. This enterprising gentleman was the common progenitor of the numerous race of Dickson who have established nurseries in various parts of the United Kingdom, until the name has

become, in the forest-tree nursery trade, as familiar to foresters and others as a household word. At the beginning of the Queen's reign, those public nurseries for the rearing and sale of trees and shrubs had been established by a Dickson, or some other enterprising sept, in every important business centre in Scotland. At Edinburgh they were numerous, and are so to this day, and they were also to be found at Aberdeen, Perth, Dundee, Inverness, Forres, Glasgow, Stirling, Kilmarnock, Ayr, Dumfries, Kelso, and many other places, which shows that the demand for young forest trees had arrived at considerable commercial importance at that period.

Early Literature of Forestry.

It may be safely said that until the advent of the Victorian era the literature of British forestry was of a meagre character; but such of it as was of any value in practical forestry was mainly the work of Scottish authors. Evelyn's *Sylva* appeared in 1664, and it is still a popular book with ardent lovers of trees. The Earl of Haddington, in 1760, published a small *Treatise on Forest Trees*, but it was of little use for practical purposes, and is chiefly valued for its rarity, and as the production of a famous planter of trees. A useful book, and one that was much valued in its day, was a *Treatise on Forest Trees*, by William Boutcher, a nurseryman at Comely Bank, near Edinburgh, published in 1772. Another useful treatise, *The Practical Planter*, by Walter Nicol, appeared in 1779, and a revised edition of it, by Mr Sang of Kirkcaldy, in 1812. Monteith's *Forester's Guide* followed in 1819, and Sir Henry Steuart's *Planter's Guide* in 1829, may be said to complete the list of useful books on practical forestry prior to the commencement of the present reign in 1837.

Forestry Appliances—Tools and Implements.

The appliances at the command of the Scottish forester in pre-Victorian times, for the execution of his work, were almost confined to the axe, saw, pick, and spade, and the various forms of those useful cutting and digging tools in vogue at the time for particular purposes. The means of transport were limited to the drag-chain, and the timber cart or waggon drawn by horses or bullocks. The friendly aid of the spring floods in the nearest river was invoked to float the timber to a seaport, often many miles distant. No lines of railway, light or heavy, steam cable, or electric; no traction

engines and portable saw-mills; no penny post, no telegraph, and no telephone; few books, and no forestry periodicals; no Arboricultural Society, nor meetings to discuss questions of interest to foresters; in short, few or none of the improved methods and appliances were then available which we are now in the habit of considering as absolutely indispensable for the efficient performance of the duties of a forester. He might plant woods and grow the timber to the highest perfection, but for want of an easy access to a market where forest produce was in demand, the trees would scarcely pay him for cutting them down. If at any time a greater quantity was cut than met the local demand, it was a serious undertaking for the forester to seek for and find a good market for the surplus. Letters travelled slowly, and postage was high, and the cost of travelling from one part of the country to another by stage-coach, or perhaps, in outlying districts, by a lumbering carrier's cart, was almost prohibitory when added to the loss of time, and unless the forests were so extensive as to induce moneyed men to embark in the timber trade, and lay convenient to good water communication, their owners reaped a poor return from the sale of the produce. From a variety of circumstances, these primitive methods were on the wane when Her Majesty began to reign, and at the end of sixty years, in 1897, they have been generally supplanted by vastly improved methods and facilities.

THE VICTORIAN ERA.

At the ascension of Queen Victoria to the throne of these realms, in the year 1837, a general upheaval was taking place among the arts and sciences. Old things were passing away, or fast becoming reorganised under the teachings of science and the beneficial influences of the spirit of inquiry and improvement that were abroad, and before half the period had passed during which Her Majesty has reigned, the old order had practically disappeared, and the new ruled in its stead. The general use of steam power, and the consequent development of railways and steamboats, which were in their initiatory stages in 1837, was undoubtedly one of the most potent of all the influences which tended to the rapid advancement of all branches of rural, as well as of urban industries. In 1837, Wheatstone and Faraday were busy at the invention of the electric telegraph, which has assumed such a wonderful development in the course of the Queen's reign,

almost annihilating time and space. It and its junior electric invention, the telephone, have quite revolutionised the rapid transaction of business and the development of trade throughout the civilised world. Another, and not the least important factor in the wonderful progress of the industries of the country in the past sixty years, was the invention of the penny post by Sir Rowland Hill, and its inauguration in 1840, when letters under half an ounce in weight were carried at a uniform rate of one penny. The weight of the letters was increased to one ounce in 1871, and, in commemoration of the Diamond Jubilee of the Queen in the month of June last, the weight was further increased to four ounces for one penny—an immense boon to the public. The beneficial results of the development of these and other important inventions in the course of Her Majesty's long reign are seen on every side and felt in every line of life, and have proved a great stimulus to the progress of forestry in this country.

Planting of Forests.

The formation of extensive woods, or forests, was carried on in Scotland with great enterprise and public spirit by landowners in the last half of the eighteenth and the early part of the present century, so that when the Queen ascended the throne in 1837, many large tracts of land that were bare, treeless wastes, in the previous century, were well clothed with thriving plantations. During the same period, and especially towards the end of the last century, when the extensive natural pine forests in Strathspey were cut over, much of the natural woodlands were entirely cleared of their crop of timber, and some of the land then cleared remains still an unafforested waste. Most of it, however, has been restocked with timber, either by natural or artificial seeding, or by planting. Among the most noted of the earlier planters of forests in Scotland were the Dukes of Athole in Perthshire, who, in the forty years immediately preceding Her Majesty's reign, planted of Larch alone about 9000 acres, as well as some thousands of acres of Scots Pine and Norway Spruce, the two latter being also extensively planted in the Moray and Strathspey districts by the Duke of Gordon and the Earl of Seafield.

After a lull of a short period at the commencement of the present reign, those extensive planting operations have been carried on all through it with more or less continuity; and judging from the extent and generally flourishing condition of

our forest-tree nurseries, which annually raise seedlings enough to plant many thousands of acres, and for all of which there seems to be a steadily growing demand, it is natural to believe that our forests are spreading in their extent, and yearly adding to their acreage. Statistics, so far as they are available and their accuracy can be depended upon, prove this to be correct, and for at least the past three decades, the forest areas in Scotland have had upwards of 4000 acres added to them annually, over and above the restocking of woodlands that have been cleared of their crop of timber. In the future the rate of increase is likely to be much greater, when the improved methods now being developed show their success, and the true principles of forestry are better understood and generally practised.

Forest-Tree Nurseries.

The institution of home nurseries on large estates is an important feature in connection with the planting of forest areas in Scotland during the present reign. They are a considerable advantage to the planter, where extensive planting operations are being carried out in a systematic manner; but although they are found on most estates of any pretensions from a forestry point of view, they do not seem to materially affect the increase and expansion of the public nurseries. In every populous and improving district in Scotland, we now find established one or more well-stocked and thriving commercial nurseries; in fact, some favoured centres may be said to be crowded with them. The annual output of forest and ornamental trees and shrubs from the whole of these nurseries must be something marvellous; but we have no trustworthy statistics available to show how many millions of plants they distribute to the public in the course of a season.

Through the enterprise and public spirit of the nurserymen, a vast addition has been made within the past sixty years to the numbers of our choicest and most beautiful trees and shrubs. Much improvement has also been made by them in the methods of rearing a healthy and vigorous stock of plants and placing them on the market in the best condition, thus adding materially to their value and success when the trees are planted in their permanent position, and, with due care on the planter's part, rendering failure almost an impossibility. The rearing of a clean and vigorous stock of trees is one of the most important functions

in Forestry, because the future success of a plantation depends largely upon it. A low price for the plants should never induce anyone to plant weak, sickly, or insect-infested trees or shrubs of any description.

Plant-Collectors.

The search for hardy trees and shrubs in foreign countries, and their introduction to Britain, received a great impetus from the success which Douglas attained in introducing so many stately conifers, and other valuable plants, from North America, in the decade immediately preceding the Queen's reign. In fact, although Douglas gathered his spoils in California, Oregon, and British Columbia, and introduced them to Britain through the Royal Horticultural Society, before Her Majesty ascended the throne, their dissemination throughout the country, and their rise into popular favour and demand, may be said truly to belong to the Victorian era.

Stimulated by the history and success of those notable introductions of Douglas and other earlier travellers, plant-collectors, as they were called, were sent abroad, or went on their own account, to ransack every accessible spot in temperate regions, to discover plants that might be worthy of introduction to this country. To name even a tithe of the useful and interesting plants introduced to Britain by the plant-collectors in the sixty years of Her Majesty's reign, would far exceed any reasonable limits of a paper of this kind, and mention will only be made of a few of the leading collectors and the most notable of the trees which they introduced, taking them generally in chronological order.

In the year 1837 Dr Royle sent home from India the handsome Indian Silver Fir, *Abies Pindrow*, which is, however, only hardy in a few of the mildest spots in Britain. In that and a few following years he introduced to Britain a few other Indian or Himalayan trees, but none of them are of any value to the forester. In 1838 Mr A. B. Lambert introduced the Monterey Cypress, *Cupressus macrocarpa*, from Monterey, California, a beautiful ornamental tree of rapid growth in mild localities, and one of the best of the Coniferæ for maritime planting, as it resists the effects of salt spray better than most other trees. In 1839 the beautiful Eastern Spruce, *Picea orientalis*, was introduced from Asia Minor; and that fine ornamental tree, the Spanish Silver Fir, *Abies Pinsapo*, which thrives so well on chalky

or strongly calcareous soils, arrived in the same year from the mountains of Spain.

With the beginning of the "forties," a period of great activity set in among collectors and introducers of hardy exotic plants, and before the decade closed, many rich additions were made to our trees and shrubs. When David Douglas lost his life in the Sandwich Islands in 1834, the Royal Horticultural Society afterwards resolved to send another collector to America, and Karl T. Hartweg, a native of Baden, in Germany, was selected in 1836 to proceed to Mexico to travel over the mountains and higher parts of that fine country, in search of new plants that would thrive in the climate of Britain. He spent about seven years in Mexico and other parts of Central America, and discovered many fine trees, chiefly Conifers, but most of them have proved too tender for the climate of the British Isles, unless it be in some of the mildest spots, such as Fota Island in the County of Cork, where such beautiful Conifers as *Abies religiosa* are seen in luxuriant growth. In 1845 Hartweg visited California, and during the next two years sent home a few new trees, the most conspicuous being the Redwood, *Sequoia sempervirens*, which had been discovered by Menzies about fifty years previously, and also seen by Douglas and other plant-collectors, but had not been successfully introduced until Hartweg sent it home to the Royal Horticultural Society in 1846.

Again the Royal Horticultural Society, ever active in searching the world for new plants, turned its attention to the Far East, and despatched thither in 1843, as their pioneer collector, Robert Fortune, another Scotsman, from Berwickshire, who gained much well-deserved celebrity for his great perseverance and success in travelling through the "Flowery Land," China, and introducing therefrom many rare and beautiful plants, including some of the choicest and most interesting occupants of our gardens and pleasure-grounds. In the first year of his travels through China, in 1844, he sent home from Shanghai the now well-known Japanese Cedar, *Cryptomeria japonica*. In 1846 he introduced the Chinese Golden Larch, *Larix Kæmpferi*; Fortune's Fir, *Abies Fortunei*; the Chinese Funeral Cypress, *Cupressus funebris*; and the Lace-bark Pine, *Pinus Bungeana*. In 1847 *Torreya grandis* from Northern China; and from the same country, in 1849, the two species of Plum-Fruited Yews, *Cephalotaxus drupacea* and *C. Fortunei*.

Proceeding to Japan in 1860, when that interesting country

was first opened to foreign travellers, Mr Fortune, then collecting plants on his own account, was the means of introducing some of the finest Japanese trees and shrubs that are now such favourites with the decorative planter; the hardy Conifers again forming a leading feature in his introductions. Among them were the Japanese Cypresses, *Retinospora obtusa*, *R. pisifera*, and numerous fine varieties of them; *Thuiopsis dolobrata variegata*, and the curious Umbrella Pine, *Sciadopitys verticillata*. He was also the introducer of many free and showy flowering plants and shrubs from both China and Japan, but they belong more to the garden than the forest, and need not be specified here.

Among plant-collectors, William Lobb, a Cornishman, will ever occupy a high niche as the introducer to Britain of the Mammoth Tree of California, *Wellingtonia gigantea*. He first went out to South America in 1840 as plant-collector for Mr Veitch, nurseryman, Exeter, and sent home many valuable tropical plants from Brazil and the adjacent countries. Afterwards crossing the continent from east to west, he visited the great forests of the Chilian Pine, *Araucaria imbricata*, in Southern Chili, and collected a large quantity of its seeds, which he brought home in 1844, and thoroughly established the tree in Britain. It had been introduced fifty years before by Archibald Menzies, but was still rare. Trees raised from Lobb's seed are to be found in every part of the United Kingdom, the most of the largest specimens originating in that importation. Visiting South Chili again for Mr Veitch in 1847 to 1849, he introduced from that country and Northern Patagonia, in 1848, such fine shrubs as *Escallonia macrantha*, *Desfontainea spinosa*, *Berberis Darwinii*, *Philesia buxifolia*, and the beautiful climber, *Lapageria rosea*; as well as, in 1849, such interesting Conifers as *Fitzroya patagonica*, *Libocedrus tetragona*, *Podocarpus nubigenus*, and Prince Albert's Yew, *Saxe-Gothæa conspicua*.

Proceeding to California in 1849, Lobb sent home to Mr Veitch large consignments of cones and seeds of many of the discoveries of Douglas, Hartweg, and others who had explored the country before him, and the plants raised from those seeds made some of the scarce species common and popular. In a country so often and so closely traversed by keen-eyed collectors, Lobb's original discoveries were not numerous; but his introduction of the *Wellingtonia* to Britain in December 1853, from the Calaveras

Grove, on the western slopes of the Sierra Nevada Mountains, in California, will ever render his name famous among the introducers of exotic trees.

The African or Mount Atlas Cedar, *Cedrus atlantica*, was introduced to Europe in 1841, from Northern Africa; the Chilian Arborvitæa, *Libocedrus chilensis*, in 1847; and the handsome *Abies Nordmanniana*, from the Crimea, in 1848.

At the commencement of the second half of the century, a few noblemen and gentlemen formed at Edinburgh the Scottish Oregon Association, for the purpose of exploring the north-west of America, with a view to introducing to Britain the trees and other plants, particularly Conifers, found in those temperate regions. The Association appointed John Jeffrey, a native of Fifeshire—who had been trained as a gardener, like nearly every other famous plant-collector, including Douglas, Fortune, Lobb, and Hartweg—as its collector, and despatched him in June 1850, by way of Hudson's Bay, from whence he crossed the continent in the winter to British Columbia, and was ready to begin his collecting operations in the spring of 1851. A keen and indefatigable worker and explorer, he collected and sent home during his first year, 1851, a splendid consignment of seeds, especially those of the Coniferæ indigenous to the regions he explored, including such grand species as Prince Albert's Fir, *Abies Albertiana; A. concolor*, *A. magnifica*, *A. Pattoniana*, and *Pinus flexilis*, all introduced for the first time by him to Britain.

Next year, 1852, there were among his original introductions such fine things as *Cupressus Macnabiana*, *Pinus Balfouriana*, *P. Jeffreyi*, which commemorates his name, and *Thuia gigantea*; and in 1853 *Libocedrus decurrens*, a distinct Conifer, but for some years afterwards much confounded with *Thuia gigantea*. The latter has borne several synonyms, and has recently been declared, on high authority, to be the original *Thuia plicata*. The large quantities of seeds sent home by Jeffrey, and distributed by the Oregon Association, proved generally fertile, and many thousands of the newer Coniferæ from North-West America were raised from them, and planted freely in the pleasure-grounds, parks, pineta, and woods in Scotland, where they now form numerous stately and handsome trees, adding fresh interest and beauty to the landscape, and some of the species are promising to become in time valuable forest trees.

One of the most beautiful and hardiest of the Cypress tribe,

the Yellow Cypress of British Columbia, *Cupressus nutkaënsis*, was discovered at Nootka Sound by Archibald Menzies, in 1794, but was not introduced into Europe till 1850, when it reached St Petersburg, and eventually arrived in Britain. Another interesting Conifer, the Japanese Thuia, *Thuiopsis dolobrata*, was introduced in 1853 by Thomas Lobb, a collector of plants in the East for Mr Veitch of Exeter. From Japan, in 1854, Dr Siebold sent to Europe the Japanese Hemlock Fir, *Abies Tsuga*; *Pinus densiflora*, and *P. Massoniana*, the two commonest pines in Japan, and very similar in their characteristics.

In 1854 William Murray sent to Messrs Lawson & Son, nurserymen, Edinburgh, from North-West America, the Cypress named after the head of that firm, *Cupressus Lawsoniana*; and also introduced from the same regions, *Abies Hookeriana*, which so closely resembles Jeffrey's *Abies Pattoniana* that they are now considered synonymous.

In the year 1860, immediately after the Island Empire of Japan was opened to travellers, John Gould Veitch, a member of the eminent nursery firm of James Veitch & Sons, Chelsea, London, —the Exeter branch of which had been so actively employed introducing new plants, and especially of the newer Coniferæ, in the forties and fifties,—resolved to visit that far-off land, to collect whatever he met with of interest to cultivators in this country of trees, shrubs, and other plants. Arriving in Japan about the same time as Mr Fortune, they covered a good deal of the same ground, and introduced to Britain simultaneously, in 1861, many valuable plants. With characteristic aptitude and energy, Mr Veitch practically cleared the ground he traversed, and left little of value for future travellers to gather up. Among the many fine acquisitions for which the lovers of Conifers are mainly or solely indebted to him for introducing, are *Abies ajanensis*, *A. Alcoquiana*, *A. firma*, *A. polita*, *Cryptomeria elegans*, *Larix leptolepsis*, *Pinus koraiensis*, *P. parviflora*, *Retinospora obtusa*, *R. pisifera*, *R. plumosa*, *R. squarrosa*, *Sciadopitys verticillata*, *Juniperus rigida*, and many other trees and shrubs, evergreen and deciduous, all brought home from Japan in 1861. These and other introductions from the islands of Japan have generally proved hardy and thrifty plants in Britain, and add greatly to the beauty and interest of our ornamental grounds and shrubberies, if but few of them have yet shown themselves to be serviceable to the forester, as trees to cultivate for their timber.

The introduction of *Abies Numidica* from Algeria, and *Picea Englemanni* from the Rocky Mountains, in 1864; *Abies brachyphylla* from Japan, in 1870; and *Abies Mariesii*, *A. Sachalinensis*, *A. Veitchii*, and *Picea Jezoensis*, in 1879, the last four by Charles Maries, a collector who explored the forests of Japan in search of new trees and shrubs for Messrs Veitch & Sons, Chelsea, must close the list. Nothing of special interest to the forester has been brought from abroad since that period, showing that the old fields have been closely gleaned, and that fresh ones must be discovered before the arborist can expect many new species of trees to be again introduced to Britain from their native habitats abroad.

It is worthy of notice, before leaving this subject, to observe how largely the Coniferæ predominate among the hardy trees introduced during the Queen's reign; and those that are likely to become profitable forest trees are entirely Conifers. No species of broad-leaved tree introduced within the period gives promise of special qualities as a timber tree. Most of them are, however, exceedingly interesting to the arborist, and of great value to the landscape-gardener for the embellishment of domains, public and private parks, and the pleasure-grounds around country seats, or the smaller areas of city mansions and villas. The wealth of richly-tinted foliage possessed by many of them, their graceful habits and brilliant flowers and fruits, give a richness and charm to ornamental grounds and gardens which could not be produced in their absence.

Forestry Literature.

In no branch of the subject has there been such a marked advance, especially in recent times, as in the literature of British Forestry. It has been already shown that, at the commencement of the Queen's reign, it was poor in quantity, and generally of a mediocre character. Within a few years afterwards, the public press began to take special notice of arboriculture, and since the *Gardeners' Chronicle* was established, in the year 1841, it has devoted particular attention to the subject, and has acquired a high reputation as an authority upon trees and shrubs, and especially in regard to the introduction of new species and varieties. Other journals and magazines dealing with rural affairs have treated the various branches of forestry more or less exhaustively in the course of the years that have passed, and several attempts have been made to establish a periodical dealing

exclusively with Forestry, but so far they have not met with the needful support from the owners of woodlands, foresters, and others who are directly interested, to command the success which their efforts merited. Twenty years ago, in 1877, the *Journal of Forestry* was established by J. & W. Rider, of London, amid considerable enthusiasm in the ranks of the profession, and promised well for a time that it had come to stay. After a stout fight to maintain itself, and its removal from London to Edinburgh, to be published in the centre of Scottish Forestry, it too had to succumb, in 1886, for want of support, like all other periodicals which have tried to occupy the field and supply British foresters with up-to-date literature and the newest information about their profession. No attempt has since been made to establish a forestry periodical, although the need for it is evident to everyone who has given a thought to the subject.

Turning from the periodical literature to the books on forestry and cognate subjects which have appeared within the past sixty years, we find that one of the most important works on trees and shrubs in the language—J. C. Loudon's *Arboretum et Fruticetum Britannicum*, or "The Trees and Shrubs of Britain"—was first issued in May 1838, less than two years after Her Majesty ascended the throne. Its appearance marked a great step in advance of all that had gone before, and supplied arborists with a valuable compendium of the history, characteristics, cultivation, and uses of all the trees and shrubs then grown in the open air in Britain. The comprehensive nature of this standard work may be judged from the fact that the letterpress, with about 2600 small engravings illustrative of the text, occupies 2700 closely printed pages, forming four large octavo volumes, with four other volumes of plates illustrating the habits and peculiarities of typical trees. The second and last edition of this splendid work was issued in 1844, and, so far as was then known about trees and shrubs, it has not been improved upon to this day.

In 1842 an abridgment of the *Arboretum et Fruticetum Britannicum* was published by Mr Loudon, under the title of "Encyclopædia of Trees and Shrubs," which has passed through several editions, and is still a popular book with arborists, as it gives the gist of the standard work at about one-fourth of the price. The text is freely illustrated with woodcuts, and it forms a large octavo volume of about 1240 pages.

At this period appeared another highly important work on the

science of plant-culture—Dr John Lindley's *Theory and Practice of Horticulture.* It deals exhaustively with the origin and growth of plants, and the various methods of raising, propagating, and cultivating them in accordance with the principles and teachings of science. A perfect storehouse of clear and concise information on the principles of science applied to cultivated plants, trees, and shrubs, the book is worthy of the careful study of every forester, farmer, and gardener in the country.

Selby's *History of British Forest Trees* was issued in 1842—a beautifully illustrated work, giving the history of British trees, with their treatment for effect in the landscape, and in plantations for commercial purposes.

In the year 1847 there appeared *The Forester*, by James Brown, which long maintained the position of the leading work on British Forestry. It passed through five editions, and three years ago it was thoroughly revised and brought up to date by Dr John Nesbit, of the India Forest Service, and is much appreciated by practical men.

Nothing else of special importance to forestry appeared in the latter half of the forties, but from 1851, the year of the first Great International Exhibition held at London, onwards to the present time, there has been a steadily increasing flow of forestry literature from the British press. At the present rate of increase it bids fair to become soon as abundant as the forestry literature of France, Germany, and other foreign countries, where, from the necessities of their case and the force of circumstances, they have been compelled to give earlier and closer attention to a system of forestry founded on sound principles. The number of books on British forestry which have appeared since 1851 is far too numerous to permit us to review it in detail, and a mere list of the principal works and their authors, with the years in which they appeared, in chronological order, must suffice.

1851. *Coniferous Trees in Britain.* Knight & Perry.
1853. *English Forests and Forest Trees.* Ingram, Cooke, & Co.
1856. *Trees and their Nature.* Dr A. Harvey.
„ *Forest Trees of Britain.* C. A. Johns.
1858. *The Pinetum.* George Gordon.
1859. *British Timber Trees.* John Blenkarn.
1860. *Pinetum Britannicum.* Peter Lawson & Son.

1863. *Firs of Japan.* Andrew Murray.
,, *The New Forest.* John R. Wise.
1865. *Remarkable Trees of Scotland.* Highland and Agricultural Society.
1866. *Arboriculture.* Grigor, Forres.
,, *Pinaceæ.* "Senilis," Lyndhurst.
1870. *Trees and Shrubs for English Plantations.* Augustus Mongredien.
1875. *Handy Book of Ornamental Conifers.* Hugh Fraser.
,, *Notes on Forestry.* C. F. Amery.
1876. *Cultivated Plants.* F. W. Burbidge.
,, *The Tree Lifter.* Colonel Greenwood.
1877. *Handbook of Hardy Trees and Shrubs, etc.* W. B. Helmsley.
1879. *Tree Planting.* Arthur Roland.
1880. *English Trees and Tree Planting.* W. H. Ablett.
1881. *Manual of the Coniferæ.* James Veitch & Sons.
,, *Manual of Injurious Insects.* Miss E. A. Ormerod.
1882. *Elements of Sylviculture.* George Bagneris.
,, *The Larch.* Christopher Y. Michie.
1883. *Woods and Forests of Perthshire.* Thomas Hunter.
1884. *Modern Forest Economy*, and other works on Forestry. Dr J. C. Brown.
1885. *Forestry and Forest Products*: Report of 1884 Forestry Exhibition at Edinburgh.
1889. *Manual of Forestry*, vol. i.: Introduction to Forestry. Prof. Wm. Schlich.
,, *Timber and Some of its Diseases.* Prof. Marshall Ward.
,, *Familiar Trees.* Prof. George S. Boulger.
1890. *Timbers and how to Know Them.* Prof. Wm. Somerville.
1891. *Manual of Forestry*, vol. ii.: Practical Sylviculture. Prof. Wm. Schlich.
1892. *Coniferæ*: Report of 1891 Conifer Conference, at Chiswick, London. Royal Horticultural Society.
,, *Timber and Timber Trees.* Thos. Laslett and Prof. Marshall Ward.
1893. *Flowering Trees and Shrubs* and *Practical Forestry.* A. D. Webster.
,, *British Forest Trees.* Dr John Nisbet.
1894. *Studies in Forestry.* Dr John Nisbet.
,, *Diseases of Trees.* Prof. Wm. Somerville.

1894. *The Forester.* James Brown and Dr John Nisbet.
1895. *Manual of Forestry,* vol. iii.: "Forest Management." Prof. Wm. Schlich.
„ *Manual of Forestry,* vol. iv.: "Forest Protection." Prof. Schlich and W. R. Fisher.
1896. *Manual of Forestry,* vol. v.: "Forest Utilisation." Prof. Schlich and W. R. Fisher.
1897. *Yews of Great Britain and Ireland.* Dr John Lowe.

The above list is not exhaustive of the treatises on Forestry subjects which have appeared in the Queen's reign, but it includes the most useful and important, and is sufficient to show that our Forestry literature has made great progress in the period. The completion of Dr Schlich's standard work, *Manual of Forestry,* about a year ago, as appropriately marks the close, as Loudon's great work, *Arboretum et Fruticetum Britannicum,* marked the opening of the Queen's "Diamond" reign.

We can only refer in a few words to that invaluable section of Forestry literature comprising the *Transactions* issued by this Society, "A Forester's Library" in themselves; and many other valuable papers in the *Transactions* of the Edinburgh Botanical Society, the Highland and Agricultural Society, and others of the learned societies. A vast amount of the science and practice of forestry is to be found faithfully recorded in these and similar publications of the Victorian era.

Forestry Education.

The education of British foresters in the science and art of their profession is entirely a creation of the past sixty years. Indeed, it may be truly said that no attention was given to the question until 1854, when the Scottish Arboricultural Society was instituted by a small band of intelligent and far-seeing foresters, who were anxious and determined, so far as lay in their power, to raise the status of their profession, and place Scottish forestry on a sounder basis as an important section of rural industry. How far their views may be ultimately carried out time alone can tell; but all through its existence the Society has kept Forestry education prominently before it, and employed every means at its command to press it forward. A great impulse was given to the question in 1884, when the International

Forestry Exhibition was held at Edinburgh. The contributions to that great exhibition from all parts of the civilised world clearly showed to the public mind how deeply interested were the leading foreign countries, India, and even the smallest of our colonies, in maintaining their forests in a high state of productiveness, and how thoroughly educated and trained in systematic Forestry were the men whom they entrusted with the management of forests, and the utilisation of their products.

A series of lectures on Forestry subjects, delivered by experts, was one of the educational features of the Exhibition, and the stimulus that was given thereby to the public interest in the question, led to the promulgation of several schemes for the education and training of foresters. The chief among those schemes was the creation of a Chair of Forestry in the University of Edinburgh, and a considerable sum of money was raised for that special purpose, but it still remains unaccomplished. After much delay, and no small amount of effort by this Society and others interested in the question, a Lectureship of Forestry was established in Edinburgh University in the autumn of 1889. Dr William Somerville being appointed lecturer, he delivered the first course of one hundred lectures to a considerable body of students during the session 1889-90. On Dr Somerville being appointed Professor of Agriculture and Forestry at the Durham College of Science, Newcastle-on-Tyne, he was succeeded in the Forestry Lectureship in Edinburgh University by Colonel F. Bailey, R.E., who has since carried on the class with much success. Forestry education also forms one of the important branches of rural economy taught in the Royal Botanic Garden at Edinburgh, under the direction of Professor I. Bayley Balfour. In the curriculum of most of the universities in this country Forestry now finds a place; and it is taught in a more or less systematic form at all of the leading centres of education. Still it is felt that this country does not yet afford the complete training to foresters which prevails in all the principal states of continental Europe, and until that is accomplished by the establishment of a fully equipped forest school, with a proper forest area attached to it for practical work and scientific experiment, foresters cannot rest satisfied with the provisions made to qualify them for filling important positions in their profession, however grateful they may feel at the substantial advance made during the Queen's reign.

Forestry Appliances.

Here the march of improvements in tools, implements, and other Forestry appliances, is perhaps more marked than in any other division of our subject. Even in the shape and quality of the commonest articles—the spade, pick, axe, and saw—a great improvement has taken place, and the number of new and better implements and appliances for performing the various operations in Forestry, are seen everywhere in daily use. Hand-tools generally are light, clean, and well made of the best materials, and specially adapted for every class of work. The implements and appliances used for horse-power are far in advance of those employed two generations ago, and improvements in their design and construction are regularly appearing.

It is, however, in the domain of mechanical power, and contrivances for saving manual and animal labour, that we find the greatest advance on pre-Victorian times. The general employment of steam as a motive power has been coeval with Her Majesty's reign, and it has worked quite a revolution in all branches of Forestry by the cheap and powerful help it supplies. Steam is now the motive power of traction engines that can haul the heaviest load, with the greatest ease, which our roads can carry. It is applied to the heavy work of felling, hauling, and sawing of timber; the driving of machinery of every description for the manufacture of timber, and for its transport by railway on land and by steamship at sea. It is also usefully employed in clearing land of surface stones and tree roots, and reclaiming the soil for tree-planting. It cuts out canals and roads, and breaks stones to macadamise the latter. As a portable motive power it still stands unrivalled; although it is hard to tell what electricity may do in the future, when it is better developed, to supersede steam. At present it is too costly and unmanageable to enter into serious competition with steam as a motive power. As a stationary motor, water is the cheapest of all, and might be with great advantage more often employed where steam is used. A good head of water and a turbine wheel develop great power at little cost for upkeep. The employment of the water in our rivers for floating timber from far inland districts to seaports has almost become one of the lost arts since the use of steam became general in this country. It might easily be reorganised and improved, to the advantage of all concerned.

Forest Produce.

After all the trouble and cost of raising forests of timber trees for commercial purposes, the labour of the forester will be in vain, unless the produce is of first-rate quality, and put into the market in its best condition. Straight, clean timber, sound and free from knot and blemish of every kind, thoroughly ripe or matured, well seasoned after being felled, and cut into dimensions most suitable for the market, is the material that will return the best profit to the owner of the forest. A considerable advance has taken place in this branch of Forestry during the long reign of the Queen, but there is still much room left for improvements being effected on many of the details in the course of the twentieth century. The various species of trees that are most in demand for timber, and which thrive best on given soils, aspects, and altitudes; the most profitable ages and sizes at which to fell the trees and dispose of their timber; the economic utilisation of the bye-products, and particularly of the small wood, which is now generally allowed to go to waste, are a few of the points that will pay for more careful thought and closer attention.

Conclusion.

In conclusion, it appears to me that when we have passed in review all the conditions under which the forester pursued his calling in the year 1837, and contrasted them with those which prevail among us in this year of grace 1897, all will agree that, although much needful improvement has still to be effected, an immense amount of progress has been made in Forestry in Scotland during the sixty years in which Her Most Gracious Majesty Queen Victoria has reigned over these realms.

X. *Experiments with Tree Seeds.* By WILLIAM SOMERVILLE, D.Œc., D.Sc., F.R.S.E., F.L.S., Professor of Agriculture and Forestry, Durham College of Science, Newcastle-on-Tyne.

In the spring and autumn of 1893, and in the spring of 1894, I took the opportunity of arranging a number of experiments with tree seeds. Some of these experiments have been quite successful, and have given interesting and useful results, while others have failed for various reasons, but chiefly owing to the unusually severe frost of the 20th and 21st of May 1894, which killed such large numbers of the young seedlings of certain species (*e.g.*, Spanish Chestnut, Sycamore, Norway Maple) as to make it undesirable to record the results in this paper. The experiments with Birch and Alder were also a failure, owing to the unsatisfactory way in which the seeds germinated; and as I have since had occasion to be dissatisfied with the results of birch-seeding—which has also given trouble to other propagators—it would be useful to the Society if some member gave an account of a method of dealing with this seed that has proved successful.

How deep may Spruce Seeds be covered?

During the second week of May 1893, nine plots or beds were laid down in duplicate, and were at once sowed with the seed of the Norway spruce. Each plot measured $3\frac{1}{2}$ square feet, and received $1\frac{1}{4}$ ounce of seed. By means of a suitable series of wooden frames, the seed was buried exactly to the depth indicated, the soil used for the purpose being a fairly strong loam. In the spring of 1894 the plants were lifted and counted, with the following result:—

Plots.	Depth of Covering of Seed.	Number of Trees produced.		
		"A" Series.	"B" Series.	Total.
	Inches.			
1	0	14	11	25
2	$\frac{1}{4}$	558	434	992
3	$\frac{1}{2}$	308	325	633
4	$\frac{3}{4}$	78	166	244
5	1	50	95	145
6	$1\frac{1}{4}$	26	33	59
7	$1\frac{1}{2}$	1	4	5
8	$1\frac{3}{4}$	0	0	0
9	2	0	0	0

It will be seen that both series of plots give consistently the same results. The largest number of plants was got when the seed was covered with soil to the depth of only $\frac{1}{4}$ inch. When the covering was increased by another $\frac{1}{4}$ inch, a large proportion of the plants never succeeded in struggling through the soil at all, the total number being reduced from 992 to 633. Further additions to the depth of the covering were accompanied by a steady reduction in the number of plants, until, when the seeds were buried to the depth of $1\frac{3}{4}$ inch, no plants whatever appeared above the surface.

While these results indicate how careful one should be in regard to the depth of covering of spruce seeds (and no doubt the results might also be applied to other tree seeds *of similar size*), they also show how extremely necessary it is to have the seeds actually covered, and not left lying exposed upon the surface of the ground. Where this method of sowing was practised, I obtained a total of only twenty-five plants, and this notwithstanding the fact that the seeds were thoroughly secured by a net against the attack of birds.

How deep may Acorns be buried?

In the spring of 1894 seven rows in duplicate were each stocked with fifty acorns of uniform size, which were buried at depths varying from $\frac{1}{2}$ to 6 inches. A year later the plants were counted, with the following results:—

Plots.	Depth of Covering.	Number of Plants produced.		
		"A" Series.	"B" Series.	Total.
	Inches.			
1	$\frac{1}{2}$	25	11	36
2	1	32	31	63
3	2	42	28	70
4	3	27	26	53
5	4	32	25	57
6	5	18	14	32
7	6	15	13	28

In this case the best results were got with a covering of 2 inches, a depth which gave seventy plants per one hundred seeds.[1]

[1] The term "seed" is here, and elsewhere in the paper, used in the popular sense.

Drilling *versus* Broadcasting small Tree Seeds.

A series of beds were stocked with the seed of the spruce, which, in certain cases, was sowed in rows, and, in other cases, broadcast. The testing of these two systems of seed-distribution was expected to prove interesting, the one (drilling) being almost universally practised on the Continent, while the other (broadcasting) is the common system in this country.

The figures which our experiment furnished cannot be regarded as reliable, the disturbing cause in this case being surface caterpillars, which are the larvæ of various species of Noctuidæ, such as the Heart and Dart and Great Yellow Underwing Moths. In the autumn succeeding the spring in which the seed had been sowed, we began to notice that the stems of many of the young spruces were bitten through, the upper part of the plant being found lying on the ground or suspended by a thread of bark. At first we suspected that the damage was due to mice; but on turning up the soil to the depth of a couple of inches, we found that the depredators were brown or slaty coloured fleshy caterpillars, about $1\frac{1}{2}$ to 2 inches in length, and furnished with eight pairs of feet. These so-called surface caterpillars are almost omnivorous in their tastes—so far as a vegetable diet is concerned—and are well known to gardeners as attacking turnips, lettuce, cabbages, cress, and a variety of other plants. During the day they lie coiled up and concealed in the soil or underneath clods, stones, etc., while at night they crawl to the surface and feed upon the stems and lower foliage of plants. Although they ruined our experiment, they were the means of demonstrating one advantage of having seedlings in rows, for, where the young trees were growing in this way, it was a simple matter to turn over the soil between the rows and destroy the pests, whereas nothing could be done where the seed had been broadcast. Sixty-six caterpillars were thus collected on the 33 square yards of drilled seed-bed, the removal of these pests being doubtless the reason why the drilled beds produced 1150 plants, as against 516 on the beds that had been broadcast.

How should Acorns be Laid in the Ground.

This experiment, and those that follow, were started in the autumn of 1893, and the results were determined in the spring of 1897, when the plants were three years old.

Six hundred average-sized acorns were selected, and divided into 6 lots of 100 each, the average weight per 100 being 11 oz. Three duplicate rows were sowed with 100 acorns each, which, in one case, were placed with the thin end lowest, in another case the thin end was highest, while in the third case the acorns were laid flat. As the stem and root both come from the thin end of

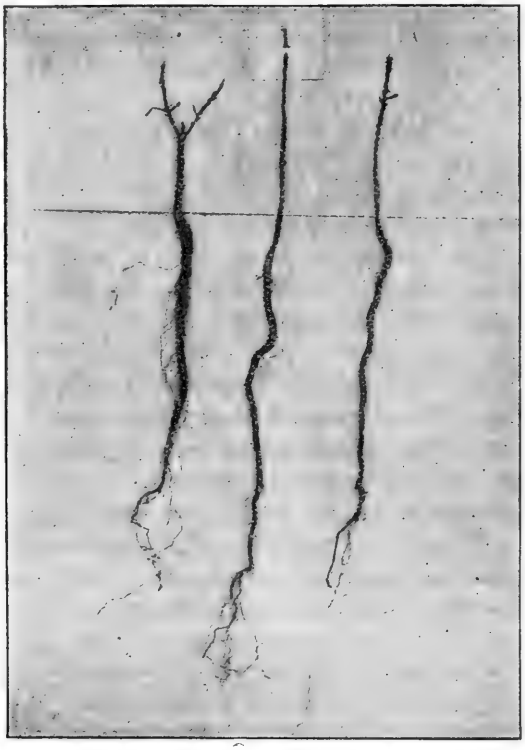

FIG. 1.—Plants produced by Acorns that had been placed with their thin end lowest.

the acorn, it follows that where this end is lowest the root will at once get freely down into the soil, but the stem will have to curve round and get past the fruit; where the thin end is highest the stem will get freely up, but the root will have some difficulty in getting down; and where the acorn is laid flat, both root and stem will have equal opportunity of pursuing their natural path. The accompanying illustrations show that, even after three years'

growth, the effect on the plant of the original position of the seed is still conspicuous. In Fig. 1, which shows three typical plants produced by acorns placed with the thin end lowest, the stem and root are in a straight line, so that no curve is noticeable at the base of the former as a result of its having to find its way round the fruit. In Fig. 2, which shows plants that originated

Fig. 2.—Plants produced by Acorns that had been placed with their thick end lowest.

in acorns placed with the thin end uppermost, a distinct twist is apparent at the junction of the root and stem, the former having had to bend itself round in order to get down. Where the acorns were laid flat there is also a slight twist upon many of the resulting plants (Fig. 3), though this is not so pronounced as in Fig. 2.

When three years old, the whole of the plants were lifted, great care being taken to get the roots out fairly entire. The length of

the stem and root of each plant was determined, while each lot was weighed after washing and drying. The results are shown in

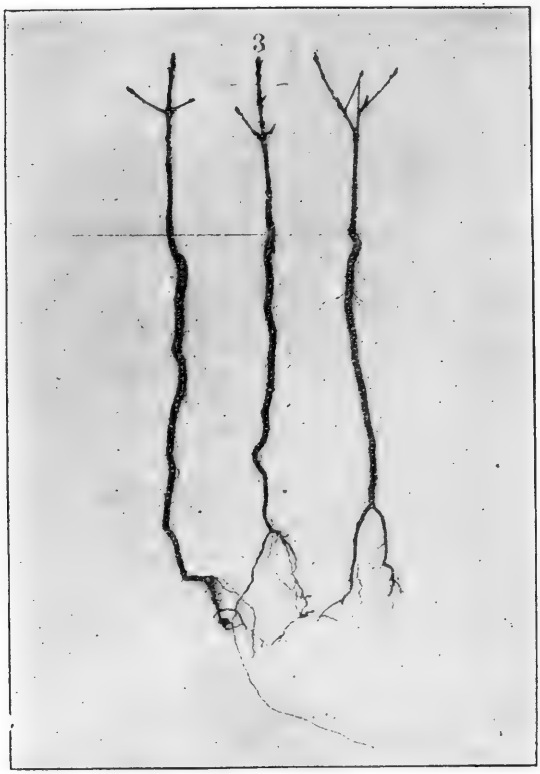

FIG. 3.—Plants produced by Acorns that had been laid flat.

the accompanying Table, which gives the average figures for the duplicate plots :—

Plots.	Position of the Acorns.	Average No. of Plants Produced.	Average Height of Stem.	Average Length of Root.	Weight per 100 Plants.
			Inches.	Inches.	lb. oz.
1	Thin end lowest, .	90	5·8	20·1	2 14
2	Thick ,, .	91	6·0	19·2	2 12
3	Laid flat, . .	93	6·0	19·8	2 12

Judged by the tests indicated in the Table, the plants produced by the three systems of depositing the acorns closely agree with each other in every respect. The number of plants obtained per 100 acorns varies only between 90 and 93; the average length of stem does not vary more than 0·2 inch; while the root-length and weight also show close agreement. Evidently, therefore, it is only in the matter of straightness of stem that the position of the acorn in the ground can exert any influence, and although the twist on the stem (Fig. 2) has had no appreciable influence on the height or weight of the plant, it cannot be regarded as a desirable feature, and might possibly prejudicially affect the value of the timber in the mature tree. One would therefore appear to be justified in concluding that acorns should not be planted with their thick end lowest; while, as regards the other two systems, there is practically nothing to choose except on the score of convenience, when the preference would be given to laying acorns on their side, as, in fact, is usually done in actual practice.

What Influence has the Size of the Seed on the Vigour of the Plant?

This experiment was carried out with acorns which were in all cases laid flat. Four duplicate lots of one hundred acorns were selected, which gave the following weights per hundred:—

Plot 4. Large acorns, ... 14 oz.
Plot 3. Medium acorns, ... 11 ,,
Plot 5. Small acorns, ... $6\frac{1}{2}$,,
Plot 6. Very small acorns, . . . 5 ,,

These were sowed early in November 1893, and, when the plants were lifted at three years of age, the following results were got:—

	Number of Plants.		Average Height of Stem.		Average Length of Root.		Average Weight per 100 Plants.			
	A.	B.	A.	B.	A.	B.	A.		B.	
			Ins.	Ins.	Ins.	Ins.	lb.	oz.	lb.	oz.
Large acorns, . .	98	109	6·5	8·1	18·8	21·6	2	12	3	15
Medium acorns, .	87	99	4·8	7·3	18·2	21·5	2	3	3	4
Small acorns, . .	89	90	4·0	6·2	16·1	17·7	1	14	2	1
Very small acorns, .	84	75	3·6	5·5	15·8	18·5	1	10	1	11

It will be seen that in each of the four tests applied, the results come out in favour of the large seed. In the first place, it is interesting to note that in one case the hundred large acorns have produced 109 three-year-old plants, which shows that a very considerable proportion of large acorns contain more than one seed. As a matter of fact, the ovary of the oak contains six ovules, and the fruit is therefore potentially capable of containing six seeds, but, as a rule, only one of the ovules develops into a seed, though, as the above figures show, the case where an acorn holds two seeds is not so rare as is usually supposed. At the lowest computation, 9 per cent. of the "B." series of large acorns have been double-seeded; but as it is fair to assume, firstly, that all the acorns did not germinate, and, secondly, that some of the plants succumbed to various influences during the three years of growth, the actual percentage of double-seeded acorns is no doubt even larger than the figures indicate.

The size of the acorns has apparently affected the length of stem more than the length of root, though this may be more apparent than real, owing to the difficulty of getting long roots out of the ground entire.

Four average plants produced by the four sizes of acorns are represented in Fig. 4, which shows the gradual reduction in vigour of the plants as a consequence of the reduced size of the seed.

Although it is unquestionable that a much larger number of plants will be got by sowing, say, a stone of small seed than by using a similar weight of large seed, it is more than likely that the large seed will prove the more profitable in the end. Although this experiment furnishes no definite information regarding the final results at the end of fifty or one hundred years, it is extremely probable that, under similar conditions of soil, exposure, etc., the plants that were strongest at three years of age will provide the largest and most valuable timber trees. It would appear, however, to be more necessary to be careful in the selection of large seed, and therefore of vigorous plants, for the stocking of a mixed than of a pure wood. Suppose that, in the former case, young oaks are introduced at intervals of 20 feet or so, with the object of leaving them to form the final crop after the nurses, or thinnings, have been removed. In this case it is the manifest intention of the forester that every oak which he plants shall stand till the end of the rotation, and if—as

is likely — the vigour of the original seedling materially influences the vigour of the resultant tree, the careful selection of the seed, as regards size, becomes a matter of the very highest importance.

For a pure wood, selection of seed is of less importance, so long as the seed employed contains a fair proportion of large individuals.

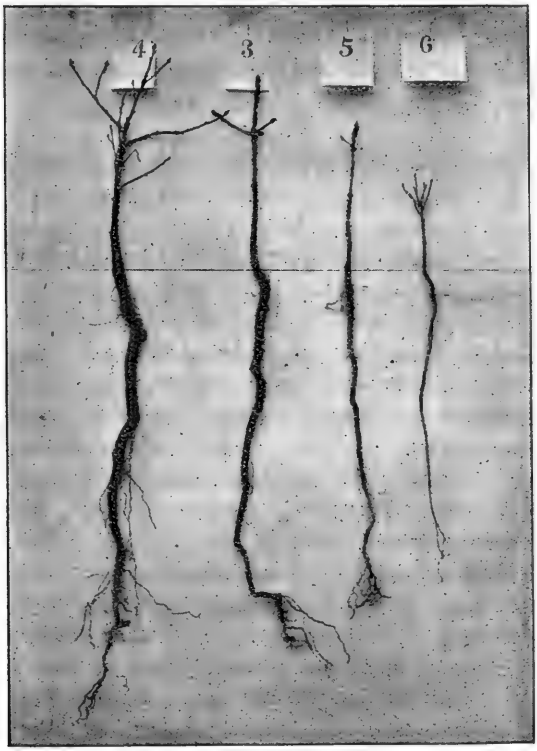

Fig. 4.—Plants produced by large, medium, small, and very small Acorns, in the order given.

When a wood is stocked with seedlings all of the same species and of similar age, though varying somewhat as regards size and vigour, competition for air, light, and growing space generally, will at once begin, with the result that in a few years the vigorous plants will be spreading their crowns more or less above the level of their neighbours, while the weaker ones will be partially over-

grown and suppressed. The latter will from time to time be removed in the thinnings, and although these will be valuable in proportion to the size of the stems that furnish them, the effect upon the financial returns as a whole will be less than if the volume of the final felling were also seriously reduced. Of course, if the whole of the seed used to furnish the plants for a pure wood is of small size, the loss will be quite as great as, in fact rather greater than in the case of the mixed wood; but if the seed is a mixture of small and large individuals, natural differentiation, aided by artificial thinning, will secure the largest stems—that is, the produce of the largest seed—for the final crop.

In a year when nearly every oak is bearing a crop of acorns, one finds that the size of the fruit varies much on different trees. If the tendency to bear large fruit is in any sense hereditary, and if small fruit means slow-growing trees, it follows that in a natural forest the trees that reach maturity and bear seed—that is, that propagate the species—must chiefly belong to the large-fruited varieties. In the course of time one may therefore expect to find an increase in the average size of the fruit or seed of any species of tree, but where the duration of the generation is to be reckoned in hundreds of years—as, for instance, in the case of the oak grown in natural forests—the inquiry becomes one that is almost palæo-botanical in its character, and possibly may never have been undertaken.

When young trees are being sent out from the nursery, it is a common practice to retain those that are of small size, so that the further growth of two or three years may make them of a more attractive size. Suppose, for instance, that 70 per cent. of all the plants in a bed of five-year-old oaks are 3 feet high, and are sent out, while the 30 per cent. which are less than 3 feet in height are transplanted into a fresh plant-bed and retained. Let it be further supposed that it is not till they are seven years old that the plants originally rejected reach an average height of 3 feet. The question then comes to be—Are young trees of varying age, but of the same size, all alike suitable for planting, or, in other words, are one thousand of the above-indicated seven-year-old oaks as valuable as the same number of the younger age? For my own part I doubt if they are, and, further, I think it is probable that if such slow-developing individuals are alone depended on to represent any particular species in a wood,

whether pure or mixed, they may occasion very serious loss to the owner. The danger, in fact, lies in the selection or classification that has been made in the nursery, sensible though it would at first sight appear to be. Had all been planted out at the age of five, whatever the size, the small individuals would soon — at least in pure woods — have been suppressed and removed, but the final yield would not have been affected, seeing that it would have consisted of the originally more vigorous trees. But where one plants nothing but naturally feeble plants — even though these, through being older, may be of normal planting size — one has not the opportunity of selecting naturally strong individuals at the periodic thinnings, so that both the intermediate and final returns may be seriously reduced.

It is perhaps worth pointing out that in a seed-bed of ordinary density the plants that lag behind in development do so because the seeds from which they sprang were of less than average size, and not because, with an equal chance to start with, they have happened to get the worst of the crowding. No doubt, when a feeble plant finds itself amongst vigorous neighbours it tends to become relatively still more feeble, but that crowding in itself is not the primary cause of debility in certain individuals is evident from the results of the experiment just cited. The acorns were in all cases placed exactly the same distance apart, so that each plant had an equal amount of growing-space. But as small plants require less growing-space than large ones, it follows that the conditions of growth for the small plants of Plot 6 were relatively more favourable than for the larger ones of Plots 5, 3, or 4, and yet, in spite of such advantage, the small-sized plants have done but little, if anything, to overtake the plants which originated in the larger seed.

An experiment with seeds of three degrees of size was also carried out in duplicate in the case of the horse chestnut, and furnished results similar to those obtained with acorns. In this case the weights for fifty of the seeds were :—

Large chestnuts,	. . .	2 lbs.	8 oz.
Medium chestnuts,	. . .	1 ,,	12 ,,
Small chestnuts,	. . .	1 ,,	4 ,,

The results were as follows :—

	Number of Plants.		Average Height of Stem.		Average Length of Root.		Average Weight per 100 Plants.			
	A.	B.	A.	B.	A.	B.	A.		B.	
			Ins.	Ins.	Ins.	Ins.	lb.	oz.	lb.	oz.
Large chestnuts, .	38	38	16·6	9·1	21·2	28·0	20	6	12	0
Medium chestnuts,	34	41	14·3	8·0	23·6	28·1	21	5	11	14
Small chestnuts, .	28	40	11·0	6·4	25·6	24·8	17	1	8	3

Although there is not absolute regularity in the results, the variations are not more than may be looked for in garden experiments. The most important test, namely, the stem-measurements, gives quite concordant results. It may be mentioned that variations between the "A." and "B." series of plots, here and elsewhere, are accounted for by the fact that the duplicate plots were always in a different part of the garden, and were consequently subjected to somewhat different conditions of growth.

May the Formation of a Tap-Root in young Oaks be prevented?

Foresters and nurserymen are well aware how troublesome in many ways is the long bare tap-root that is characteristic of seedling oaks, Spanish chestnuts, walnuts, etc. Such a root-system makes transplanting difficult and uncertain, and represents a form which is the exact opposite to what is wanted, namely, a dense fibrous mass of rootlets. By means of frequent shiftings and root-prunings in the nursery, the formation of the tap-root may be largely suppressed, and the production of lateral roots encouraged; but as such operations are costly, and frequently attended by a considerable death-rate, any simple form of treatment that will improve the root-formation must be of considerable practical value.

In the autumn of 1893 a few hundred average-sized acorns were spread out on a moist earthen floor, and covered by a damp sack. In three weeks a large proportion of the seeds had protruded their radicle or young tap-root to the distance of 2 or 3 inches, and, when this stage had been reached, 200 of such acorns were selected from the heap and divided into two duplicate sets of 100 each. By means of a knife, or pressure between the finger

and thumb, the radicle was removed or "pinched back" to within a quarter of an inch of the seed, after which the acorns were planted. At three years old the plants were lifted, when it was found that, instead of having a single large tap-root, most of them were provided with two, three, or more (up to six) smaller roots (Fig. 5), and although these were still but poorly furnished with

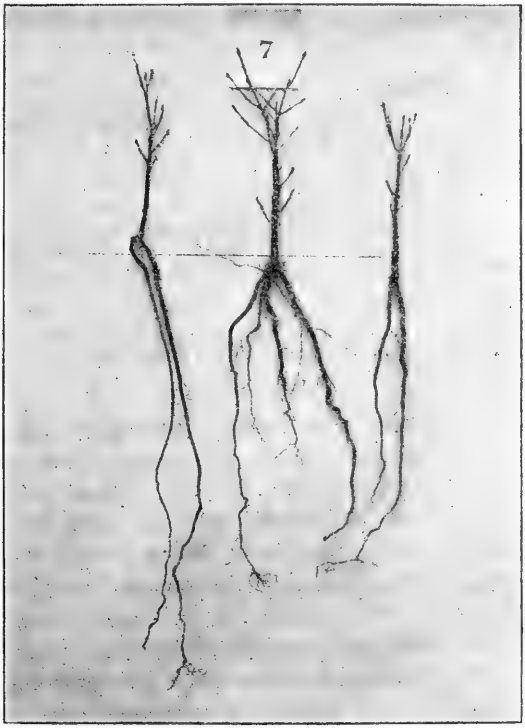

FIG. 5.—Plants produced from Acorns that had been allowed to germinate before sowing, and whose radicles had been pinched back.

lateral rootlets, and persisted in going straight down into the soil, they cannot but be regarded as an improvement on the typical form of oak-root as seen in Figs. 1–4.

As the accompanying Table shows, the treatment may possibly, in one set of experiments (the "B." series), have had a slightly prejudicial effect on the germination and on the height-growth, though in the other series no such effect is visible. The root-

measurements and the weight per hundred show considerable variation under the two systems, but as the root modifications are of the nature of an improvement, while the aggregate weight is largely influenced by the curtailment of the development of the massive tap-root, the figures in the respective columns cannot be said to tell against the system. The following figures deal with the results of using acorns of approximately the same size, which were in every way treated alike, except as regards the shortening of the radicle.

	Number of Plants.		Average Height of Stem.		Average Length of Root.		Average Weight per 100 Plants.			
	A.	B.	A. Ins.	B. Ins.	A. Ins.	B. Ins.	A. lb.	A. oz.	B. lb.	B. oz.
Radicle not shortened,	87	99	4·8	7·3	18·2	21·5	2	3	3	4
Radicle shortened, .	87	81	4·8	6·5	17·5	14·1	1	15	2	9

Can Ash Seed be induced to Germinate in the First Year?

The seed of the ash is one which, when sown in spring, lies dormant for a year. It is therefore generally "stratified," that is, buried in the soil in a layer or stratum, or mixed with soil in a heap, or treated in some similar way, and finally sowed in the seed-bed after the lapse of a year. But it is evident that this delay of a year in the germination of ash seed must in all cases be undesirable, and various methods of treatment of the seed have been tried with the object of stimulating germination in the first year. Some considerable measure of success is said to have attended certain of these methods, two of which were put to the test in the College garden. In one case the seed was steeped in spring for an hour in water, at a temperature of about 120° Fahr., while in the other case it was stored in damp sand throughout the winter and sown in spring. It may be mentioned that another lot of untreated seed was sowed on November 3rd, while a further supply was stored dry during winter, and sowed in spring. The result was that in no case did a single plant appear in the year succeeding that in which the seed ripened, so that this experiment furnished only negative results.

Some propagators are said to have succeeded in obtaining a large proportion of plants in the first year, by pulling the ash

seed before it has quite lost its green colour, and sowing it at once. This period will usually be reached about the end of October, and we have this year arranged an experiment to test the point, but with what success remains to be seen.

I have recorded the results of these simple experiments, not so much for the information that they convey, as in the hope that they may encourage some of the younger members of the Society to take up similar work. There are many simple problems of a forestal character, whose solution only requires the careful avoidance of disturbing factors of growth, scrupulous accuracy in all weighings, measurements, and record-keeping, and a little patience, but which are yet capable of adding considerable interest to the routine of a forester's occupation, and of furnishing results of no small practical importance.

XI. *Report by the Judges on Essays on "The Best Form of, and the Best Method of Establishing, an Experimental Forest Area in Scotland, for the Exhibition of and for Instruction —Theoretical and Practical—in Scientific Forestry."*

Four essays were received in competition for the prizes offered in this subject. This number may appear to be small when the unusual value of the prize is taken into account; but, although the subject appeals to all, it is not one that many foresters may feel competent to deal with, so that the number of competitors need not cause any disappointment.

In judging the essays, we have been careful to keep certain points steadily in view. In the first place, we have considered that no scheme, however attractive, could be regarded as valuable unless it appeared to be capable of practical application. We have also looked out for originality of conception in the drafting of the scheme, as manifestly the movement would not be materially advanced by a mere restatement of previous arguments and suggestions. It has appeared to us desirable that, in estimating the cost of acquiring an area of land for the object in view, reference should as far as possible be made to concrete cases, and this, we are glad to say, has been done by one of the essayists. With these remarks we shall proceed to state our opinion of the essays individually.

No. 1, by "Novice."

After dwelling on the necessity of attempting to stem the tide of rural depopulation, and on the desirability of providing a training-ground for young foresters, the writer advocates the suggestion that a limited liability company should be formed to acquire at least 2000 acres of suitable land, with convenient buildings, at a cost of from £20,000 to £30,000. He looks to the landlords to subscribe the most of the capital, and suggests that an appeal for subscriptions should be made through this Society, as well as by personal canvass. The writer does not submit either estimates or evidence, and we do not recommend his essay for a prize.

No. 2, by "South Esk."

This essayist is strongly of opinion that forestry can be demonstrated to pay much better than is frequently believed, and his main object in acquiring an area of land for sylviculture would be to show how this can be done. He considers that the Government should provide the funds, but appears to have but scant hope of assistance from this quarter. He has also a good deal to say in favour of a joint-stock scheme, but doubts if the money can be raised in this way. Having but little faith in these two proposals, he suggests that a landlord who contemplates planting on a considerable scale in the near future should be asked to allow the work to be done under the direction of a committee of this Society. He indicates the belief that such a landlord exists within a few miles of Edinburgh; and expresses the opinion that most landlords would be glad to allow the whole or a part of their sylvicultural operations to be managed by the committee, in consideration of the valuable scientific knowledge that would thus be gratuitously placed at the service of their estate. The area of land proposed to be dealt with is 1000 acres, which would be stocked at the rate of some 40 acres per annum, involving an aggregate expenditure of £5800, which, of course, would be borne by the landlord.

It appears to us that, so far as it goes, the idea is worth considering, though not as a substitute for the class of forest or forests that the Society has in view. This scheme altogether lacks several qualifications—such as continuity of tenure and freedom of action—which are absolutely essential to the success of any scheme with which this Society should identify itself. But, as providing some means of offering extended educational facilities to the young men in attendance at forestry classes in Edinburgh, it would be a distinct gain to have an area of private woodland in the neighbourhood of the city worked upon a definite system, where improved processes of stocking, mixing, thinning, cropping, and utilising could be demonstrated. Such a woodland, being possibly more accessible to this important educational centre than the other forest areas in contemplation, would be a valuable supplement, and need in no way interfere with the larger scheme. Though containing this idea, the essay does not otherwise reach the standard that we have set up, and we do not therefore recommend it for a prize.

No. 3, BY "NIL DESPERANDUM."

The reasons that this writer adduces for the necessity of establishing a model forest area and a forestry school are :—

(1) The presence in this country of wide areas of comparatively unproductive land that could be made to return a much improved nett revenue if placed under a system of rational sylviculture.

(2) The rapid growth of our requirements for structural timber.

(3) The rapid diminution in the extent of virgin forests abroad.

(4) The necessity of a proper training-ground for young foresters.

After some pertinent remarks on the duty of the State in providing facilities for forestry education and the development of commercial forestry, the writer proceeds to show that an area of land suitable for the objects in view may be obtained by lease, by feu, or by purchase. If the land were obtained on lease, a tenancy of one hundred and twenty years, with a mutual break at eighty years, and periodically thereafter, is suggested. An interesting form of lease is given—probably the first of the kind that has ever been drafted in this country—which provides that the timber on the land which is leased shall either be paid for by the incoming tenant (in this case probably a limited liability company), or shall be managed by the tenant without restraint, and the nett proceeds of the sales handed over to the landlord. All forests created or buildings erected by the tenant are to be taken over by the landlord by valuation at the end of the lease, by which time, as the writer says, "a good deal will have happened, and a good deal of knowledge gained." In our opinion there are many insuperable objections to the leasing of land or woodlands for experiments, demonstrations, or education in forestry. The temporary acquisition of land in this way would probably mean its abandonment at a time when the woods had been got into a state of the highest value from an educational point of view, and this prospect alone is much too serious to make the leasing plan feasible.

Although the writer dismisses the system of feuing land at, say, 1s. 6d. per acre per annum, without a word of commendation, it seems to us that the proposal is quite as worthy of attention as that

of leasing; although as, in our opinion, neither mode of acquisition is satisfactory, we need not further pursue this part of the subject.

In discussing the question of the purchase of an estate for the purposes of forestry, the writer points out that the area may or may not possess woods and buildings to start with. In the event of an area of purely pastoral or waste land being obtained, at a price of 36s. to 40s. per acre, plans are given for a suitable set of buildings in the Scottish style of architecture, at an estimated cost of £3000. In our opinion these plans should have included a biological laboratory and a forestry museum, though otherwise they would appear to be well adapted for the requirements of a school of about twelve pupils.

The essayist gives the preference—and in this we agree with him—to an estate containing a considerable proportion of woodland, and possessing buildings that could, if necessary, be adapted at a small cost to the needs of a forest school. He points out that many suitable estates can be purchased for £3 or less per acre, and appends a list of several that are at present in the market. He more particularly recommends that an effort should be made to secure a property with which he is acquainted in the north of Scotland, comprising some 20,000 acres, of which 3240 acres consist of thriving woodland, which he values at £32,000. Of the rest, 2800 acres are tillage, and the remainder mountain land, much of which is suitable for planting. The nett rental is a little over £3000, while the price asked is £85,000. Allowing £15,000 to make the place suitable for the object in view, the writer thinks that £100,000 would meet the requirements of the case, and fairly set the model forest area and school agoing.

The great difficulty with "Nil Desperandum," as with some others, has been the discovery of ways and means of raising the necessary funds, and this he proposes to do in one or other, or all, of the following ways:—

(1) By selling Government ground-rents in London, the said rents having been at one time purchased with money realised by the sale of Scottish Crown lands.

(2) By this Society making a universal appeal to Scotsmen, through the medium of lord-lieutenants, provosts, mayors, and other influential personages.

(3) By appealing, more particularly to the small subscriber, through the newspapers.

(4) By a yearly grant from Government.

He concludes by recommending that the institution should be placed under a department of the Government, and managed by a resident director and consultative committee, which would comprise, amongst others, the Council of this Society.

While this essay does not break fresh ground, nor really greatly advance the subject of the creation of model forests, it has a good deal to recommend it. It provides a set of plans of buildings for a forest school and other offices that it is to be hoped will be wanted some day, it contains the detailed description of five Scottish properties containing over 80,000 acres which may be purchased at about £3 per acre, and it offers some useful suggestions regarding the administration of the institution For these reasons we think that this essay should be published, and the writer rewarded with a prize of Five Guineas

No. 4, BY "MOON RAKER."

This writer starts with an interesting sketch of the history and present position of Scottish forestry. He recognises the beginning of organised attention to forestry in the introduction and extensive cultivation of the larch by a Duke of Athole about the middle of last century, and he proceeds to show, and with manifest reason, that the acclimatisation of this tree in Britain has been by no means an unmixed benefit. The larch, more than any other forest tree of importance, is intolerant of crowding and shading, and planters soon found that early and frequent thinnings were an absolutely essential condition of its successful growth. Probably, without giving much thought to the subject, foresters concluded that the sylvicultural treatment best adapted for the larch would also be equally suitable for other trees, with the result that our home-grown wood is a drug in the market, woodlands are unprofitable, and forestry generally is a somewhat discredited industry.

In endeavouring to place British forestry on a sounder basis, the essayist very wisely deprecates any drastic or sweeping reform to start with. While no one doubts that the so-called Continental system has reached an almost ideal state of perfection, it would be most unwise to clamour for the cut-and-dry importation of this system into Britain. Landowners have not to choose between this and that system, but have got to reckon with existing woods, mismanaged it may be in the past, and at present neither profit-

able nor satisfactory, but still woods that represent a large capital sum, and which financial, climatic, and æsthetic considerations alike demand shall not be suddenly improved out of existence.

The writer regards the purchase of an estate containing at least 1000 acres as the only feasible method of acquiring the necessary area, and, like "Nil Desperandum," he gives the preference to one containing a considerable area of woodland to start with. He submits the plan of what he regards as a suitable estate situated in Perthshire, but whether this estate is actually for sale or not is not stated. He also furnishes the plan of a set of buildings which, though somewhat restricted, are well arranged.

He regards the following as the main objects of the institution:—

(1) The demonstration of economic forestry.
(2) The instruction of practical foresters and estate agents in the scientific management of woods.
(3) Experiments and researches in connection with the principles underlying the practical operations of forestry.

To meet these requirements, the buildings would have to include a lecture-room, museum, library, reading-room, laboratory, and office, besides the necessary domestic accommodation. These, he believes, could be erected for £750; but even if galvanised iron were largely used, as he suggests, it is to be doubted if this sum would suffice.

His estimate of capital expenditure is as follows:—

Purchase of 1000 acres, . . .	£5,000	0	0
Outlay on buildings, fences, and nursery,	1,000	0	0
250 acres of growing timber, . .	10,000	0	0
Total, .	£16,000	0	0

His estimate of annual expenditure, neglecting theoretical instruction, and also disregarding any revenue from the estate, is as follows:—

Supervision, ...	£150	0	0
Labour and plants, ...	150	0	0
Rates and taxes, etc., ...	50	0	0
Total, .	£350	0	0

In our opinion the essayist has been too parochial in his estimates for the realisation of a scheme whose scope is distinctly

national; and although he remarks that we must mould our desires, not according to what we should like, but in accordance with what we are likely to get, still this consideration must not lead the Society into abandoning the reasonable ideal that it has already set up. It is in dealing with the question of finance that this essayist has given us least satisfaction. Not only is his scheme too contracted, but he would also resort to borrowing to raise the comparatively small sum that he regards as requisite. He suggests that the Government should lend the purchase price of the growing stock (£10,000), while the other £6000 required could be got by a voluntary assessment by Scottish landowners of 2d. per acre of woodlands, or otherwise by a popular appeal in the usual way.

This essay we consider to be superior to the last, though not of sufficient merit and originality to be worthy of the full amount of the first prize. We would therefore recommend that the writer receive a honorarium of Ten Guineas, and that the essay be published.

In concluding our Report, we cannot refrain from expressing a feeling of disappointment that the competition has failed to throw any fresh light on the important subject of practical demonstration and instruction in scientific sylviculture. It seems to us that the arguments used at the conference with Mr Long in October 1895 have not been improved upon; and it must be a disappointment to many to find that the country is still unprovided with the model forest area that is capable, as we believe, of benefiting our national sylviculture to an extent that is out of all proportion to the expenditure involved. It now remains with the Society to take what steps it deems desirable to secure the success of a practicable scheme, and if this means a fresh effort and more exertion, the ultimate attainment of the object in view will be a fitting reward.

R. C. Munro Ferguson.

William Somerville.

Edinburgh, 16*th August* 1897.

[Since this Report was presented, both Prize Essays have been condensed, that by Mr Mackenzie having also been somewhat modified. The Council have not thought it necessary to reproduce the Plans which accompanied the Papers.]

XII. *On Establishing an Experimental Forest Area in Scotland, for Instruction in the Theory and Practice of Scientific Forestry.* By ARTHUR C. FORBES, Wood Manager, Bowood, Wilts ("Moon Raker").

INTRODUCTION.

If we consider for a moment as to what period the present system of Scottish forestry owes its existence, we shall probably find that the introduction of the larch by the Duke of Athole, in or about the year 1738, gave the chief impetus to that planting of bare or heath-covered ground which has resulted in the present system of managing plantations in Scotland. Before that period Scotland appears to have been sparsely wooded, and with the more or less unsettled state of the country, planting was not carried on to any extent. But with the introduction of the larch, landowners saw a means of deriving a good return from poor land, and adding to the amenity of their property, by planting that tree, which not only proved the means of increasing the woodland area, but also of originating a system of sylviculture, which, while undoubtedly suited to the requirements of the larch, has been applied to every other species in Scottish plantations with questionable results.

Another feature of Scottish forestry may also be traced to the introduction of the larch to a great extent, viz., clear-felling without subsequent replanting. Rightly or not, the larch is regarded as a tree which ought never to follow on, or be planted on ground which has recently been cleared of a crop of the same species. As a result of this, ground cleared of larch is frequently left unplanted for many years, and sometimes abandoned as a woodland area altogether. These latter cases are partly due to the fact that the herbage under larch is comparatively good, and the grazing rent from a larch plantation frequently equals, if it does not exceed, that from adjoining hill pasture. After clearing off a crop of trees, therefore, the question arises whether this rent should be sacrificed, and the ground replanted with a less profitable species, or remain as rough pasture land. Irregular clearing and planting of this kind introduces several objectionable features into Scottish forestry. Amongst these may be mentioned the uncertainty which exists regarding the nett annual value of woods on an estate, and the impossibility of

knowing how much of the income is made up of capital, and how much of interest thereon in the shape of the realised value of the total annual growth. Another and perhaps even greater evil which accompanies this spasmodic felling and lack of organisation, is one which most Scottish planters know to their sorrow. After a considerable outlay in planting and management, it is no uncommon thing for owners of promising young plantations to find the latter wrecked by one of those periodic gales to which our islands are liable. Plantations standing on thin soils will always be exposed to this danger; but there is little doubt that a proper distribution of age classes in a large plantation would greatly diminish, and in many cases altogether prevent, the bad effects of these gales.

To remedy the state of matters complained of above, systematic management is absolutely necessary, and this can only be attained by the adoption of an organised policy or plan of operations, which shall exist so long as the woodland area of an estate remains as such. Systems of management which change with each forester or proprietor can never produce satisfactory results, for in such changes the aims of the planter are lost sight of by the thinner, and the final cutting is effected quite independently of the relation borne by that particular unit to the woodland area as a whole. There are doubtless many difficulties in the way of introducing a uniform system of working the woods on an estate which would be accepted by all parties. If we could fix the normal proportion of woodlands on an estate, and induce proprietors to maintain that proportion, the advantages of organisation would be at once apparent. But with the vast extent of waste or semi-waste land which exists on most estates, any obstacle in the way of afforestation would be undesirable; and when the wooded area constantly varies, the determination of a normal stock is impossible. Under such circumstances, the application of correct principles of forest organisation to estate forestry must always be attended with considerable difficulty, until the country has developed the various methods of economical land utilisation which have been adopted with such success in one or two parts of the Continent. All we can do at present is to render our systems of sylviculture as perfect as existing conditions will permit, and trust to time and the development of economic laws to gradually raise Scottish forestry to a higher level as a national industry.

As means to so desirable an end, steps which are now well known

to most have been taken within the last few years to disseminate correct theoretical information on economic forestry amongst the various classes connected with the management of landed estates. But in spite of these aids to improvement, it is felt by those who have paid much attention to the subject, that too wide a gap exists between the real and the ideal to enable the theories taught by these means to be applied to estate forestry without the creation of many necessary conditions which do not already exist. No opportunities exist at present for demonstrating in the actual forest what is taught in the class-room or text-book, except it be by such operations as are already practised in estate forestry; and many are apt to regard the theoretical instruction thus imparted as of little value in after life. Whether this be the case or not, however, there is little doubt that the advocates of economic forestry, as well as those who wish to qualify themselves for its practice, are at a great disadvantage in having no suitable ground on which the arguments advanced by the former can be put to the test, and where practical experience can be gained by the latter in the more advanced stages of forest management.

By devoting an area entirely to economic timber production, the true position of forestry as a profitable industry can alone be demonstrated, for when combined, as it invariably is, on estates with many conflicting objects in view, no evidence for or against it can be considered satisfactory. It is doubtful if the necessary conditions for the practice of economic forestry will ever be entirely fulfilled on private estates, and until they are, *estate* forestry, whether considered successful or the reverse, cannot be held up as an object-lesson on *economic* forestry. In spite of the public spirit and generosity which landowners as a class have always shown in promoting rural industries, we can hardly expect them to sacrifice their own immediate interests entirely in creating an ideal state of matters in their woods for public edification. If we want to see ideal forestry practised, we must go to an estate where timber-growing is the one and only form of land utilisation. Such estates only exist in the form of state or corporation forests, and in Scotland these are practically non-existent. But there is little doubt that their gradual creation is the only means by which Scottish forestry can be permanently improved; and as great undertakings have often small beginnings, it is the object of this paper to discuss, however imperfectly, what form that beginning should take.

The Best Form of an Experimental Forest Area.

In dealing with the question as to the best form an experimental area should take, it is necessary to keep the main objects to be attained steadily in view. Forest science, in the abstract, is so comprehensive a subject, that any attempt to embrace it within the compass of a necessarily limited scheme, would lead to no definite result being obtained for many years. By placing a judicious limit to our ambition at first, we are better able to inaugurate a scheme based on the principle of steady progression; and by building upon existing foundations, an element of security may be introduced which is not likely to fail us at a pinch. Our chief aim should be the improvement of the existing systems of forestry in Scotland, rather than the introduction of novel methods of managing woods which have little prospect of being generally adopted; and in discussing the subject, we may divide it into three parts, as follows :—

1. The demonstration of economic forestry to landowners, and the public generally.
2. The instruction of practical foresters and estate agents in the scientific management of woods.
3. Experiments and researches in connection with the principles underlying the practical operations of forestry.

1. *Demonstration of Economic Forestry.*

What is wanted in this direction is a practical demonstration of forestry, free from the defects mentioned in the introduction to this paper. As we saw, systematic organisation is the chief thing needed to transform the forestry of the present into a profitable branch of estate work. We must show landowners that the various assertions made regarding the benefits of scientific forestry are not the mere theories of text-books and lecture-rooms. We must prove beyond dispute that forestry is of greater value to an estate as a source of income than as a means of raising and sheltering game, or its artistic effect upon the landscape. In order to do this, we must make our forest area pay, for that will be probably the first point to which critics will draw attention. We must endeavour to show that much, if not all, personal loss could be avoided by strictly economic methods, which have in view the increase of the future value of woods. At the same time, little inducement can exist for

landed proprietors to improve the value of their estates in this respect, until the public generally realise that any such improvement is rather a public than a private gain, and that the afforestation of practically waste land, and the economical working of existing woodlands, affects favourably the wealth and well-being of the country generally. Until this fact is recognised more fully, and the public are willing to bear their share of the initial expense of what is essentially a national industry, woodland and estate proprietors have a reasonable excuse in declining to take up work of this kind. State forests not only find employment for a numerous class, but, as a source of profit, ultimately relieve the taxpayer's pocket, and their establishment in this country on an adequate scale is quite as much needed as is the case in France or Germany, where the recognition of the fact has been succeeded by good results. If we can prove, therefore, that forestry in Scotland can be made a profitable industry, the cause of State forestry will be materially strengthened, for without such proof, those in authority are hardly justified in going to much expense in the matter.

2. *The Instruction of Practical Foresters and Estate Agents in the Scientific Management of Woods.*

At the present time, more progress has been made in this matter than in the application of the principles taught to practical forestry. Any facilities, however, which have thus far been provided are of a purely theoretical character, which are, of course, insufficient in themselves to complete the training of a practical forester. The latter, however, who works his way up by taking a share in the manual labour of estate woods, is usually well posted up in the practical details of his calling, and the mere fact of the theoretical and practical parts of his training not being contemporaneous, would not in itself be a serious drawback. But, as already pointed out, the practice of forestry in Scotland is not always based on such sound principles as to constitute the forest department of every estate a suitable training-ground for a young man who aspires to a highly technical acquaintance with economic forestry.

In addition, the practical forester, and, to a much greater extent, the student of the forestry class in Edinburgh University, are at a great disadvantage in having no suitable training-ground in advanced forestry. Many of these students ultimately become land-agents, and in that capacity have considerable influence upon the system

of wood-management adopted on the estates under their charge. A sound acquaintance with the principles of scientific forestry is, therefore, of the first importance, for, acting in most cases as an intermediary between proprietor and forester, a sympathetic interest in the latter's work could remove many administrative obstacles over which the forester has no control. With theoretical acquaintance with forestry only, however, his interest in the subject is in danger of being lost, after the mental efforts necessary to pass, say, an examination have been relaxed. Frequent excursions to a properly managed forest during the course of theoretical instruction would undoubtedly leave an impression upon his mind not easily effaced, and this defect in the Edinburgh University forestry course would be almost entirely removed. It could also be used as an adjunct to the Botanic Garden course, by arranging for students attending the latter to put in a few months' work in the forest, and thus get acquainted with those features which are not general in estate plantations.

It might, however, be arranged to divide the course into two parts, one of which would include the more scientific subjects, and be taken in Edinburgh, while the other, including sylviculture, mensuration, etc., could be gone through in the forest itself, the students, at the same time, assisting in the working of the latter at a fixed rate of wage. Short courses in sylviculture, etc, could also be provided for young foresters unable to take the full course, and no doubt many proprietors would be willing to defray, or assist in defraying, the cost of such visits, for the benefit of their employés and the woods under their charge.

3. *Experiments and Researches in Connection with the Principles underlying the Practical Operations of Forestry.*

Special care and attention are necessary in laying out this branch of work, if time and money are to be strictly economised. Research and, in most cases, experiments are only indirectly remunerative, and much expense and labour may be incurred for years before definite results are obtained. For the first few years, therefore, we should confine ourselves to elucidating those points which have a strictly local bearing, or which have some definite relation to practical Scottish forestry. Amongst such may be named :—

Comparative rates of growth of indigenous and exotic forest trees under varied sylvicultural conditions.—While British

landowners have lost few opportunities of experimenting with exotic trees with regard to their hardiness and suitability for our climate, little has been done in testing their behaviour under strictly sylvicultural conditions. What has been done, however, enables us to predict with comparative accuracy what species are and are not likely to succeed in this capacity, and the problem remaining for such an area as ours to solve consists in demonstrating that system of sylviculture best suited to their habits and peculiarities. Not only exotics, however, but indigenous trees also require investigation into their rate of growth under different systems of thinning under varying conditions of growth. While the carefully drawn-up "yield tables" of German foresters are accessible, and to some extent available in this connection, climatic differences render it difficult to draw a safe comparison between Continental and Scottish plantations, and until we gain reliable data of our own in the matter, the vexed question of light or heavy thinnings cannot be satisfactorily settled. Then, again, the effect of a humus layer upon the fertility of plantation soils, and the necessary means to obtain that layer, should receive attention. Various sylvicultural mixtures suitable for different soils and situations are worthy of consideration, and, in short, any questions regarding the improvement of sylviculture generally should be taken up and answered, if possible.

With regard to species dealt with, much must depend upon the soils and situations of the area, but we should advise that the number be practically confined to those which have already proved, or are likely to prove, of special value in Scottish forestry. Any tendency to convert the area into a mere station for acclimatisation experiments should be checked, for, as already said, such stations practically exist on every estate in the country.

The raising of improved strains of forest trees by careful selection of seed from approved types.—Considering the great progress made in agriculture and horticulture in the way of improving upon wild forms of plant-life, there seems to be an opening in this direction with regard to forest trees. It is well known that individual trees of the same species vary greatly in their habit of growth, and in commencing or finishing their growth; but we believe that no definite observations have yet been made as to the extent to which these peculiarities are transmitted from the parent tree to the seedling. Yet it is obvious that a plantation in which the most desirable type of tree predominates

must be much more profitable to the owner than one in which the majority of the trees are of a bushy habit, or are liable to begin growth under the influence of short spells of warmth, as is often the case with larch. Carefully arranged observations might, therefore, do good service to practical forestry by clearing up this question. These are a few of the objects of research which, in our opinion, have a distinct bearing upon practical forestry, and which, at the same time, require no expensive process for their fulfilment. Many others of a similar nature could be named, but enough has been said to afford an idea of the general scope of research work suggested.

Principal Features of an Ideal Experimental Forest Area.

In considering the various features which a suitable area should possess, we shall assume that it is desired to attain the whole of the objects named above. The first thing we have to settle is

Geographical Position.

This must be partly decided by the extent to which the forest will be used in connection with existing educational institutions, actual and possible. Considered as an appendage to the forestry classes in Edinburgh, the nearer to the latter city the better. But we take it that it is more desirable to first of all establish a forest area which shall combine the several functions already enumerated, and this being so, the needs of purely academic institutions cannot alone be considered, but also those of the majority of practical foresters, estate owners, etc., who would regard the area as a convenient object-lesson and source of information.

As a necessary condition for its position, we should consider as indispensable a sufficiently inland locality, out of the reach or influence of strong sea-breezes, which have an injurious effect upon many trees. Latitude is of less importance than elevation; but, considered as a national experimental area, the more it approached the central districts of Scotland the better, both in respect to the convenience of all concerned, and the collection of data for reliable yield tables. It need scarcely be said that proximity to a railway station is of great importance, for if situated in a remote and almost inaccessible district, its value would be greatly decreased.

Physical Features.

These should be as nearly typical of the class of land specially adapted for afforestation as possible. The chief physical features of Scotland consist of low hill ranges, rising in the Grampians and southern Highlands to the dignity of mountains. With the low-lying tracts of fertile land forestry has little to do, but enormous scope exists for its development on the hill-sides and elevated land which possess little value for agricultural purposes. There are large tracts, however, which, owing to elevation, or the absence or character of the surface-soil, are quite unfitted for growing a profitable crop of timber, and no useful purpose would be served by experimenting with such land. The planting enterprise of Scottish proprietors in the past has placed us in the position of knowing pretty accurately the conditions necessary for the successful growth of a plantation in Scotland. With this knowledge before us, we may describe land favourable for profitable afforestation as that forming the sides of hills at moderate elevations, and possessing a healthy surface-soil, or loose and porous subsoil of not less than 18 inches or 24 inches in depth. Whether the site selected should occupy the breast of a mountain, or the entire area of one or more smaller hills or tracts of undulating ground, will probably be decided by force of circumstances. The former would probably be most favourable in many respects. On a mountain side the conditions of growth are usually more uniform than where the ground rises and falls alternately, and where the aspect or exposure is continually changing. The removal of timber from a slope having a steady fall in one direction is more easily effected than from ground broken up by hills and valleys, and this has some influence upon the value of the timber when felled. On the other hand, varied localities allow a greater variety of species to be used, and on an experimental area this may be an advantage, providing it does not interfere with the regular succession of age classes and systematic working of the forest. For Scots pine and larch, good natural drainage is a desirable feature, and the presence of running streamlets and brooks usually indicates a healthy soil

Soil.

This is usually divided into subsoil and surface-soil. On the class of land we are dealing with, what lies on the surface closely approaches, in composition and texture, the subsoil of more fertile

tracts of land, although, where covered with grass or heather, a thin skin of turf or peat may be present. Generally speaking, however, the stratum in which the roots have to collect plant-food is a bed of more or less disintegrated rock, varying in depth and texture with the rock from which it has been formed. The harder the rock, the thinner we usually find this penetrable layer to be, while on soft rock, which easily breaks up by chemical and mechanical agencies, fresh portions of the solid rock are more easily detached, and become part of the subsoil. This difference in the character of rocks is of considerable importance in growing timber trees. The length of time which trees take to mature, and the persistent and far-reaching character of their root-systems, enable them to thrive where smaller and shorter-lived plants could scarcely subsist. While, therefore, the geological formation on which a soil rests may be practically without importance, it determines, in a great measure, the rate at which the transformation of rock into soil proceeds. As is well known, unprotected soils resting on sloping ground are often washed away by heavy rain at a faster rate than the weathering process of the rock beneath goes on. A thin soil, on easily weathered rock, is consequently of more value for timber-growing than the same depth of soil on a hard and imperishable foundation, because the presence of the trees not only prevents or retards denudation by rain, but also assists in the weathering process, through their roots penetrating cracks and fissures, and there acting both mechanically and chemically on the upper and loose strata.

By far the greater part of the semi-waste land which calls for afforestation rests on metamorphic rocks composed of gneiss and mica-schist, both comparatively slow-weathering rocks. The latter of these, however, being of a more slaty texture, is frequently loose and crumbly, and a large proportion of this land is well adapted for the growth of coniferous timber, the valleys being frequently suitable for agricultural purposes. While we do not consider it absolutely necessary that the geological character of the area should be minutely defined, it would nevertheless be an advantage to have it on land answering in every particular to the description roughly given above. As it is principally the Highlands of Scotland which most need development, we should be affording a practical test of their suitability for afforestation by placing our forest upon the same class of soil as that formed from the rocks peculiar to the Highlands, although this, as all other matters, may be affected by circumstances.

The soil of the selected area should, in any case, be of such a nature as to allow a normal rate of growth to be made by the species represented on it. For Scots pine, larch, Douglas fir, and most conifers, a porous gravel is suitable, the first-named being less fond of moisture than the other two. As these trees are really of most economic importance in Scotland, at least two-thirds of the soil should be adapted to their growth, while, if possible, the remainder should be of a better nature, so as to accommodate oak, beech, ash, etc. Very thin soils, or those containing iron-pan, should be avoided as much as possible, while peat-bog is also ill-adapted for the purpose in view, as we already know that cases of profitable forestry are not found upon soils of this class.

Elevation and Exposure.

As a general rule, the greater the elevation the thinner the soil. If the conditions as to the latter are observed, therefore, there is little danger of too great an elevation being reached for *profitable* timber growth, which usually has its upper limit at 1200 or 1500 feet above sea-level in Scotland, according to species and exposure. On a southern aspect, trees ascend to greater heights than on northern exposures; but in a climate like that of Scotland, with an excess of cloud and moisture, a sunny aspect undoubtedly produces better ripened wood, and ultimately better timber, than one on which the direct rays of the sun rarely fall. On undulating ground exposures vary, of course, but on a limited area the ground usually has a tendency to slope one way or the other, and we should pronounce in favour of a southern, south-western, or south-eastern aspect—preferably the first or last, as a south-western slope has always to bear the brunt of prevailing winds and gales. With a southerly exposure, the growth of oak and beech would be possible at a higher elevation, and the productive power of the area increased generally.

Size of Area.

Financial considerations compel us to limit the size of our area to the smallest dimensions compatible with the objects in view. Organised working, on the assumption of a perpetual yield being one of our guiding principles, too small an area would allow too little play in regard to fellings and revisions of working plans,

while the costs of supervision and maintenance would be proportionately higher on a small than on a large area. Taking everything into consideration, a compact area of 1000 acres would be quite small enough to accommodate the number of species and systems of sylviculture necessary to give a fairly complete picture of scientific forestry on an economic scale. A larger area than this, on the other hand, would increase the initial cost and working expenses of the undertaking, possibly without a commensurately higher yield or income, while large areas are not favourable to intensive forestry, which is always most economical on enclosed land.

Condition of Ground when Acquired.

We have already referred to the class of land in question as heath-covered, chiefly because it is from such land that the lowest agricultural returns are usually obtained. But we have also to consider whether the area should be in its original rough and unimproved condition, or whether it should be partially or entirely stocked with timber. If our area were simply intended for the benefit of a coming generation alone, and had no function to perform during the next thirty or forty years, it would doubtless be cheaper and simpler to acquire a tract of waste land, and plant it as time, opportunity, or expediency allowed. But in such a case the land would be of very little value as a means of instruction to the present generation of estate owners or foresters. The introduction of a desirable system requires some recognition of existing woodlands, for we cannot draw an arbitrary line between the plantations of the future and those of the present, and apply one principle of management to the former and another to the latter. Just as the inspection of a model farm is often of little assistance to a tenant farmer whose surroundings are totally different, so an estate proprietor probably regards scientific forestry as entirely out of place on his own estate, and we may pardon him if he fails to see at first sight how the ideal state of matters he reads of in text-books can be brought into touch with the state of his own woodlands, without revolutionary changes being made for which he is little disposed. If this scheme is to be of real service to the present generation, therefore, we must demonstrate the practicability of transforming existing plantations, with all their weak points, into an organised forest area, and to do this effectually we must start work under conditions similar to those prevailing on most estates which possess

woodland areas already. In many other respects the absence of woods at the outset would detract from the educational value of the area for a considerable time, for it is obvious that the majority of sylvicultural operations cannot be practised until the plantations have reached a mature age. For these reasons we should strongly recommend the acquisition of an area a certain proportion of which is already under wood, and in a fit condition for demonstrative purposes. The exact age and composition of the woodland must be decided by circumstances, but at least one-fourth of the total area should be stocked, and preferably with timber between middle age and maturity, for reasons which will appear later on. All bridges, fences, and buildings of any kind which would add to the cost value of the estate, without being likely to prove of subsequent utility, would be undesirable features. The area should possess as many natural boundaries as possible, so that the cost of fencing may be reduced as much as possible; and it would also be an advantage to have it detached from land used for grazing cattle, as expensive fencing would not then be required. The land should be as compact as possible, without running out into narrow arms or projections, which would add to the boundary line without increasing the area to a proportionate extent. It is hardly likely that an area which fulfils all the above conditions will be readily obtained, although there ought to be no great difficulty in finding one which agrees in its most essential points with the one thus outlined.

Equipment of the Area.

Regarded as an institution for practical and theoretical instruction in forestry, the area could not be considered complete unless provided with some accommodation for the delivery of short courses of lectures, a library and reading-room, museum, etc., while a forester's house and other offices would also be necessary. The formation of a nursery would be an indispensable undertaking; together with seed-kilns, store-houses, etc., all of which are necessary if forestry is to be taught in all its branches. Fences, gates, drains, etc., we may take for granted, but as their presence would be determined by circumstances, we need not specify them in detail.

The lecture-rooms, etc., might be erected cheaply with timber and corrugated iron roofing, and match-boarded inside. If so constructed, they would be comparatively inexpensive, and would possess the advantage of being capable of easy replacement at a

future date by a more imposing structure, should circumstances render it desirable. The house and outbuildings should be substantially put up, and the best materials used in their construction, as, whatever development the area may undergo in course of time, they would still be serviceable without great alteration.

For the nursery itself we may allow an area of about an acre, being sufficient to provide plants for the extent of ground likely to be planted annually. It may also be desirable to erect a few frames or a small green-house, for the purpose of raising tender seedlings, or for carrying on simple experiments in plant growth.

Suitable System of Management during first few Years.

Although no definite system of management can be laid down which would be of any use in dealing with a concrete case, yet we may briefly discuss a policy of administration which would fall into line with the various conditions already assumed to exist on the suggested type of area.

In preparing a working plan for such an area, a careful examination of soil, situation, etc., should be made, in order that the various parts, which closely resemble one another in these respects, may be allotted to their respective working classes.

In a normal condition of stocking, these working classes would each contain a complete series of age classes, and the problem which presents itself is how best to bring the area into its normal condition without undue delay on the one hand, or incurring financial loss on the other. By paying too much attention to existing conditions, and the maturity or immaturity of the original stock of timber, the normal condition may not be attained in several rotations. On the other hand, to ignore the existing stock of timber and its condition, by keeping the ideal too closely in view, an unreasonable loss may be experienced by allowing timber to get over-ripe in one case, or cutting it when immature in another.

The aim of the forest organiser is usually directed towards giving the annual fellings a direction contrary to that of the prevailing winds, which in Britain usually blow from the south-west. Felling and replanting should therefore commence at the east side of the stocked area, and proceed steadily westward; but as we may have to modify our method of working to suit existing conditions, it will probably be better to stock all bare ground as soon as possible, and in such a way that the stock of timber during the second rotation may be

practically normal. In practical forestry, an uninterrupted gradation of age classes in a continuous line does not exist; soil situation and conformation of ground rendering absolute regularity an impossible feature. We need not concern ourselves greatly, therefore, as to the precise order in which the various bare portions of ground are planted up, as by planting 40 acres or so of these parts annually, the whole of the ground may be completely stocked in about fifteen years. If we allow for re-planting and under-planting 10 acres of cleared and thinned ground, we have a total of 50 acres to plant annually.

With regard to felling, much must be regulated by the age of the standing timber; but to complete the idea so far kept in mind, let us assume that the average age is about forty years, and that a certain proportion is already ripe enough to cut, we may allow for the clear-felling of 5 acres annually, at which rate the whole of the original stock would be cleared off in fifty years. But in order to make the most of this stock, a system of selection felling might also be introduced throughout the whole of the standing wood, and all ripe, sickly, and dead trees taken out at regular intervals. It might also be advisable to clear small patches or clumps where such trees predominate, and re-plant with quickly maturing species, which may be again cut over with the surrounding wood at the proper time. In the same way thinly stocked ground could be under-planted on the same principle, and by such means we could increase the yield during the first temporary rotation, without complicating matters for the second or normal rotation later on.

Until more than half the ground has been planted, it may be possible to let the bare ground for grazing purposes until required, as this would prove a source of income at a time when most needed.

The above method is one which we consider applicable to most estate plantations, and, therefore, likely to suit those with which we may have to deal.

The Best Means of Establishing a Forest Area.

In dealing with this part of the question, we may assume that the typical area we have described is the one to be acquired, as we shall thus be in a position to treat our various points in a more definite manner.

We may treat this part under three heads, as follows:—

1. The best means of acquiring the land and administration of the area.
2. The amount required to carry out the scheme.
3. The best means of raising that amount.

1. *The Best Means of Acquiring the Land, etc.*

Two methods present themselves as feasible in this direction—direct purchase, and taking it on lease for a long period. The latter method, however, in view of the nature of the undertaking, appears to us unsuitable, and need not be further discussed. The only satisfactory method would be direct purchase of the area by the proper authority responsible for its acquisition. This authority, in our opinion, ought to consist of trustees of the sum subscribed from various sources in aid of the project, and who would be appointed by the public bodies under whose auspices it would be developed. Amongst such we may assume that the Royal Scottish Arboricultural Society and the Highland and Agricultural Society of Scotland would occupy prominent positions, while the general public would be represented by the Board of Agriculture. In addition to these trustees, the bodies above named should appoint a committee entrusted with the duty of finding and selecting a suitable area, and which should consist of experts or authorities on forestry and forestry education. With regard to the *modus operandi* adopted by such a committee, we should suggest that a circular should be issued by them to the land-owning members of the above-named societies, setting forth as clearly as possible the kind of area required, and inviting the owners of such areas to enter into communication with them with a view to sale.

When the area has been finally selected and acquired, the same committee should be reappointed to arrange for its being worked in accordance with adopted principles. This committee should constitute a board of management, before whom all administrative matters in connection with the technical and financial working of the forest area should come, and who should issue a report yearly or half-yearly, showing what progress has been made in the organisation of the area, and the state of its finances.

The above committee should be composed, as much as possible, of *ex officio* members representing the educational institutions in

which forestry is a subject of instruction, and its appointment should hold good for as long a period as possible, so as to give a definite policy and continuity of method to the working of the area. A committee of three, with power to add to their number, would be quite sufficient if unanimity is to be secured.

2. *The Amount required to Carry out the Scheme.*

The chief points requiring consideration here are the purchase of the area and growing stock, and the outlay on the working expenses of the forest.

The purchase of the area requires an amount which is more easily reckoned if we separate it entirely from fixtures and growing stock, so that nothing but the unimproved value of the land remains to be accounted for. The annual value of such land as that which has been described varies from 1s. 6d. to 5s. per acre, according to the character of the pasturage, proximity to a town or farm-house, etc. From the situation specified for our area, we ought to allow for not less than an annual value of 3s. per acre, and we must also take into account the fact that a selected area of comparatively small extent would be valued rather higher than a large tract taken over entire.

If a part of the ground were sufficiently good for the growth of hardwoods, the value of this would probably be greater than 3s. per acre, but it ought not to exceed 5s., if belonging to the class of land we are keeping in mind. The total cost of 1000 acres, at twenty-five years' purchase, of the above annual values, would be—

Allowing 800 acres at 75s. per acre, . .	£3000
200 „ 125s. „ . .	1250
	£4250

The cost of the growing stock will probably prove the most formidable item to be dealt with, but the actual sum required depends, of course, upon the age of the plantations and their density. The cost of standing wood, of an average age of forty years, bought at its market value, would vary with situation, species, and rate of growth, and would also be affected by the previous treatment of the plantations. But assuming that the plantations are stocked with Scots pine, and are of normal density, and that the sylvicultural locality corresponds to that of

Class III. in the pine forests of North Germany, we are able to take Schwappach's yield tables as the basis of our valuation. According to these tables, the value of one acre of Scots pine, of the age and on the locality above named, is £35, which is probably quite up to the average value of either pure Scots pine woods or a mixture of Scots pine and larch at that age in Scotland. At this rate 250 acres would represent a value of £8750, or in round numbers, and allowing for cost of transfer, etc., £10,000.

It is evident that this estimate can only be regarded as an approximate one, as the probability of finding an area stocked exactly as is here assumed is but remote.

The outlay on the area, after purchase, would be occasioned by the erection of the buildings, etc., already referred to, fencing, formation of nursery, etc. The buildings, if erected as suggested, would probably involve an outlay of £750 or thereabouts, according to situation, nature of ground, etc.

The cost of fencing would depend upon those already existing and their condition, but we may reasonably allow for about two miles, which, at 1s. per yard, or £90 per mile, would amount in round numbers to £200, which ought also to provide for gates. Roads, bridges, etc., beyond those already existing, would probably be unnecessary for the first few years.

The laying out of the nursery would involve trenching, levelling, making of walks, and fencing, and would require an initial outlay of at least £50.

The annual working expenses for the first ten years would be chiefly incurred in supervision, planting, and rates and taxes, the cost of felling and thinning being deducted from the sales of timber and poles. The cost of supervision would be practically included in the forester's salary, and out-of-pocket expenses of the board of management. A competent forester could not be obtained under £100 per annum, with house, fuel, etc., and this would hardly be sufficient to secure a man versed in the higher branches of practical forestry. A total expenditure of £150 per annum ought, however, to cover all costs of supervision likely to be incurred during the first ten years, or until the area has been placed in proper working order.

For planting, say, 50 acres annually, we should allow at the average rate of £2 per acre, which would include both planting bare ground and under-planting thinly stocked parts of the wooded portion. The cost for the first year or two would

probably exceed this rate, as the plants would have to be purchased until they could be raised in the home nursery, but after that it should not exceed the sum named. In addition to the actual cost of planting, some expense would be incurred in maintenance and repairs, but if things are in fair condition at the outset, however, charges under this head should not exceed £50 per annum during the first decade, but would, of course, be greater as the area of young woods increased.

Summarising the various items of expenditure above mentioned, we have as follows :—

CAPITAL EXPENDITURE.

1. Purchase of area—						
800 acres at 75s.	=	£3000	0	0		
200 ,, ,, 125s.	=	1250	0	0		
Expenses of purchase,		750	0	0		
					£5,000	0 0
2. Outlay on buildings, . . .					750	0 0
3. Fencing, ...					200	0 0
4. Formation of nursery, . . .					50	0 0
					£6,000	0 0

ANNUAL EXPENDITURE.[1]

1. Supervision, ...	£150	0 0
2. Labour and plants, . . .	150	0 0
3. Rates, taxes, and sundries, . .	50	0 0
	£350	0 0
Growing stock, ...	10,000	0 0
Total, . .	£16,350	0 0

3. *The Best Means of Raising the required Sum.*

In suggesting any scheme by which the sum named may be obtained, we must consider the various quarters from which sympathy with the object in view is most likely to be forth-

[1] No allowance is made for annual expenditure on theoretical instruction, as this should be covered by fees and grants.

coming. As possible subscribers to the scheme, we have—(1) the Government and public bodies; and (2) private individuals.

In discussing the probability of Government aid, we have only the experience of educational institutions of a similar nature to guide us.

As the special grant annually voted towards education of this kind is in Scotland distributed through the Scottish Office, it is to that department of the Government we must look for whatever assistance we are likely to obtain in that direction. The Office has at its disposal annually a sum for assisting work of this kind, and a small portion of it is already given towards assisting forestry education at Edinburgh University, and in the Botanic Garden.

Moreover, thanks to the enterprise of the Royal Scottish Arboricultural Society, the Board of Agriculture has already been sounded on this particular matter, through a deputation to its President, organised by the Society in 1895. From the reply then given to the representations made, we are in the position of knowing the views of the Department on this question, and, as will be recollected, its President declared himself in sympathy with the wishes of the Society as regards the establishment of experimental areas in Scotland, providing the expenditure incurred did not prove a serious obstacle in the way of their acquisition. To what extent the Government would be willing to aid us was not, however, clearly indicated. But if we may take the promise made with regard to the proposed endowment of a Chair of Forestry as any criterion by which the extent of possible aid may be gauged, we may look forward to the Government meeting us half-way, by granting one-half of the estimated cost, provided the other half is subscribed locally. Of course, the most simple and satisfactory way would be for Government to acquire the necessary land by purchase, and hand it over to the proper authorities to be worked as a State forest, the proceeds from which would be paid into the Imperial Exchequer, less cost of working. But it may be possible for Government to first render us more valuable assistance, at less expense to itself, in another direction, for we can hardly expect a large pecuniary grant being made to a hitherto novel and untried scheme.

As we saw in our estimate of expenditure, the largest item is that incurred in the proposed purchase of the growing stock. No doubt this sum alone could be easily raised by effecting a mortgage

on the timber and land combined, but it is probable that the rate of interest borne by the mortgage would be higher than the area could conveniently pay without over-taxing its resources.

The security offered in the shape of a crop of growing timber would probably be assessed much below its real value, and it is hardly likely that we should obtain an advance through ordinary channels at a lower rate than five per cent., and this would be much higher than we could expect the growing stock to produce as interest on its capital value for a long-sustained period. By raising the sum required on such terms, we should be incurring an annual debt for probably many years at least, and possibly encumbering the area with a perpetual burden. But if we were able to obtain the necessary advance at a rate of interest not exceeding 3 per cent., we ought, with good management, to be able to meet our liabilities for the time being, and gradually pay back the amount borrowed. If, therefore, Government would lend us the purchase-money of the growing stock at 3 per cent. interest, with an additional 1 per cent. as a sinking fund bearing interest at $2\frac{1}{2}$ per cent., our greatest difficulty would be removed, and in fifty years' time the loan would be paid off. While such a means of assistance would be both of great service to the area itself, and certainly no loss to the Treasury, it would not altogether bar the way towards further Government aid if we were fortunate enough to get it. A sum of about £6000 on capital expenditure would still have to be raised, and a good deal of time and energy would have to be expended before we could get such an amount together unaided by Government. No doubt we might expect valuable assistance from such public bodies as the Highland and Agricultural Society, but, in our opinion, too much reliance need not be placed upon assistance from these latter bodies in the initial stages of the undertaking, although we may possibly get something in the way of annual grants after a time. In any case, we ought to succeed in raising £3000 from Government and public bodies combined if the scheme is promoted in a national and unprejudiced spirit.

The reception likely to be accorded the project by private subscribers will probably depend in a great measure upon their direct or indirect interest in it. The best and surest way of enlisting public sympathy would be by having all, or nearly all, preliminary matters arranged before we make any serious appeal to the public purse, so that those who are asked to subscribe may be assured

that something definite is within reach of being accomplished before all interest in the scheme has died out. It is quite possible that subscriptions might be more readily obtained from private subscribers by inviting them to make up the sum required for the growing stock on the terms suggested for the consideration of the Government; but it appears to us that the introduction of a feature of this kind into the scheme might deter Government and public bodies from assisting us with a due amount of freedom. Our best and safest course seems rather to appeal to the generosity of those who wish to see forestry promoted in Scotland on a sound basis. If every Scottish estate-owner contributed at the rate of 2d. per acre of woodland in his possession, no less than £7000 would be raised, which would entirely cover the cost of land and buildings on the estimated basis. The mere fact of this alone ought to convince landowners that the efficient education of their foresters could be provided for at no great cost to themselves. Moreover, a sum universally subscribed to by Scottish landowners would be the best means of convincing Government that the scheme was being supported by those most interested in the matter. Without reckoning on universal support from this quarter, however, we think that all classes connected with landed estates should contribute the greater part of the necessary sum to be raised from private individuals, if only to prove that a desire for such an experimental area was general.

Providing for Annual Expenditure.

Until the income from the timber produced equals the cost of maintenance, a reserve fund would be necessary to meet the annual charges. These amount in all to about £800 a year, half of which is made up of interest on £10,000 at 4 per cent. Now, the growing stock for which the latter amount has been raised practically constitutes such a reserve, and if part of this stock is already ripe, we should at once be able to realise it for the purpose in question. Let us assume that we are able to cut five fully-stocked acres annually, which contain on an average 5000 feet of mature timber, valued at 4d. per foot. This would bring us in £400 per annum for a period of fifty years, at the end of which our loan would be paid back, supposing the age of the timber to be so graded as to enable this to be done. But as in actual practice this would be very improbable, we should endeavour to realise this growing

stock to the best advantage, independent of any definite annual amount, and allow so much annually to assist in meeting the necessary expenditure, and keeping any surplus back for a reserve fund to meet past or future deficiencies. From thinnings and partial clearings another £200 might be obtained, which would still leave us £200 to make up. The value of shooting and grazing rents might possibly amount to £100 of this, which would practically bring our annual income and expenditure within measurable distance. As a matter of fact, it is not probable that these two amounts would approach each other so closely, but there is nothing impossible about their doing so under the supposed circumstances. But we must also bear in mind that the capital value, and ultimately the annual yield, would tend to increase after the bare ground on the area became stocked, and a slight excess of expenditure over income may be expected for the first few years without great anxiety.

We have allowed nothing in our estimate of annual expenditure for interest on the capital value of the land and fixtures. If these items of expenditure were provided for in the manner suggested, no expenditure under this head would be necessary; but if we regard our scheme as an experiment in economic forestry, the accumulating value of this interest should be ultimately covered by the returns, although the latter cannot be expected to do this for many years. We have allowed nothing for depreciation of stock and fixtures, as we consider that the cost of planting bare ground should be considered as a set-off to this item, coming, as it should, under the head of capital expenditure, rather than working expenses.

In carrying out such a scheme on the lines indicated above, many modifications would doubtless have to be made to suit the circumstances of the case. Our chief endeavour has been to sketch out a project which, while worthy of the spirit in which it ought to be conceived, would, at the same time, reduce the cost to the lowest point consistent with the importance of the objects in view. Forestry is an industry which requires more time than any other in which to develop, and we cannot, therefore, expect that such an area, if established, would at once be brought into such a state of perfection as to satisfy every critic. But its chief value would consist, as already indicated, in its being a means of demonstrating the various ways in which Scottish forestry may

be improved upon without introducing violent changes, which estate proprietors would be little inclined to sanction on their estates. If an experimental area can accomplish this much, it will at least justify its existence, and, with a fair measure of success, ought to form the nucleus of a system of similar areas throughout Britain that would eventually bring British forestry nearer to the desired condition, if it did not reach as high a standard of perfection as that practised on scientific methods in other countries.

XIII. *On Establishing an Experimental Forest Area in Scotland, for Instruction in the Theory and Practice of Scientific Forestry.* By D. F. MACKENZIE, Factor, Mortonhall, Midlothian ("Nil Desperandum").

It is now generally admitted that the extension of our forest areas is of sufficient importance to warrant the establishment of "experimental areas for the exhibition of, and for instruction—theoretical and practical—in scientific forestry."

In a country like Scotland, with a large area of land producing less than 3s. per acre per annum, but highly suitable for the production of valuable timber under proper management, and with a very large and annually increasing consumption of timber, the available supplies of which from abroad are gradually diminishing, it is of the utmost importance that such an institution should be established without delay.

Our consumption of timber indicates that our necessities have increased by leaps and bounds, due, no doubt, to the constant increase of population and wealth. This necessitates a corresponding increase in our timber imports, as there is no corresponding increase in the extent of timbered land in the country. The reasons for this are, to a great extent, the prevalent idea that land under timber does not pay, and the fact that fairly large returns are got for the land for sporting purposes, the owners forgetting, or perhaps not knowing, that timber and certain kinds of game are compatible.

It is quite evident that the existing state of matters is lost sight of by the Government, or is not sufficiently appreciated by it. The large expenditure of capital required and sent out of the country at present for the purchase of timber, amounting, as it does, to over sixteen millions annually, is surely worth the expenditure of one-sixteenth of one year's outlay, so as to enable us to help ourselves.

As a nation, we have been fortunate in maintaining our commercial prominence; but it is the view of some who may be trusted to see a little way into the future of our supply of timber, that it is time for us to take a new departure, so as to be prepared for any altered conditions in our timber supplies from abroad which may and are likely to arise. In order that we may be so far prepared for such altered conditions, the question we have now to consider is, What steps are necessary to be taken? Clearly, in view of a great extension of our forest areas in the near future,

the first step is the establishment of proper machinery for the instruction of those interested in acquiring a knowledge of forestry, so as to provide for ourselves what is at present provided for us by others, and thus save a great sacrifice of capital, and consequent loss to the bread-winners of this country. It is certainly the duty of the State to provide facilities for the obtaining of such knowledge, because it is required in the interests of the whole community. This is not a question of personal or landed interests. It is one which affects statesmen, capitalists, tradesmen, producers, manufacturers, and private individuals alike. It is the duty of statesmen to economise the national resources, but, so far, a mine of wealth has been neglected in leaving our waste lands practically barren and unproductive. Under proper instruction, and with the means provided, a great and beneficial change could be effected.

Taking all circumstances into account—circumstances well known to the leaders in arboricultural and sylvicultural affairs—it is not an easy matter to define the best method of creating such an institution as is required for practical demonstration in all branches of forestry and kindred subjects; but it is quite easy to lay down an ideal or theoretical plan. What is required, however, is one, the details of which can be carried out in practice. The writer believes the following would go a long way to meet the requirements of the case.

In Scotland, with very little Crown land available, and such as there is unsuitable, land for such a purpose can best be had in the usual way, viz., by a simple commercial transaction between a willing seller and an equally willing buyer.

There are several ways in which land may thus be acquired for the purpose under review, viz.:—

1. The purchase of a property having an area of wooded land with the trees in a forward state, and a considerable further area suitable for the profitable growth of timber.
2. The purchase of an area of waste land, of a quality capable of producing timber.
3. The feuing of suitable land, with or without burdens, the feu-duty not to exceed 1s. 6d. per acre per annum.
4. The leasing of land and woodland, or of waste land only, to "farm." The lease to be for say one hundred and twenty years, with mutual breaks.

There can be little doubt that the first is the most desirable method, and, moreover, there would be no difficulty in finding a suitable property. There are several in the market at present offered at good value. The following example of those suitable properties is now being advertised for sale:—"A great sporting domain, with a magnificent castle. Extent of estate, 19,448 acres. Average bag, four seasons—1018 grouse, 4 red deer, 4 fallow deer, 19 roe deer, 872 pheasants, 365 partridges, 75 duck, 75 hares, 1769 rabbits, 26 snipe, 36 woodcock, 16 pigeons, 12 blackgame, and 6 various. Good salmon fishing in river. Excellent trout fishing in lochs. Rental over £3000, exclusive of castle and shootings. Large quantity of very valuable timber. Valued in 1890 by two experienced valuers at £115,000. Price, £85,000." This appears to be in every way a most suitable and desirable property, and in fact is known to be such by the writer. The writer knows the property well, and he values the woods at £32,000. These extend to 3240 acres, the greater portion consisting of Scots fir and larch; but there are to be found clumps and single specimens of most if not all of our forest trees, including exotics. There are excellent buildings upon the property, suitable for the purposes of such an institution. There are also over 2800 acres of good agricultural land, very suitable for carrying on experimental agriculture, if such should be added to the institution. The gross rental is £3651, the public burdens nearly £500, and the nett return £3151 or thereby. This yearly income would naturally decrease as the area put under timber increased, but quite sufficient would be left to maintain the establishment for a long time.

The property is beautifully situated in the north of Scotland, and is easy of access by rail and water.

It will be observed that the price asked is a moderate one, which, after deducting the value of the woods, amounts to 56s. per acre. A portion of the woods is "ripe" for cutting, and might be converted into money should a favourable opportunity present itself.

There are many other properties offered for sale besides the above, very suitable, and at a fair value, whether acquired for afforestation purposes by the State, timber growing companies, or syndicates. One or two are offered at a valuation of 3 per cent. on their present rental for a definite period. When the means are limited, this system of purchase might be tried. There

is no lack of land suitable in every respect for experimental forest areas, the only drawback at present is the want of means wherewith to purchase. The writer is convinced that the system here advocated would be successful if attempted boldly. The sum required is £100,000.

With regard to Method 2, land of this description can be had at from 36s. to 40s. per acre. At that price, however, the land is dear, and the method is less satisfactory than Method 1, even although the necessary buildings are left out of consideration, and they would cost a considerable sum. Assuming that Method 2 was decided upon, buildings would require to be erected and fitted up suitable for the proper management of the establishment. The plans submitted herewith show, hypothetically, what the writer considers the necessary buildings for such an establishment.

The sketches show the principal's, assistant forester's, coachman's, and carter's houses. The ground plan so far explains the position of those several houses. The "school" consists of lecture-room, class-room, chemical laboratory, and library. These plans can be extended indefinitely, by simply extending the area under buildings to the length required for any additional rooms, such as a forestry museum, etc. The following is merely an outline specification, as to enter into full details here is quite unnecessary. All that need be said is, that the rooms are to be heated by hot water, and to have ceilings of an average height of 12 feet. On the first floor there will be accommodation for twelve pupils, with an assistant's bedroom. The principal's house will consist of parlour and dining-room, with kitchen accommodation on the ground floor, and bedrooms, with bath, etc., on the first floor, with hot and cold water laid on.

The building to be of local stone rubble walling, with freestone rybats, sills, and lintels; all corners to be of hammer-dressed and pick-scappled stones to a rounded form, and all the walls externally to have one coat of cement plaster, and be afterwards rough cast with cement; wall-head line to have embrasures or battlemented finish—these stones to be of concrete, cast to forms. The roofs to be of Limmer asphalt upon the ceiling joisting, which will require to be kept a little stronger, and have tapered pieces nailed on top, and all covered with $\frac{7}{8}$-inch flooring, and afterwards laid with Limmer asphalt to the proper specification.

Regarding cost, if the materials can be got locally near the building, the work should be completed for a sum of £3000.

With regard to Method 3, it may be found suitable for some case under peculiar circumstances, but it has nothing more to recommend it, than that it would be better than a lease of land, or Method 4, which should not be adopted unless there is no chance of carrying out any of the others, from want of means or any other cause.

As has already been said, land suitable for the purpose in every way may at present be obtained without any difficulty, except that of finding the money wherewith to acquire it and to equip the establishment. Indeed, it is in the want of money that the whole difficulty lies, and the writer has now to suggest several ways of obtaining it.

1. The suggestion made by the President, Mr Munro Ferguson, that the Government having sold Crown lands in Scotland, and invested the proceeds in London ground-rents, etc., these should be sold, and suitable land purchased with the proceeds. This is an admirable suggestion for a legitimate disposal of the Scottish funds in question.

2. Failing the success of No. 1, another method is by an appeal to patriotic Scotsmen throughout the world by the Royal Scottish Arboricultural Society, through the Lord Mayor of London, and all Lord-Lieutenants of counties, Provosts, and Mayors, and also Her Majesty's representatives abroad; the appeal to be signed by the President of the Society and as many influential members of Parliament as may be pleased to attach their names thereto.

3. An appeal signed in the same way, and by the same gentlemen, made through the newspapers, on the penny subscription principle, and of course intimating that small subscriptions would be acceptable. Such a course would meet with general satisfaction, and, with the influence and patronage of the press and members of Parliament, the scheme would undoubtedly be a success.

4. By a yearly grant from Government through the Board of Agriculture. There is no doubt that the teaching which might be given by an institution, as is here contemplated, would prove to be on the lines of "Higher Education," while the Board of Agriculture might well and easily supply the means, if for no other reason than the fact that forestry is the "handmaid" of agriculture.

The writer feels certain that an appeal on one or all of the above lines would be certain of obtaining the money, more especi-

ally if the appeal was made in this, the most auspicious year of the reign of Her Majesty Queen Victoria. A more fitting monument for Scotland to commemorate her Diamond Jubilee could scarcely be conceived, and if the institution was to be established in Scotland, there is little doubt but that the Scottish people throughout the world would freely respond.

It should be made known to "the man in the street" that Her Majesty is a keen arboriculturalist, and a great lover of the sylvan beauties of Scotland and other countries; and it is just possible that Her Majesty might be graciously pleased to lend her name and influence in order to obtain the funds in the manner indicated.

The writer has given this subject of forestry teaching long and careful attention, and he has come to the conclusion that if an institution is to be thoroughly successful, agriculture must be added to it. Scotland, and especially the north of Scotland, would be greatly benefited by such an arrangement. A director capable of giving instruction in both branches could be assured a better salary.

Whether land be taken by purchase, feuing, or leasing, it should be in a situation and of a quality thoroughly adapted for experimental purposes in all the branches of sylviculture, and generally such as would lend itself readily to the practical teaching of Æsthetic, Descriptive, Economic, Historic, Legal, and Sanitary Forestry. Such facilities would readily attract others than those desirous of learning the art for a living. Such an institution, too, under proper direction, would be suitable for training students for the Indian Forest Service.

It might not be out of place to state shortly what, in the opinion of the writer, might be the constitution of the staff. If the funds for the purpose were supplied by Government, the institution might be under the Minister of Agriculture, Secretary for Scotland, or Board of Education, having a resident lecturer or director, who would be assisted by a committee of gentlemen having a thorough knowledge of forestry and kindred subjects, such as lecturers on forestry, etc., in the various universities in the kingdom; and the Council of the Royal Scottish Arboricultural Society. The committee should be purely consultative, and the resident director should be the convener. The director should be thoroughly conversant with the Continental methods, and with all branches of sylviculture, forestry, and arboriculture,

scientific and practical; and if agriculture be added, he should be well acquainted with that subject, and be capable of imparting his knowledge to others. The director should have at least one assistant capable of teaching and leading in the "out-door" demonstrations, and several others under him, such as a capable working forester, sawmiller, nurseryman, and a joiner. The director should have the full control of the establishment, including the teachers, for whom he should be held responsible, such responsibility to include the exercise of discipline, arrangements from time to time regarding the teaching, and the engaging and dismissal of the servants of the institution. He should also be responsible for all sales and purchases in connection with the establishment.

In conclusion, the writer is of opinion that the key of the scheme is the finding of the means wherewith to purchase land suitable for the purpose, and thinks that, failing the Government taking the matter up heartily in either of the ways indicated, steps should be immediately taken to obtain the funds from the public, either through the agency of the press or the county and municipal authorities throughout the country, or through all combined. If such steps are taken, the success of the scheme is assured.

REPORTS BY THE HONORARY SCIENTISTS.

1. *Report on the Meteorology of Scotland for the Year ending September* 1897. By R. C. Mossman, F.R.S.E., Honorary Consulting Meteorologist.

The following generalised abstract of the weather experienced over Scotland during the year ending with September last, has been largely deduced from the data given in Dr Buchan's quarterly reports to the Registrar-General. The monthly abstracts issued by the London Meteorological Office have also been utilised.

October 1896.—Unusually cold weather prevailed during nearly the whole month, the depression of temperature being greatest over the southern parts of the country, and least in the Shetland Islands, where the ameliorating influence of the ocean was well marked. Northerly and easterly winds predominated; showers of snow being of frequent occurrence. A good deal of rain fell, and was distributed over the country in a very irregular manner. Over the western districts the amount was on the whole decidedly below the normal, but on the east coast, from Aberdeen to Berwick, more than double the average was precipitated. Bright sunshine was slightly below the average, the deficit being most marked over the south-eastern counties. On the other hand, there was a slight excess in Lanarkshire, while the amount recorded at western stations approximated closely to the average.

November 1896.—The weather during November was unusually dull and dry, with a mean temperature slightly in excess of the normal. The mildest weather was experienced in the west and north, but cold conditions prevailed in the south, where, at inland places, the depression amounted to 2°. The rainfall was only half the average, taking the country as a whole, but at many places less than a fourth of the average was registered.

There was an excess at Stornoway and at a few other stations in the far north. Bright sunshine amounted to but two-thirds of the normal, the deficit being most marked in the vicinity of Edinburgh, where less than 10 per cent. of the possible was recorded.

December 1896.—The characteristic features of the weather of December were a great amount of rain, little sunshine, and a large number of thunderstorms. The mean temperature was just the average over very wide districts, but there was a decided depression in Galloway, amounting to nearly 2°. Rainfall was in excess of the average in all districts excepting the Shetlands and Skye, where but half the normal downfall was recorded. On the other hand, it was more than double the mean in the Tweed valley, and in parts of Perthshire and Berwick. Bright sunshine was barely half the average, but there was a slight excess in the valley of the Caledonian Canal.

January 1897.—During the first week rather mild weather was experienced, with heavy rain in many places, but thereafter very cold conditions predominated, with frequent snow showers. The mean temperature was 3° below the average over nearly the whole country. Rainfall was less than half the normal, the deficit being considerable except at a few widely separated stations in the north and east. At some places in Aberdeenshire double the average fell. Bright sunshine was in excess in the west and north, but dull weather was experienced in the east.

February 1897.—The weather of February was very variable, with considerable falls of snow, and very low temperatures during the first week. After the 4th milder conditions set in, and the mean temperature of the month rose 1° above the average, taking the country as a whole, but as much as 3° at some south-western stations. Towards the close of the month very mild weather set in, the thermometer on the 22nd exceeding 60° at some places in Aberdeenshire. Rainfall was slightly under the average, the deficit being most apparent at places on the east coast, where only a quarter of the normal downfall was recorded. Sunshine was very deficient in the west and south, but there was a slight excess at Aberdeen.

March 1897.—Very unsettled weather prevailed during nearly the whole month, with frequent falls of snow, sleet, and rain, and several heavy gales. The mean temperature approximated to the

normal over the greater part of the country, the most noticeable feature being the rather high nocturnal values, brought about by the densely overcast skies. The mean rainfall was nearly double the average, very large amounts being precipitated in the counties of Inverness (West), Perth, and Renfrew. In Strathspey, on the other hand, it was slightly below the mean. Very gloomy weather predominated, the sunshine being little more than half the average.

April 1897.—The weather of April was very changeable, and showed but little improvement on that of the preceding month. During the first half, snow and sleet fell in many places. The mean temperature was 2° below the normal, the deficiency being most marked at inland stations; at coast stations, on the other hand, the temperature did not vary much from the average. The rainfall was about the average, there being a deficiency at stations on the coast, more particularly those in the extreme north and south of the country. There was a slight excess in the counties of Sutherland, Ross, and Lanark. Bright sunshine was slightly below the average, but there was a decided excess at Stornoway, which was the sunniest station in the British Isles.

May 1897.—The weather of May was characterised by changeable conditions at the beginning and end of the month, but in the middle of the month it was fair and dry. The mean temperature was below the average, the greatest deficiency being in the north-east of Aberdeenshire. Rainfall was in defect over the counties of Peebles, Berwick, Galloway, Fife, and the Lothians, where, on the mean, only half the average was recorded. There was a considerable excess over the extreme northern and north-western districts. Bright sunshine was very generally in excess of the average.

June 1897.—The weather of June was of a most remarkable character, being cold, wet, and sunless to an unprecedented degree. The protean character of the weather was evinced by the great variability of temperature, the greatest, with one single exception, during the last fifty-seven years. The mean temperature was slightly under the average, there being an area of relative warmth over central Scotland and at Stornoway, which had three times as much sunshine as many stations on the east coast. Rainfall was more than double the average at places in the south of Scotland, but there was a marked deficit in the north-west, the total fall at Stornoway being only 15 per cent. of the normal. Very sunless

weather prevailed, especially in the Edinburgh district. In the far north, as has been shown, there was a slight excess.

July 1897.—July, in marked contrast to the previous month, was favoured with remarkably fine dry weather, the mean temperature being high, the humidity low, and the rainfall considerably under the normal. On the east coast rather cool weather prevailed, but in the interior, where the air was very dry and the sunshine strong, temperature exceeded the normal by 2°. Rainfall was above the average over the Hebrides and at a few stations on the north-western coasts; but there was a great deficiency in the Lothians, where, at some stations, only one-fifth of the average was precipitated.

August 1897.—An unusually low barometric pressure was the principal characteristic of the month of August, but in spite of this the mean temperature was very high, and the mean humidity a little under the average. The rainfall, however, was much above the normal, and the sunshine deficient. The mean temperature was much the same over the country, but was, as is usually the case, relatively higher at inland than at coast stations. The rainfall was a quarter more than the average, but was very irregularly distributed over the country, there being a deficiency to the north of the Grampian range. Double the mean quantity fell at many places in the counties of Perth, Forfar, Dumbarton, Renfrew, Dumfries, and Kirkcudbright. Thunderstorms were unusually frequent, with the result that most of the rain fell in the daytime.

September 1897.—The means of the various climatic elements, taking the country as a whole, approximated closely to their averages, the only marked departure from the normal being the mean temperature, which was decidedly below the mean, the defect being principally brought about by the low nocturnal values. The distribution of the rainfall was extremely irregular, there being a decided excess over the western districts, and in Banffshire, Orkney, and Shetland. Less than half the average fall was measured over large tracks of country, Aberdeen, Edinburgh, and Haddington having the smallest amounts.

The Year ending September 1897.—The year under review was characterised by a temperature half a degree below the average, by a rainfall 5 per cent. above the average, falling on seventeen days more than the average, and by a marked deficiency of sunshine, equivalent to 20 per cent. of the average. The early

summer was cold and wet, but July and August were characterised by warm, sunny weather. September, over the greater part of the country, proved an ideal month for harvesting.

Abstract of Observations of Temperature, Rainfall, and Sunshine as recorded at Sixty-seven Stations of the Scottish Meteorological Society during the Year ending September 1897, *and compared with the Averages of the previous Forty Years.*

	Mean Temperature.				Mean Rainfall.				Hours of Sunshine.	
	Mean.	Difference from Average.	Mean Daily Range.	Difference from Average.	Total Rainfall.	Difference from Average.	Number of Rainy Days.	Difference from Average.	Hours of Sunshine.	Difference from Average.
	°	°	°	°	Ins.	Ins.			Hrs.	Hrs.
October 1896,	42·2	−4·2	12·6	+0·7	4·62	+0·57	18	+1	83	−22
November ,,	41·5	+0·9	9·8	−0·6	1·90	−1·92	13	−3	46	−27
December ,,	37·6	−0·2	9·3	−0·3	5·61	+1·64	21	+5	32	−25
January 1897,	34·2	−2·9	9·2	0·0	1·75	−2·15	14	−3	52	− 9
February ,,	39·4	+1·0	10·1	0·0	2·84	−0·22	15	0	56	−29
March ,,	40·4	+1·0	10·4	−1·6	4·89	+2·09	24	+9	72	−51
April ,,	41·9	−2·2	14·8	+0·4	2·17	+0·03	14	+2	140	−21
May ,,	47·3	−1·7	16·6	+1·2	2·29	0·00	14	+1	185	−11
June ,,	54·3	−0·5	14·5	−1·3	4·10	+1·62	16	+3	120	−96
July ,,	58·2	+1·1	16·8	+1·9	2·44	−0·73	12	−3	238	+39
August ,,	58·9	+2·3	14·8	−0·4	4·59	+0·96	19	+3	153	−43
September ,,	51·0	−1·8	15·3	+1·5	3·46	−0·08	18	+2	118	−24
Means and Totals,	45·6	−0·6	12·8	+0·1	40·66	+1·81	198	+17	1295	−319

2. *Report by* WILLIAM SOMERVILLE, D.Œc., D.Sc., F.R.S.E., F.L.S., Honorary Consulting Cryptogamist.

During the past year two inquiries have reached me regarding damage to trees by fungi. The first was from Mr William Forbes, Swinton, Yorkshire, under date 30th July 1897, and refers to an attack of *Trametes radiciperda*. Mr Forbes's attention was first called to the disease by his noticing certain larches in a mixed wood, five years old, assuming a sickly appearance, and finally dying after an interval of two years. The soil is a sandy loam resting on gravel, and the disease was most prevalent at a place where the bed of the river Ure is only 10 feet below the level

of the surface of the wood. The present wood succeeded another that was felled eight years ago, and in which the larches, but not the hardwoods, suffered from red-rot.

Usually the fructification of this fungus is found in the form of a white porous encrustation (tawny underneath) girdling the stem, partially or entirely, just above the surface of the ground, but so close to it that grass, moss, dead leaves, etc., are enveloped in its tissue. Where conifers, and especially Scots firs, are seen to be dead or dying here and there throughout a wood, the cause in the majority of cases—and especially on replanted land—will be found to be *T. radiciperda*. A tree attacked by this fungus is soon brought into an unhealthy condition, and so attracts numerous forest insects, whose work may be mistaken for the cause instead of the result of the trouble; but there is no doubt that the fungus is, in the majority of cases, the true primary cause.

Such trees should be at once removed and burned. Not only are they a centre of infection for the disease, but they also constitute breeding-places for many injurious insects which may afterwards move on to healthy plants.

Mr Forbes's proposal to restock with hardwoods is a good one, as the fungus in this country shows a marked preference for conifers, which should not be planted on infected ground.

The other inquiry came from Mr George Leven, St Quinox, Ayr, who, in sending a young Douglas fir about 4 feet high, writes:—

"My attention was drawn to it to-day while passing through the wood by its rather unhealthy colour, and on examination I found it evidently attacked by a fungus; and the peculiar thing is, that the affected part is about half-way up the plant and has a compressed appearance, owing to the cortical tissues being dead at that part. You will observe that the part above the wound is dying, while the lower part is fairly healthy, and has developed two or three dormant buds this year. The *A. Douglasii* in question was planted along with others in an old wood, where a few standards had been left, in March 1896. A few more plants of the same species are dead or dying, and show the same appearance as the one forwarded."

The plant was found to agree with Mr Leven's description. A patch, about 4 inches long, and extending round the stem about

2 feet from the apex, was dead and shrunken, and the whole of the plant higher up was evidently in a dying condition.

Reference to Tubeuf's book on "Plant Diseases" shows that the cause of the disease is almost certainly a minute fungus, *Phoma pithya*, Sacc., regarding which but little is known, and which has probably not previously been recorded in this country.

All that can be recommended in the way of cure or prevention, in the meantime, is the careful removal and destruction of the diseased parts. As the point of attack of the fungus appears to be some distance from the ground, it is possible that, when the diseased portion has been removed, the plant may continue to grow in a bushy fashion; and such a tree may be regarded as better than none at all, though on this point individual opinion must give the decision. If the seat of the disease is below all healthy branches, then even partial recovery is impossible, and early removal becomes very desirable.

3. *Report by* R. Stewart MacDougall, M.A., B.Sc., Honorary Consulting Entomologist.

During the past year the inquiries have been few, but so interesting that one feels sorry not to have had more requests for information. Most of the queries related only to the identification of insect specimens which were sent to me, interesting specimens being received from Mr A. C. Forbes, Calne, Wilts; Mr Mitchell, Dunraven, Glamorganshire; and Mr J. Clark, Haddo House, Aberdeen.

The only communications which indicated pestiferous attack were those dealing with the Small Brown Weevil (*Pissodes notatus*) and the Pine Beetle (*Hylesinus piniperda*), both of which pests I dealt fully with in the last issue of the *Transactions*. *Pissodes notatus* was sent to me both from South Wales and from Aberdeenshire, and I feel certain that this pest is much more common, and does much greater harm, than is generally believed. From my experiments with this beetle (a record of which I will publish in next year's *Transactions*), I have clear proof that, in supplement to the remedies suggested last year, an excellent means of offence against *notatus* is to collect the beetles found feeding on the pines during the summer months, but in greatest number in the spring and autumn.

One gentleman, in writing to me for information on the Pine Beetle (*Hylesinus piniperda*), sent me an interesting account of its ravages in his part of Scotland, and from his letter I quote the following:—"The beetle has made fearful ravages among the fir-woods here during the past three years, in trees from one hundred years old downwards to plantations three years planted, particularly in the neighbourhood of a 'blow-down.' Some plantations here, from fifteen to twenty-five years old, are completely eaten up, presenting a very sad picture, and not a single fir plantation has escaped the attacks of the beetle."

In combating *Hylesinus piniperda*, while some benefit will be derived by removing from the trees the shoots bored for feeding purposes by the adults which have issued from the pupal condition, care being taken that the beetles do not escape in the process (which they are very apt to do), and by collecting these blown shoots in autumn and winter, yet, as I wrote in my last year's report, "once the beetles have got to work, no remedial measure can compare in efficiency with the system of 'catch-trees' or traps. From February or March onwards till the autumn let there be a series of such traps, to be examined at regular intervals, and peeled, and the bark burned. These 'catch-trees' may be sickly pines, standing in the forest and marked, or else trees felled here and there for the purpose. In such trap-trees or logs the pine beetles will breed, and in the peeled and burnt bark eggs and larvæ will be destroyed." Where the bark is thin, and the later stages may be on the outside of the wood, means should be employed to kill these after stripping.

But prevention is always better than cure, and never can this principle receive greater justification than in relation to the Pine Beetle. All thinnings, therefore, and all felled and blown timber, must be removed as quickly as possible, or else barked, for if these be allowed to remain, they are all just so many invitations to *piniperda* to come and breed.

In such careful oversight, and in the adoption of catch-trees and traps, the forester will find, beyond all comparison, his best means of dealing with the Pine Beetle. The great principle is, "attack in the beginning," for insect onsets cannot be properly combated when they have reached a certain degree of intensity.

In Aberdeenshire Mr Clark has found the squirrel busily at work destroying *piniperda* grubs and pupæ, from the beginning of July till the end of September. These it finds by stripping the

bark, and then taking the larvæ or pupæ found on the outside of the wood. Curiously enough, where the bark is thick and the larvæ and pupæ are contained therein, the squirrel remains ignorant of the fact, and passes these over. As bearing out my advice last year in my notes on the squirrel, Mr Clark, after mentioning the grub-destruction by the squirrel, hastens to add, "squirrels, however, must be kept under, for I have taken from a wood over ten thousand fir trees killed by squirrel."

Specimens of the Steel-blue Wood-Wasp (*Sirex juvencus*) were sent from Dunraven, and the borings of the Giant Wood-Wasp from Aberdeen, so a note on these two pests may be timely.

Description of Insects.

Sirex gigas, the Giant Wood-Wasp.—This insect varies much in size, from over half an inch to one inch and a half. The smaller male has all the rings of the abdomen reddish-yellow, except the first and the last, which are black. The female has the first two and the last three segments of the abdomen yellow, and the rest black.

Spruce and silver fir, and sometimes larch and pine, are attacked by this species, old timber being preferred.

Sirex juvencus, the Steel-blue Wood-Wasp.—Here also the males are smaller, and the colour varies. The females are blue, while abdominal rings 4 to 7 of the male are yellowish-red. Pine, in the pole stage, is chiefly resorted to by this species, but there are also recorded attacks on spruce and silver fir.

These two species of Hymenopterous insects are not uncommon in Britain, and imported coniferous timber often harbours them. It is the larval stage which is injurious, the tunnels made in solid timber by the larvæ often rendering the timber useless for technical purposes. The mature insects are large and striking, and, from the humming noise of their flight, invite attention.

The life-history is as follows:—The female, by means of a long and strong ovipositor, bores a hole through the bark into the alburnum or sap-wood of standing sickly trees or on blown or felled timber. This she does very quickly. One egg is deposited in each such boring. From the egg hatches out a grub, which when full grown measures over an inch in length. It is cylindrical and whitish, with three small pairs of thoracic feet, and strong biting jaws. A spine on the last segment is very characteristic.

The tunnel made by the larva is curved or circular. The young grub bores in the softer sap-wood, but as it grows goes deeper, and in the second season curves outwards again towards the surface, so as not to leave too great a thickness of wood to be bored through by the imago when ready to escape. The tunnel may be as long as 8 inches, and the hind part of the burrow is stuffed with frass. When full fed the larva makes a chamber in which it pupates, and when the wood-wasp is fully developed, it gnaws the round hole by which it emerges. The generation lasts never less than two years, and is often longer, there being a number of cases on record where the wasps have issued from worked timber forming floors, etc.

The jaws of the larvæ are very strong. They are known to have bitten through lead-piping, and Blandford relates that at the time of the Crimean War bullets were found to have been penetrated by larvæ which had emerged from the unseasoned wood of the ammunition-boxes. The same authority tells of the boring of the larvæ of *S. gigas* from the timber supports into the lead chambers of sulphuric acid works, with a loss of acid.

Prevention and Remedy.

Remove attacked sickly trees, and so prevent spread and infection. It is wise, too, to cover over any wounds and barked spots, otherwise suitable places for oviposition, with some mixture which would deter the insect from egg-laying.

Mr Mitchell of Dunraven, Glamorgan, has taken up enthusiastically inquiry into what species of injurious insects may be conveyed to South Wales in driftwood. Might I cordially recommend this research to foresters in other parts of the country well situated for the purpose, as a work of much scientific interest, but also for its possibilities on the practical side. In the history of insects all over the world, many of the most injurious forms in a country have often not been native, but have been introduced. Twenty years ago a French entomologist introduced into New England, United States, for purposes of experiment, a few specimens of the Gipsy Moth (*Liparis dispar*). A few escaped from confinement, and in spite of warnings issued, this insect has so multiplied that its polyphagous caterpillars have stripped the leafage of the trees of half a State, and necessitated the spending of some hundreds of thousands of dollars on exterminative

measures. In another connection, I myself this year have had sent to me from different places in Britain, as doing considerable harm, two pests imported with plants from Asia, and another introduced in the same way from Central America.

Keeping in mind this possibility of the introduction of injurious forms from other countries, with their chances of gaining a footing and spreading, I am always grateful to receive any specimens from driftwood or imported timber or saw-mills.

NOTES AND QUERIES.

Driftwood and Insect Attacks.

This year our insect visitors have been both numerous and varied.

Hylurgus piniperda has, as usual, come ashore in pretty large numbers. As early as 13th March one log had a gallery with fifty ova already deposited, but with both parent insects dead inside. Not till a month later did any more appear, and then three logs arrived, with about fourteen or fifteen galleries each, and about fifty eggs in each gallery. At least, I destroyed ova and galleries to these numbers, but on visiting the same logs about three weeks or so later, I found them quite fully stocked with larvæ, so there must have been some more bore-holes hidden in the fissures of the bark which had escaped me at first. This time I burned *all* the bark, instead of only those parts in the immediate vicinity of the galleries. The amount of damage to young pine shoots possible by such a swarm is not pleasant to contemplate, not to mention the possibility of more deadly attacks later on. There were fourteen live insects in the galleries—some singly, some in pairs, and some with one dead and one living in the boring. These probably owed their preservation to their being in the upper end of the gallery when the log was immersed, the compression of the air on the ingress of the water preventing their being touched by the sea-water. One entrance hole had been filled up with sand for quite an inch, and one of the imprisoned beetles (both were alive) was actually burrowing its way out through it, and had already got about half-way, when I found it.

The next in importance, in point of numbers actually seen, was *Bostrichus bidens*. Of these there have been a good many—so many, in fact, that I gave up counting them. They came first about the end of July, and afterwards in September. This insect seems to have got a hold of the woods in this locality, for I found

it last year, and again, in considerable numbers, this year. Two small Austrian pines, about 10 feet high, which were blown over in spring and left as decoys for *Pissodes notatus*, fulfilled that office for *Bostrichus bidens* instead, the stems and branches becoming thickly infested with them. It has also appeared on *Pinus Laricio* and *P. strobus* in various portions of newly planted woods; and on a neighbouring estate—Coed-y-Mwstyr—I found some Austrians which had been transplanted last season owed their sickliness and death to its depredations, along with others. These latter were growing about eight miles inland, and in the direction of the prevailing wind, so may have had their first swarms from the sea, or possibly from the pitwood carried past on the railway, which is but a short distance away. The double generation of *Bostrichus bidens* makes it very troublesome, and its habit of burrowing in the sap-wood for pupation renders the ordinary barking of the tree of little avail. The only way to get rid of it is to burn the tree, stem, bark, and branches, and the veriest twig.

On the logs bearing the *B. bidens* there were also several workings and specimens of *Bostrichus stenographus*, of which several were alive, and had just reached the adult stage.

About the same time, several specimens of *Lamia aedilis*, the Timberman Beetle, came ashore. This, though, according to Mr MacDougall, not of first importance as an injurious insect, since it lays its eggs only on dead wood, is very interesting, from the fact of its antennæ being three to five times as long as its body, and from its making a squeaking noise when disturbed. The noise is something like that made in cutting a piece of cork, only much more faint, and appears to be caused by the creature's rubbing the front part of the middle segment of the thorax against the hind part of the first thoracic segment.

Pissodes notatus is our worst enemy here, and the more so as the supply is undoubtedly kept up from the driftwood. I have seen no live full-grown beetles washed ashore this year, but have found exit holes, and dead imagos, and live larvæ and pupæ several times. On one log there were no fewer than 104 pupal chambers hollowed out, but fortunately the bark had been removed by the action of the water, and all the inhabitants were missing. I found this insect also on the estate above mentioned, and in Roath Park at Cardiff, where it had done considerable damage to recently planted Austrian pines.

In conclusion, I should like to express my indebtedness to Mr MacDougall for much kind assistance and information in relation to the various insects found during the year.

ARCHIBALD MITCHELL, Forester,
Dunraven Castle, Glamorganshire.

NOTES ON *Pissodes notatus* OCCURRING AT DUNRAVEN, GLAMORGANSHIRE.

After Mr MacDougall's exhaustive account of the genus *Pissodes* in last year's *Transactions*, perhaps the following notes with regard to *P. notatus* may be interesting.

The trees attacked here are chiefly the Corsican pine, *Pinus Laricio*, though it often occurs on the Black Austrian, and sometimes on the Weymouth pine. I have found hand-picking a very good means of lessening the attack. The beetles are usually found on sickly plants—those barked by rabbits or weakened by the feeding of the insects the previous year. The latter are easily distinguishable, because of the resin exuding from the puncture in the cortex. If these are looked over once or twice a week in early spring, before much egg-laying can have taken place, a good many beetles may be gathered, and many trees, otherwise doomed to be the birthplace of further swarms, may recover. September and October are also good months for hand-picking. It takes some practice to be able to pick out the insect among the needles and bark scales, the general colour being so similar. The 15th of April is the earliest I have found the beetles out on the branches.

A favourite place for the larval borings is the pith of the last two or three years' growths. The thinness of the cortex there seems to induce the larvæ at an early stage of its existence to bore right through the wood into the medulla. It continues its boring either up or down the pith, where at length it forms its pupal chamber. It sometimes happens that an attacked tree is met with when there are no means at hand for burning it. In such a case, the readiest method of extermination is barking the tree and destroying the insects inside; but all such trees should also be split down from the top, and it is surprising how many beetles will be met with in the pith.

The lower branches of Austrian pines, up to thirty or forty years old, are here also favourite breeding-places. These branches are from 1 to 3 inches in diameter, and sickly on account of their close environment by their neighbours; and though little or no damage is done to the trees actually attacked, still there is the possibility of the swarms next attacking the adjoining young plantations. I have found many trees here, 3 to 4 feet high, bearing between fifty and sixty insects.

ARCHIBALD MITCHELL.

In August 1896 Mr G. W. Constable, Traquair, Innerleithen, forwarded to me an insect which had been found in cutting up a larch tree, twenty-five to thirty years old. The insect proved to be a very fine specimen of a female *Sirex juvencus*, whose occurrence in Scotland is very rare, so rare, indeed, that it would be interesting if members who have met with the insect would record the fact in this page. Mr Constable reports that the estate foresters at Traquair have only once or twice previously seen the insect, though on the present occasion three specimens were obtained.

I may also mention that in the same month a specimen of the female *Sirex gigas* was sent to me from Wolsingham, in the valley of the Wear.

W. SOMERVILLE.

TRANSACTIONS

OF THE

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VOL. XV.—PART III.

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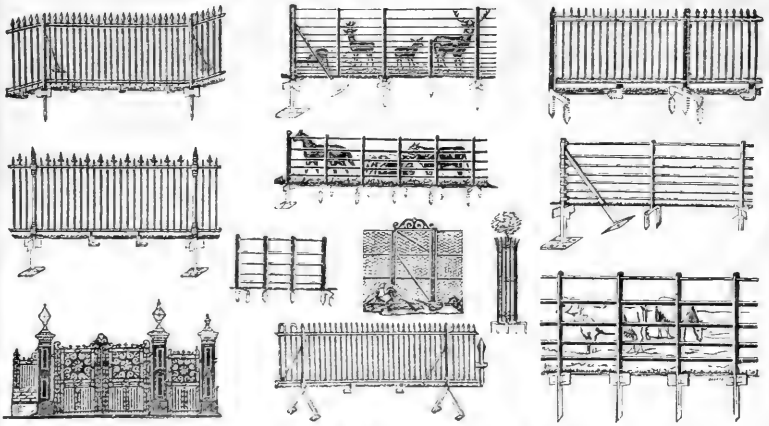

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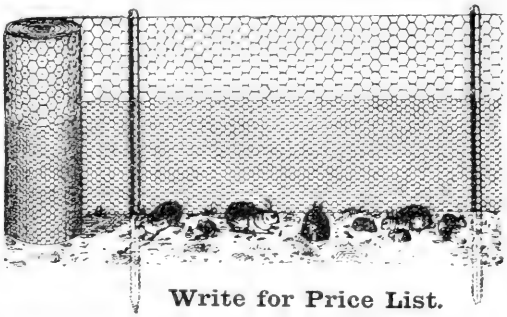

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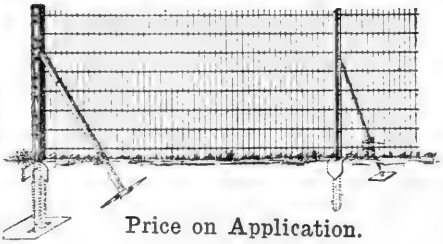

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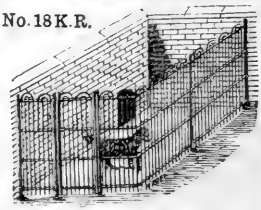

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TRANSACTIONS.

CONTENTS.

The Society, as a body, is not to be considered responsible for any statements or opinions advanced in the several papers, which must rest entirely on the authority of the respective authors.

Special Notices to Members.

HONORARY SCIENTISTS.

The Council desires to direct special attention to the appointment of Honorary Scientists of the Society recently made, with the object of affording to Members the opportunity of obtaining gratuitously scientific information upon subjects connected with Forestry.

The names and addresses of the present Honorary Scientists will be found on page 8 of the *Proceedings* appended to this Part.

Members wishing for information should write direct to the Honorary Scientists they desire to consult, sending full particulars regarding the subject of inquiry, and also, if possible, any Specimens, such as pieces of stem, twigs and leaves, fruits and seeds, fungi, insects (in all stages of transformation) and their food-plants, etc., that bear upon and would help to elucidate it. The replies sent to Members by the Honorary Scientists will, if of sufficient interest, be published in the *Transactions* of the Society.

FORESTRY NOTES AND QUERIES.

The Council begs to remind the Members that a few pages of the *Transactions* have been set apart for suitable Notes on subjects of interest connected with Forestry, which have come under the personal observation of Members, and that they are invited to send contributions. Notes should be short and duly authenticated.

It is hoped that advantage will be taken of this invitation by a large number of Members, and that much valuable information will thus be preserved and made available to every Member of the Society.

The Council also invites Members to submit Queries on Forestry Subjects, which, if suitable, will be inserted in the *Transactions*.

Notes and Queries may be sent to the Secretary at any time; but unless they reach him before the end of October, they cannot be inserted in the next issue of the *Transactions*.

THE SOCIETY'S CABINET OF LANTERN SLIDES.

The Council has resolved that the Society's Cabinet of 100 Micro-Photographic Slides—illustrative of the Structure of Timber, and suitable for the purpose of Lectures with Lantern Exhibitions—may be lent to any applicant who is willing to comply with the printed Conditions, copies of which can be obtained from the Secretary.

NEW MEMBERS.

The Council has prepared and printed a Memorandum containing particulars regarding the past and present work of the Society, which, it is hoped, may lead to the introduction of New Members. The Secretary will send copies of this document to any of the Members who may ask for them, and will forward a copy to any person likely to join the Society whose address may be sent to him by a Member.

The Secretary will receive applications for Membership at any time. See Form of Proposal and Conditions of Membership on opposite page.

ROBERT GALLOWAY,
Secretary.

5 ST ANDREW SQUARE,
EDINBURGH.

Royal Scottish Arboricultural Society.

FORM OF PROPOSAL FOR MEMBERSHIP.

To be signed by the Candidate, his Proposer and Seconder, and returned to the SECRETARY, Royal Scottish Arboricultural Society, 5 St Andrew Square, Edinburgh.

Candidate's

Full Name, ...

Designation, Degrees, etc., ...

Address, ...

Life, or Annual Subscriber, ...

Signature, ...

Proposer's

Signature, ...

Address, ...

Seconder's

Signature, ...

Address, ...

[CONDITIONS OF MEMBERSHIP, see Over.

CONDITIONS OF MEMBERSHIP (excerpted from the Laws).

III. Any person interested in Forestry, and desirous of promoting the objects of the Society, is eligible for election as an *Ordinary* Member in one of the following Classes:—

1. Proprietors the valuation of whose land *exceeds* £500 per annum, and others, subscribing annually . . One Guinea.
2. Proprietors the valuation of whose land *does not exceed* £500 per annum, Factors, Nurserymen, and others, subscribing annually . . . . . Half-a-Guinea.
3. Foresters, Gardeners, Land-Stewards, and others, subscribing annually . . . . . Six Shillings.
4. Assistant-Foresters, Assistant-Gardeners, and others, subscribing annually . . . . . Four Shillings.

IV. **Subscriptions are due on the 1st of January in each year, and shall be payable in advance.** A new Member's subscription is due on the day of election.

V. Members in arrear shall not receive the *Transactions*. Any Member whose Annual Subscription remains unpaid for three years shall cease to be a Member of the Society, and no such Member shall be eligible for re-election till all his arrears are paid up.

VI. Any eligible person may become a *Life* Member of the Society, on payment, according to class, of the following sums:—

1. Large Proprietors of land, and others, . . . £10 10 0
2. Small Proprietors, Factors, Nurserymen, and others, . 5 5 0
3. Foresters, Gardeners, Land-Stewards, and others, . . 3 3 0

VII. Any *Ordinary* Member of Classes 1, 2, and 3, who has paid *Five* Annual Subscriptions, may become a *Life* Member on payment of *Two-thirds* of the sum payable by *new* Life Members.

XII. A Candidate for admission into the Society must be proposed by at least one Member, and shall, *on payment of the Annual Subscription* or *Life Composition*, be immediately admitted a Member of the Society, subject to the confirmation of the first General Meeting thereafter. Any Member of the Society proposing a new Member *shall be held to be responsible* for his first year's Subscription.

Resolution adopted at the Annual Meeting held on 26th January 1898, for the temporary alteration of Law XII.:—

> "Every nomination for Membership of the Society must be made in writing, and must be signed by the proposer and at least one seconder; such nominations shall be submitted by the Secretary to the next meeting of Council, and shall thereafter lie on the table until the immediately succeeding meeting of Council, when they shall again be read over and accepted or declined, as the Council deem best in the interests of the Society. The Council shall at such subsequent meeting pass the accepted nominations to the effect that the Treasurer may accept the Annual Subscription or Life Composition, on payment of which the Candidate shall be admitted a Member of the Society, subject to the confirmation of the first General Meeting thereafter."

TRANSACTIONS

OF THE

ROYAL SCOTTISH ARBORICULTURAL SOCIETY.

XIV. *Establishment of State Model Forests for Scotland.*[1]

Opinions of French and German Experts on our Present Practice in Forestry.

In 1881, M. L. Boppe, Inspector in the French State Forest Service (now Director of the French Forest School and C. I. E.), accompanied by M. Bartet, Sub-Inspector, visited some of the more important of our Scottish woods, and wrote a report,[2] in which he expressed surprise that, of our vast uncultivated lands, so small an area as 734,490 acres was classed as woodland—and he said:—"As foresters of the Continental School, accustomed to live amongst forests regularly managed, and having for their sole object the production of timber, we had no little difficulty in understanding the widely different motives which actuate forest cultivation in this country."

Coming from a country where Natural Regeneration is such an important feature of forest management, the French visitors "were also struck by the monotonous regularity in the height and age of the trees—unmistakable sign of their artificial origin and want of methodical management. . . . And Nature, in spite of the immense resources at her disposal, is quite powerless to modify the

[1] Adopted at a meeting of the Council of the Royal Scottish Arboricultural Society on 25th May 1898, as embodying the views of the Society on this subject.

[2] *Transactions*, Vol. XI. Part 2.

work of the planter, or repair the errors committed by woodcutters. When, under such circumstances, the time arrives for the trees to be cut down, or should they be uprooted by a hurricane, the forest disappears in its entirety, owing to the total want of young growth, which is necessary as a link between the old forest and the new one which ought to be created. Such, at least, appears to us to be the case in all the forests that we visited in the valley of the Tay and its tributaries, and farther north, near the foot of Cairngorm. Not far from a mansion to which are attached some of the pleasantest recollections of our tour, we saw the remains of a noble forest, which some twenty years ago had been cut down and converted into railway sleepers. The sight of the huge stumps, blackened by time, with their gnarled roots twisting themselves over the ground, gave us the idea of some vast charnel-house. This scene of utter ruin was indeed a sad spectacle, though the present proprietor is doing his best to again cover his estate with timber; with a better system he might have been spared both time and expense."

Fifteen years later, in 1896, Dr Adam Schwappach, Professor of Forestry at Eberswalde, in Prussia, came over at the invitation of the Royal Scottish Arboricultural Society, and he also wrote a report,[1] in which he expressed himself as follows:—

"The main difference in the management of woods in Scotland and in Germany is found in the manner of thinning. The specimens of thinning that I met with at Dunkeld, Scone, and Airthrey were entirely opposed to what we would consider good practice in Germany. . . . It seemed to me during my short visit, that woods are greatly over-thinned in Scotland, and are too much managed like the trees in a park. The great mistake that Scottish foresters make is to start thinning too early, in order to give the trees sufficient room to develop large crowns, and to grow rapidly in thickness. The object would appear to be an attempt to induce the woods to furnish some saleable produce, such as sleepers, at the earliest possible age.

"However desirable early returns may be from the point of view of the landlord or of the forester, the fact must not be lost sight of that they are obtained at a great sacrifice. Trees grown in woods managed in this way have not the opportunity to clean their stems naturally of dead branches, and therefore it is necessary

[1] *Transactions*, Vol. XV. Part 1.

to incur considerable expenditure on artificial pruning—an operation which is practically out of the question on a large scale. The thinnings obtained at a very early age are of such poor quality as to be of little or no value. Growth in height is interfered with to an extraordinary extent, and the production of a well-shaped bole becomes almost an impossibility. Further, when a wood is thinned to its utmost extent it does not contain a reserve supply of trees to serve as substitutes for those that have lost their leaders, or are otherwise defective. This matter is of special importance in Scotland, where the squirrel does an amount of damage to trees that is unknown in Germany: in consequence of the removal of the bark from the upper part of the stems, the trees develop misshapen crowns, and are greatly reduced in value. . . .

"It cannot be too much emphasised that strong and early thinning prevents the production of the maximum mass of timber, and at the same time makes the formation of valuable timber impossible. If the commencement of strong thinning were delayed for other ten or twenty years, the woods would give a permanent yield of timber fit for sleepers, while the main crop would develop into heavy timber suitable for all structural purposes. Instead of removing well-formed trees in the early thinnings, one ought to fell only such as are badly shaped, and I am afraid that this system is at present too little practised.

. . . . . .

"At Scone Palace I inspected a very fine oak-wood, from ninety to one hundred years old. The trees were showing vigorous growth, and one can only regret that the ground was not more fully stocked, as would have been the case under a different system of management, and which would have resulted in the production of finer and more valuable stems.

"Between Callander and Balmaha I saw numerous woods of oak coppice on the lower slopes of the hills. These woods are managed on a rotation of twenty-one years, and furnish tanning bark and light timber, the latter being partly used for firewood. On the steep slopes with a shallow soil the system of coppicing is to be commended, but, with tanning bark as the main object, the manner of thinning appeared to leave much to be desired. Tanning bark should be as smooth on the surface as possible, and the stems which furnish it should be long and clean. I found, however, that owing to severe thinning about the seventh and

fourteenth years, the bark was coarse and inferior in quality, and the stems were short and branchy. It also appeared to me that many of the stools were too old, and should have been replaced by fresh saplings."

The above are the opinions of eminent experts of two different schools of forestry, and Dr Schlich of Coopers Hill College has repeatedly confirmed their views. In the address on Forestry Education,[1] which he delivered to the Society in January 1897, he says :—

"You are aware that the general drawback, from which forestry in this country labours, is the absence of a regular demand for home-grown timber. You also know that, until a comparatively recent date at any rate, most Government contracts for works of construction contained a clause to the effect that no home-grown timber would be allowed to be used. If we take these broad facts into consideration, it is easy to perceive that the explanation may be condensed into the following two statements :— (1) The home-grown timber is, generally speaking, inferior in quality to that imported from abroad; (2) it comes into the market at irregular intervals and in fluctuating quantities. Exceptions exist, but here only the average conditions can be considered. These drawbacks can be removed only by improved sylvicultural methods, and a systematic management of the forests."

Writing on the Timber Supply of the British Isles,[2] Dr Schlich gives as one of two impediments to the afforestation of waste lands "that a more complete knowledge of systematic forestry is required by those engaged in the formation and management of woods, worked on economic or commercial principles."

Causes of the Existing Conditions.

Many reasons may be given why we have in the past exposed ourselves to criticism of the above nature. We have, within our own shores, vast supplies of coal and peat fuel, also of iron, which is largely used for purposes of construction, while our islands offer remarkable facilities for the importation of timber from abroad. Hence the want of a plentiful supply of wood from home sources has not yet been seriously felt; and proprietors of woodlands, many of whom have in past years maintained their woods principally as

[1] *Transactions*, Vol. XV. Part 2.
[2] *Indian Forester*, June 1897.

game-coverts and to increase the beauty of their estates, have not, generally speaking, wished them to be managed on strict commercial principles, with a view to profit; and thus, especially during periods of agricultural depression, funds for the improvement and extension of woodlands have rarely been available. Game, in one way and another, has had a powerful influence on the rural economy of this country, and *inter alia* it has been the means of inducing landlords generally to keep their woods less dense than is consistent with good sylvicultural practice. Unfortunately this tendency has been encouraged by the fact that the two timber trees which have received most attention in this country during the last century or more—the oak and larch—are intolerant of crowding, and the result has been that foresters have come to look upon an open (really over-thinned) condition of woods as a desirable feature under all circumstances, and with all species. This view has been responsible for much of the discredit into which our home-grown timber has fallen: for without normal density a plantation or forest cannot produce timber of first-rate quality. The greater attention recently given to improved methods of sylviculture, as enunciated in the class-room and in current literature, has doubtless had some influence in checking the tendency to over-thinning, but no amount of theoretical instruction can ever effect so much improvement as practical demonstration in a sample forest. Many foresters would readily modify their system of management in conformity with the principles of modern sylviculture, if they had the opportunity of witnessing the application of these principles in actual practice; nor indeed would they be justified in changing their methods unless they had the opportunity of studying both the application and the results of other systems.

On this subject M. Boppe says:—

"It would certainly not be fair to hold the Scottish foresters responsible for the present regrettable state of affairs, for, though they have for the most part admitted the inefficiency of the present system, they are powerless to effect any improvement so long as the landowners and general public have not learnt to appreciate the manifold advantages to be derived from a regular and methodical management. They have to struggle against many adverse interests and hindrances, such as grazing and shooting interests, questions of routine, pecuniary exigencies, and the fancies of sportsmen from all parts of the world."

This is undeniably true, the wood-managers and foresters having, as in duty bound, loyally and conscientiously carried out the policy of their employers.

Views held here on Continental Forestry.

In countries, such as France and Germany, where forests owned by the State and managed on economic principles cover vast areas, the sylvicultural systems pursued are based on the observation of facts, recorded throughout a long period of time by competent men of science specially trained to the work in schools maintained by the State for the purpose. In those countries correct views on systematic forestry are much more commonly held than they are here. With us the subject is but little understood, and comparatively few people, even amongst those whose interests are the most affected, realise the degree in which forestry is truly a science. The recent publication in our language of scientific works on sylviculture has drawn considerable attention to the question of wood-management; and a body of members of the Royal Scottish Arboricultural Society made, in 1895, a most instructive tour in the forests of Northern Germany; but it cannot be expected that the mere study of books, with rapidly made visits of this kind, can, useful as they are, alone lead to a full comprehension of Continental methods, and to an adequate appreciation of the conditions under which one or other of them may be employed in a particular locality. Hence these methods and their application are sometimes imperfectly understood, and any suggestion that our woods might be treated under them meets with objections, some of which at least would not be raised if a fuller knowledge of Continental methods prevailed. But there is no doubt that a conviction is rapidly gaining ground that all has not been quite right in the past; and a strong desire is now very generally evinced that practical proof should be given of the extent to which methods of treatment successfully employed in other countries are really applicable to our forests.

Reform is Necessary.

All doubts as to the sylvicultural methods most suited to the woods of our country should long ago have been set at rest by practical demonstration of what can here be done in the way of profitably growing high-class timber under various conditions. Though a limited quantity of timber of first-class dimensions and

quality is produced in this country, it cannot be denied that our home-grown wood is, for the most part, inferior in quality to that imported from abroad; and this is so far generally recognised that home-grown produce, even of the best quality, is but little used in Government or in private works of construction. Indeed, until recently, the use of such timber for the erection of buildings under the Land Improvement Act, 1864, was not permitted without the special sanction of the Board of Agriculture, and even now it is thought necessary to prescribe that when thus used it must be of suitable dimensions and be cut from trees that are sound and of proper age and size. Again, the Postmaster-General, having been recently requested to try home-grown Scots fir as telegraph posts, replied,—"The results . . . show that Scots fir is less strong than the Norway red fir in general use by the Department. It is, moreover, less straight, and less free from large and rough knots. Apart from the question of the comparative merits of the Scots and Norwegian fir, the difficulty and delay experienced in obtaining even small parcels of Scots fir suitable for telegraph poles renders it necessary for the Department to resort to the Norwegian market in order to obtain adequate supplies."

Dr Schlich, in his exhaustive paper[1] on the Timber Supply of the British Empire, has pointed out that, while the annual value of our imports has risen by about £2,000,000 during the past eight years, the permanence of our supplies from abroad is very far from being assured; and thus we may before long find ourselves face to face with a scarcity which must lead to an enhancement of the price of timber. It may also be mentioned as a significant fact that timber has maintained its price during recent years better than almost any other raw material, and this can only be ascribed to the more accessible supplies of foreign timber having been appreciably exhausted.

Again, the forest question has much greater importance in Scotland than in England; for the agricultural returns show that out of a total area of mountain and heath land used for grazing, amounting in the United Kingdom to about $12\frac{1}{2}$ millions of acres, nearly $9\frac{1}{2}$ millions are in Scotland; while out of a total additional area of nearly 9 millions of acres of unused waste land and inland water, about $4\frac{1}{4}$ millions are situated in Scotland. It is not known what proportion of these vast extents of country are suitable and available

[1] "Forestry Education," *Transactions*, Vol. XV. Part 2.

for planting; but it may safely be assumed that the existing woods, plantations, and nurseries, which cover little more than 900,000 acres, might be increased to at least four or five times their present area. And such extensions would no doubt for the most part be effected in the Highlands, the more remote and poorer part of the country, where the increase of wealth and prosperity accompanying the extension of woodlands is already very noticeable, and where many hundreds of thousands of acres might be rendered as productive under timber as much of the agricultural or pastoral lands in England, which yield a nett income to their owners of not more than 5s. to 10s. per acre. We may, therefore, feel reasonably confident that the introduction of remunerative sylvicultural methods will not only lead to an important improvement in the quantity and the quality of the produce of our existing woodlands, but that the area under forest crops will be largely added to, and that we shall thus become less dependent than we are at present on supplies coming to us from foreign countries.

Why we require Model Forests.

There seems no reason to doubt that the owners of waste lands which might be suitably and profitably afforested would be much more willing to plant them than they now are, if a practical object-lesson could be presented demonstrating the methods by which a fair return on their outlay could be assured; and the sooner such a demonstration can be provided, the better for the landowners and for the country at large.

We require a Model Forest then, first of all, that we may be in a position to offer to proprietors, their wood managers and foresters, a practical proof that the principles of modern economic forestry, as taught and practised in France, Germany, India, and other countries, are equally suited to our islands. It is, of course, well understood that the application of these principles does not involve hard and fast methods of treatment; and that French and German foresters regulate important matters, such as the density of planting and the degree of thinning, in accordance with the objects in view and the conditions prevailing in the locality they are dealing with. We want to show that improved methods of treatment, under our own conditions of soil and climate, would lead to results similar to those obtained in other countries where the scientific principles of economic forestry have long been followed. Dr Schlich, in his address on Forestry Education, says,—"We are

justified in concluding that there is no reason why just as good timber as that now imported from abroad should not be grown in this country, provided improved sylvicultural treatment and a systematic working of the forests are introduced." This cannot be doubted. M. Boppe speaks of the "marvellous timber-producing properties" of our soil and climate, and the "wonderful aptitude of (our) soil to forest vegetation, favoured as it is by a regular climate and the constant humidity of the atmosphere." He found growing, both singly along the roadside, and collectively in the forests, "magnificent specimens of oak, maple (sycamore), elm, ash, beech, and lime, which by the vigour of their growth and the rich colouring of their foliage, bore testimony to the favourable conditions of soil and climate under which they grew." Speaking of the Dunkeld woods, M. Boppe says, "From a forest point of view, the results obtained by these two species (Scots fir and larch) are truly marvellous;" and he adds, "It is, therefore, a matter of regret that nothing has yet been done to place forest management in Scotland on a sound economic basis." It appears unlikely that it ever will be placed upon a sound basis throughout the country until we have a Model Forest in which we can demonstrate methods and point to results.

The Model Forest is also required as a station of experiment and research into matters connected with the development and characteristics of the various species when grown in this country, such as would indicate the correct sylvicultural treatment to be applied to them, and would enable our teachers of sylviculture to base their instruction on data obtained in this country, instead of relying on figures the result of observations conducted elsewhere. Volumes I., II., and III. of Schlich's "Manual of Forestry" necessarily bristle with such figures; but, useful as they are, it cannot be denied that they lose much in value for the British forester, through having been obtained in countries and under conditions with which he is not personally familiar. The time has long since arrived when the applicability or otherwise, to our own geological and climatic conditions, of Continental systems, figures, and results should be thoroughly tested; and this can only be done in woods unhampered by the restrictions that are necessarily associated with private ownership.

Again, we want a Model Forest as a field of practical instruction for students. Dr Schlich writes,—"Something more is wanted than theoretical instruction. Instruction in the field must also be

provided. There must be forests which are managed on the right lines, where students find the theory of economic forestry practically illustrated." M. Boppe expresses himself as follows :—"The science of forestry is, however, a science of observation based upon facts which must be studied both from a practical and theoretical point of view. It is therefore absolutely necessary that a forest school should have attached to it a forest which has for some time past been under scientific management, serving, so to speak, as a natural laboratory for experiments, and without which the best theoretical teaching in the world would be of no avail. This is especially the case in England, where the young men, by reason of their national character and their mode of education, are accustomed to pay more attention to facts than to theories; here the teacher of a technical profession, resting solely on theories, would command very few disciples. It is therefore a matter of regret that, among all the forests visited by us in our travels, there is not a single one suitable for the teaching of sylviculture on that broad basis so essential when the pupils are called upon to apply it in all quarters of the globe." Those who have for some time past endeavoured to carry on instruction in forestry without a practical training-ground of the kind above indicated, can best appreciate the want of it. The owners of Scottish woodlands have certainly been most generous in granting facilities for the visits of students or of organised parties of foresters, but it will be readily understood that, in this country "forests which have for some time past been under scientific management" are rare, and that even the best managed of private forest estates lack that continuity of aim and action which alone can produce woods suitable in every respect for educational purposes.

Forest Schools.

To train for the superior staff of the French State Forest Service, officers who are to be charged with the administration of about 11,500 square miles of State and Communal forests, a National Forest School is maintained at Nancy, with a staff of thirteen professors and assistant professors, who teach sylviculture, working plans, geology, mineralogy, entomology, botany, forest law, political economy and forest statistics, surveying, forest engineering, and agriculture. The school is accommodated in spacious buildings, embracing residences for the staff and students, halls of study, recreation rooms, model rooms, museum, library, and chemical

laboratory; and an area of 7500 acres of forest in the neighbourhood is under the control of the Director of the school as a field of practical instruction, as well as for purposes of experiment and research. In the German Empire there are eight superior State forest schools which are equipped on a like scale; and in nearly all countries of the European continent, schools of a similar kind are maintained for the training of officers for the Government forest service. A considerable portion of the Windsor Crown Forest is managed, for purposes of practical instruction, by the professor of forestry at the Indian Engineering College, Coopers Hill, near Windsor; while the Forest of Dean will, it is understood, shortly be brought under systematic management, and will thus also become available for instructional uses. But the students of the Forest Branch at Coopers Hill College still receive a considerable part of their practical training in State forests of France and Germany, which have been subjected to rational treatment for a long period of years.

Forests used as the main practical training-ground for students are always placed under the control of the Director of the school. Speaking of the area that should be provided for instructional purposes in this country, M. Boppe says :—

"This accessory forest must necessarily be incomplete at first, but would be perfected in time; but the essential point is that it should be placed under the absolute control of the officers of the school. This can only be done by choosing a State forest. If it should be considered desirable, also, in order to render the teaching more complete, the State ought to purchase or lease in Scotland a forest suitable for the purpose." The chief reason for this is that if the estate were managed merely as an ordinary forest, it might not, and almost certainly would not, serve in the best possible way as a field for practical instruction. To meet the latter requirement, work must be carried on so as not only to furnish an object-lesson in economic forestry, but also to illustrate in the fullest manner the course of lectures given to the students; and on this account the work carried on in a school forest will always be of a more varied nature than that in an ordinary forest, and its details must be arranged, as far as possible, so that the course of theoretical instruction may run hand in hand with it. These conditions would not be fulfilled unless the Director of the school had control of the forest. If the control were not in his hands, constant friction between him and the manager could

hardly be avoided, especially as the practical instruction given to the students would necessarily often take the form of a criticism of the latter's work.

The Forest School in Edinburgh.

If we had a sufficiently large area of State forests in Scotland, with a proportionately strong staff of Government wood-managers, a State Forest School, such as the above, would be a necessity; but existing circumstances hardly appear to warrant the immediate foundation of an independent school, at which, in addition to forestry proper, the necessary auxiliary subjects, such as botany, chemistry, geology and mineralogy, entomology, engineering, etc., must be taught by a special staff of instructors. Candidates for the Indian State Forest Service will continue to be trained at Coopers Hill; and although an independent forest school in Scotland would no doubt receive support from young men seeking Colonial appointments, the number of these and of students who might be expected, at the present time, to enter it with a view to employment in this country, would not be sufficient to provide funds for the maintenance of an independent establishment. The only plan now feasible seems to be to teach forestry in some university or college, where instruction in subjects necessary to the complete understanding of the course is already obtainable: and this is what is now being done in Edinburgh. It is true that such an arrangement has many important drawbacks. First of all, it is not to be expected that the Model Forest, in which the practical part of the course is given, can be situated in close proximity to the class-rooms, where the students assemble to hear lectures. And again, in a university or college, the auxiliary subjects are necessarily taught without that special reference to forestry which is so desirable, and which can only be secured at a special school. In such an institution students would be taught *forest* botany and *forest* entomology; geology and mineralogy would be treated with special regard to the formation and properties of soil in reference to tree growth; chemistry in relation to the nutrition of plants, and the utilisation of forest produce; and the engineering course would deal with simple surveying, timber measurement, the construction of forest roads, bridges and buildings, with saw-mills, forest tramways, timber slides and other labour-saving means of moving timber, rather than with engineering in its general aspect. Education of this highly specialised

type implies forestal conditions that are correspondingly advanced, and under existing circumstances a simpler form of academic instruction will suffice.

In Edinburgh, at the present time, three courses of lectures on forestry are given, viz.:—

First.—That delivered daily, during the winter session, at the University, usually to a small number of students who are following other courses, and who for the most part wish to qualify themselves as factors or estate managers. The class has been attended by a few sons of landed proprietors, a few men who contemplated seeking a career in the Colonies (though it is not known that any of these have left the United Kingdom), and by others whose aim, directly or indirectly, was associated with the management of land, and who selected forestry as one of the alternative subjects provided for the degree of Science in Agriculture. In addition to class-room lectures, these students are given such practical instruction as is found possible in neighbouring woods, saw-mills, nurseries, timber-yards, creosoting works, etc., the owners of which have courteously made them welcome. The course of lectures on Forestry at the University was opened by Professor William Somerville in the autumn of 1889; and since then the number of students enrolled has been 107.

Second.—Lectures delivered by the University Lecturer at the Royal Botanic Garden, to a class which during the past winter numbered thirty-one students, of whom sixteen were foresters and the remainder were gardeners. The curriculum embraces evening classes in chemistry, physics, meteorology, geology, surveying, mensuration, entomology, botany, forestry (about forty lectures), and horticulture, and it extends over three years. The students are employed in a paid capacity during the day, and are therefore prevented from participating in excursions. Their practical training in sylviculture proper is obtained either before they enter, or after they leave the Garden.

Third.—A course of lectures in forestry was commenced this year at the Heriot-Watt College—where the University Lecturer has addressed a class of thirty students on one evening a week during the past winter session. The members of this class were for the most part clerks and law apprentices, who were qualifying themselves for situations as land agents, factors, estate architects, clerks of works, superior bailiffs, foresters, gardeners, nurserymen,

and seedsmen: and among their other subjects of study at the College may be mentioned botany, entomology, mensuration and bookkeeping, agriculture, agricultural chemistry, building, land surveying, and geology. They were employed in the city and neighbourhood, and could not attend day-classes, or follow courses of study elsewhere.

Such is the work now being carried on in Edinburgh, where, during the current year, sixty-four students have attended courses in forestry given by the University Lecturer, and were, for the most part, also studying auxiliary subjects at the institutions where the lectures in forestry were given. The course at the University is fuller than the other two; but its value would be very greatly enhanced if a Model Forest for practical instruction were available. Few of the students of this class have sought to follow the career of wood-manager; but their object has evidently been to obtain a knowledge of forestry that would be useful to them in occupations connected with land. It may, however, reasonably be hoped that as proprietors come to realise the advantage of bringing their woods under a regular system of management, the prospects of wood-managers will improve, and that young men who may desire to follow this career will attend the University class as the best means for obtaining professional instruction available in Scotland at the present time: the establishment of an independent school of Forestry will no doubt follow sooner or later, as future developments may indicate.

It would probably be an advantage if the evening classes at the Royal Botanic Garden and the Heriot-Watt College could be amalgamated. But there can be no doubt that in existing circumstances these classes meet a want. To men who have already been employed in woods, or who intend to become agents, factors, or foresters, an insight into the principles of economic forestry cannot fail to prove an advantage. It will be some time before the sole charge of the woods on estates in this country is placed in the hands of expert wood-managers; the foresters are the men on whom, for the present, the majority of the proprietors will rely for the management of their woods. Experience has shown that the foresters now in charge of Scottish woods take a most keen and intelligent interest in the subjects dealt with in the class-rooms, are quick to appreciate improved modifications in practice, and to grasp new ideas presented to them.

It can hardly be doubted that the lectures given in Edinburgh

during the past nine years have, amongst other influences—such as the Arboricultural Society's tour in Germany, had an effect on the opinions held by persons in this country who are interested in forest management, and that they have done much to remove the prejudice with which, until the last few years, innovations were generally regarded.

Location of the Model Forests.

At the present time, Edinburgh is the only place in Scotland where lectures on forestry are given; and there does not appear to be any immediate necessity for the establishment of lectureships at other centres. It is the best policy to concentrate our efforts in one place, and to leave nothing undone to improve the facilities for teaching here, rather than to dissipate our strength in attempts to sustain the machinery of instruction in several places. Dr Schlich entirely supports this view, for he says in his article on Forestry Education: "In my opinion, you would do better if you, at the start, were to concentrate operations, so as to make *one* definite scheme a reality, and that scheme should be to perfect the education of your future wood-managers, or under whatever title they appear upon the scene. In other words, I should advocate *one* centre of instruction, consisting of (1) theoretical instruction in connection with a university or agricultural college, where instruction in the auxiliary sciences is already provided; (2) woodlands where practical instruction can be imparted, because in forestry theory and practice must go hand in hand. As regards the first point,—theoretical instruction,—a beginning has been made in this very city [Edinburgh] . . . The arrangement needs only further development, and to be put on a proper footing, so as to bring the subject of forestry, as regards its importance, on a par with other branches of learning."

Part of the recognised training for a young forester consists in the spending of a year or more in a commercial nursery, and Edinburgh offers unusual facilities in this respect, nor can any other town in Scotland offer educational conditions of the nature of those provided at the Royal Botanic Garden.

In view of the fact that students, while attending the forestry classes in Edinburgh, are either following other courses of study at the same time, or are employed in the city, it is essential that a Model Forest for their practical instruction should be provided

within such a distance of Edinburgh that they may be able to visit it and return on the same day, as is now done by the students, who visit woods in the Lothians, Fife, and other places. But it is most desirable that the conditions under which we are to work should be as varied as possible, and there is no reason why the whole area should be situated in a single locality. The wants of the Edinburgh students would be met by the provision of a model forest situated within easy reach by them, and a second area might subsequently be obtained in some other part of Scotland. It will not suffice to acquire bare land only, with a view to planting it, as this would involve waiting for a long series of years before anything but planting, sowing, and the management of young crops could be practically dealt with. What we want is to obtain control of growing woods, or at any rate of areas which carry a large proportion of growing woods, of all ages, and of as many species as possible. We should ultimately be able to deal with various kinds of soil, and various slopes, altitudes, and exposures in two different parts of the country. The examples of forest management thus obtained would serve as models or object-lessons to all interested in sylviculture, whether as students, forest owners, or foresters.

Working Plan.

One of the first matters to be attended to, on acquiring an area to be converted into a model forest, would be the construction of a working plan, which would lay down once for all the general lines of management to be followed, and would prescribe in some detail the work to be done during the first few years. Such a plan would be preceded by a more or less detailed survey of the growing stock on the ground, by observations of the rate of growth of the several species, and of the resulting annual increment per acre, present and to be expected, under the improved system of management to be adopted. This would enable the annual yield to be determined with due regard to the existing condition of the stock, and a programme of fellings would then be drawn up. Such a plan must form the basis of all systematic forest work. Without it, continuity of aim cannot be secured, or even hoped for, throughout the life of a generation of trees, which may exceed the working lives of several successive generations of foresters; neither can there be any security that the forest capital will not be drawn upon by fellings in excess of the annual production of wood.

The Manager.

To carry out the scheme above indicated, in such a manner that the model forests may answer all the purposes for which it is sought to establish them, the services of a manager of the highest professional attainments must be secured. On him will depend the success of an undertaking which must assuredly have far-reaching effects on the management of woodlands in this country, and may lead to an important increase of their area. He must be a man thoroughly versed in the theory and practice of economic forestry as followed in other European countries; and it is important that he should not be a mere student from some Continental school, but should have had considerable experience in practical work. He must be familiar with the French and German languages, so that he may be able to keep himself abreast of the most recent developments of Continental forestry. He must undertake the researches which are to be carried out in the model forests, and be familiar with the results obtained by other workers. It will be his duty to prepare working plans, and to inaugurate a system of records which will bring out clearly the results of his system of management, and enable the fullest possible use to be made of them by the proprietors, wood-managers, and foresters of the country. It is believed there would be no difficulty in securing the services of a thoroughly qualified man, if a salary, commensurate with the exceptional nature of the work he would be called upon to perform, were provided.

Relation of the Manager to the Edinburgh Forest School.

Reasons have been given why the forests assigned for the practical instruction of students must be placed under the control of the Director of the Forest school. M. Boppe's opinion "that it (the model forest) should be placed under the absolute control of the officers of the school," has been previously quoted; and Dr Schlich thus expresses himself in his paper on Forestry Education:—"There being no State forests in Scotland, I think the Government would not go out of its way if it were to buy an estate, a considerable proportion of which is already under wood, and to affiliate it with the Forestry School at the University of Edinburgh, with a duly qualified wood-manager in residence on the spot. This wood-manager, under the

advice of the Lecturer and a duly constituted committee of control, would have to draw up a working plan of the area, giving full details of the objects aimed at, and the manner in which they will be utilised. This area could at once be utilised for the practical illustration of the theories set forth in the lecture-room, and it would also afford opportunity for the training of working foresters." The model forests would presumably be under the Board of Agriculture; and it would be necessary to place the lecturer, or head of the forest school, at Edinburgh, in such relationship with the manager as would ensure the forests being made to answer his instructional requirements in the fullest manner.

Board of Visitors.

A board of visitors should be appointed, who would report direct to the Board of Agriculture any suggestions that they might, from time to time, desire to make regarding matters affecting the management and use of the model forests.

Personnel and Equipment.

Subject to the limitations above indicated, the manager would have control of the model forests. He would reside in or near them, and would be assisted by a suitable staff of assistants and workmen. Houses for the accommodation of the manager, foresters, and woodmen, if not found in the area acquired, might, no doubt, be purchased or hired in convenient situations. The manager's residence should include his office, and the forester's house should contain a room set apart for the use of the manager and other officials during their visits. All that would be needed—at least in the first instance—in the way of accommodation for the students would be a large room in the forest nearest to Edinburgh, in which they could take shelter, and be addressed by their instructor should bad weather come on during their visits.

Will the Model Forests be a Financial Success?

Dr Schlich has calculated that land capable of producing, on an average, $1\frac{1}{2}$ tons of coniferous timber annually, can be profitably afforested with Scots pine if it does not yield an annual soil rental of more than 7s. 6d. per acre. Of course this estimate is based on the assumption that the forest grown on it will be

managed on true economic principles; and there is no reason to doubt that areas can be found for the proposed model forests which will more than answer the above description. But in considering the amount of profit we may reasonably expect from them, several important facts must be borne in mind. In the first place, work will be laid out not solely with a view to the profitable production of timber, but also with the object of affording practical instruction to students; and it may thus be necessary to undertake work and incur expenditure which would be saved if the forests were not required to fulfil this purpose. Secondly, it would be necessary, especially at first, to undertake a good deal of work of an experimental kind, which would not at once yield a direct return; and the compilation of data regarding matters for which we now have to rely on figures derived from observations conducted abroad would cost money, but would not be immediately remunerative. Lastly, the nature of the work required renders it essential that a man of very special attainments should be employed as manager, and his salary must therefore be fixed at a comparatively high rate.

Estimates.

In regard to the funds necessary for the acquisition of the land and trees required for conversion into a model forest, it may be said that the cost of 1500 to 2000 acres of suitable land within reach of Edinburgh, and including some 500 acres of growing woods, averaging forty years in age, would not exceed £40,000. The nett annual income from such an estate would not be less than £1000, and might be as high as £1500; and this, with an annual grant of £500 from Government, should be sufficient to meet all the charges of maintenance. To meet the necessities of the Edinburgh Forest School, it is imperative that this land should be obtained with the least possible delay.

Provision of Capital.

In conclusion, it is necessary to consider the source from which the required capital can be provided. Why, it might be asked, should the land be *acquired* at all? Could not a proprietor be found who would be glad to profit by having his woods brought under systematic treatment, and would thus permit them to be used for all our purposes? The answer to this suggestion is, that however ready a private proprietor might be to place his woods at

our disposal, we could not rely for our purposes on any privately owned estate, as we could never be sure that any system of management which we might introduce with the proprietor's approval, would be continuously followed; nor could we even feel confidence that the forest itself would not be withdrawn from our use at any moment. The ownership of private estates changes by succession or sale, and successive owners may desire to alter the object of management; while, in any case, they do not all take the same interest in their woods, nor have the same degree of knowledge as to how they should be treated; and circumstances may even constrain a proprietor to follow a course which he knows is not that best calculated to improve his property. "But," it might be urged, "even so, the woods of Scotland are the property of private owners, who would benefit by any improvement the model forests might lead to. Let them provide the needful funds." At first sight this may seem a strong argument against the State coming to our assistance. But private owners can hardly be expected to respond readily to a suggestion of this kind until it has been proved to them what measure of financial success may be looked for here under improved methods of management. The practical demonstration of this prospect is one of the principal objects we have in view when desiring to establish model forests. Then again, proprietors are not by any means the only class who would benefit by the introduction of system into our management; for if it could be proved that profits are assured, and if this led to an extension of the wooded area, our supplies of timber would be better secured than they now are, and employment would be given in country districts to a large number of people who would be very glad to obtain it.

We may thus approach the Minister of Agriculture, feeling assured that our cause is a good one, and may urge that he will induce the Government to aid us in these our first efforts towards the improvement of the position of forestry in this country, by providing the sum necessary for the acquisition of a State Model Forest in connection with the Forest School at Edinburgh. The difficulties which oppose themselves to private action in this direction are so strong, and the importance of the forest question in Scotland is so great, that we feel confidence in submitting that of all enterprises to which the State can offer aid or encouragement in the public interest, Forestry is that which has the strongest claim for consideration by the Government.

Letter addressed to the Right Honourable W. H. LONG, M.P., *President of the Board of Agriculture, etc., enclosing copies of the foregoing paper :—*

SIR,

On 23rd October 1895 you were good enough to receive a Deputation from the Royal Scottish Arboricultural Society, which submitted to you the views of the Society on certain matters connected with Forestry in Scotland; amongst them was the desirability of acquiring a State Forest Area for Experimental and Educational purposes.

In compliance with the wishes you expressed on that occasion, the President of the Society forwarded, in November 1895, memoranda by certain Members of the Council, which set forth their individual opinions as to what the necessary expenditure by the State might be, in connection with the proposed Forest Area. But the whole question has recently been fully considered by the Society, whose views are embodied in the printed note which we are now authorised to submit for your favourable consideration.

In this note you will find quoted the opinions of distinguished foreign experts that the sylvicultural practices prevailing in Scotland are open to adverse criticism; it is explained how these practices arose, and why it is now a matter of great importance that reforms should be introduced; and it is shown to be impossible to hope for such reforms unless practical demonstration can be afforded, by means of model forests, of the results which improved methods lead to.

After a brief statement as to the nature of the instruction given in the State Forest Schools of other countries, and as to the provision of practical training-grounds as necessary adjuncts of such schools, the opinion is expressed that existing circumstances hardly appear to warrant the immediate foundation of an independent school in Scotland, and that the only plan now feasible is to improve and develop the courses of instruction in Forestry now conducted in Edinburgh, by the provision of a State Forest within easy access from the city; such a forest, while serving as a model for landed proprietors, agents, and factors throughout the country, and as a station of experiment and research, would also be available for practical training in connection with these courses.

It is estimated that a capital expenditure of £40,000, with an

annual grant of £500, would suffice to provide the required area; and the concluding section of the note shows why privately owned forests would not answer the object in view, and why the Society is therefore compelled to ask the Government to aid it in these its first efforts towards the improvement of Forestry in this country, by providing a *State* Model Forest in connection with the Forest School in Edinburgh.

We trust that you will consider our representations favourably, and will use your influence to induce Her Majesty's Government to accede to the petition of the Society.

We have the honour to be,

SIR,

Your obedient Servants,

(*Signed*) FRED. BAILEY, *President.*
„ R. C. MUNRO FERGUSON, *Hon. Secy.*
„ R. GALLOWAY, *Secy.*

XV. *Working Plan for the Pit-Wood Working Circle, Raith Estate.*

By Colonel F. Bailey, assisted by George U. Macdonald.

INTRODUCTION.

As the Working Plan for Raith is the first such plan drawn up and brought into operation in Scotland, it may not be out of place to explain briefly in what a Working Plan consists, and to give the reasons which render a plan of this kind necessary for all woods to be worked for profit.

It has frequently been stated that home-grown wood can never compete with imported timber, because the soil and climate of these islands are alike incapable of producing either the quality of material or the quantity per acre that can be grown in the countries from which we draw a large proportion of our supplies. On this subject Dr Schlich[1] says:—"*In the first place*, British timber cannot compete with the imported timber, because, as at present grown, it is of inferior quality, being generally shorter and less clear of branches and knots. Moreover, conifers generally grow too quickly in Britain, because the woods are too heavily thinned while young; hence the individual trees increase too rapidly, and produce timber inferior to that of the same species imported from the Baltic, and grown in crowded woods. *Secondly*, the home-grown timber is brought into the market in fluctuating quantities, so that neither a regular timber trade, nor superior methods of working up the material, nor forest industries, have a chance of developing and thriving. In short, the whole business is far too haphazard. Economic forestry, to be successful, must be conducted on true sylvicultural principles, and the yield must be so regulated that, approximately, the same quantity of material may be brought into the market every year; in other words, the principle of a sustained and well-regulated yield must be recognised. Then, and then only, can adequate financial results be expected from forestry."

There can be no reasonable doubt that the above represents the truth of the matter, and that our frequent failures to obtain satisfactory financial results are not due to defects in our soil and climate, but rather to the non-observance of sylvicultural rules,

[1] "Manual of Forestry," vol. iii., preface, pp. vi. and vii.

and to want of system in working. Forest management, like any other business, must be conducted on true economic principles if it is to be successful; success cannot be looked for unless continuity of aim, and persistent action towards the attainment of that aim, are maintained throughout the entire life of the crop of trees; and in view of the considerable number of years which must elapse between the planting of a wood and the time when it is fit to be cut down, even when timber of comparatively small size is grown, such continuity of aim and action are impossible unless all work be regulated by a plan or scheme, setting forth the object of management, and indicating at least the broad outlines of the measures needful to its realisation. In the absence of such a plan, it is inevitable that each successive proprietor or manager should follow his own line, which is sure to depart more or less from that of his predecessors, simply because no settled scheme of management exists which all are bound to follow. Haphazard work, and the frequent changes involved therein, have a most prejudicial effect on crops of trees; under such treatment, when the time arrives at which they should yield a substantial and long-awaited profit to their owner, they are often found in a disappointing condition. And this is not necessarily due to the negligence or incapacity of all or any of the successive proprietors or managers; in many cases it is due solely to lack of system. Woods treated unsystematically are, after the lapse of forty or fifty years, not infrequently found poorly stocked, incapable of satisfactory improvement, and adding but little to their value by the growth of successive years. Such woods do not occupy the ground profitably. It is manifestly in the interest of the owner that the ground which he devotes to the production of timber grown for profit should be kept fully stocked, and should be made to produce up to its full capacity; for there is then less necessity to restrict the areas which he desires to treat as game-coverts or as ornamental woods. Moreover, in proportion to the value of the produce they yield, fully-stocked woods are more cheaply fenced, worked and controlled, than woods of less density occupying a larger area; while, at the same time, the quality of their produce is greatly superior.

It is with a view to gain the advantages and avoid the drawbacks above alluded to, that a working plan should be framed for all woods to be managed for profit; and in order

that the nature of such a plan may be fully understood, certain matters with which it deals will now be explained.

A Working Plan, then, is a plan or project which, in the words of the late Mr D'Arcy, "sets forth the purpose with which a forest should be managed, so as to best meet the interests, and therefore the wishes, of the owner; and indicates the means by which this purpose may be accomplished. In other words, it is a forest regulation prescribing the application of certain cultural rules, and the execution of certain works, in order to produce a given desired result. . . . Both the object sought, and the means by which that object can be attained, depend on a variety of facts relating to the forest and its management; and, in order that the prescriptions contained in the Working Plan may be fully understood, it is necessary that these facts should be stated, and the manner in which the prescriptions have been deduced from them explained." These *facts*, *deductions*, and *prescriptions* are recorded in a report which forms the Working Plan.

The stock grown on the ground constitutes the *Forest Capital*, which yields annual interest in the form of a certain amount of new wood laid on to each of the individual trees composing the crop; and this amount may be taken out every year, in the form of a number of trees of equivalent volume, without diminution of the capital; for the timber removed is replaced by the growth of the next year. Indeed, if the forest capital be complete, the proprietor of the day is not only entitled to the wood-interest as his legitimate liferent, but he ought to take it annually or periodically, in order to maintain the organisation of the woods, and by so doing he will act in the best interest of his estate. But before determining the form in which the wood-interest, or *Yield*, of the forest is to be taken, it is necessary, when working for profit, to consider the kind of material that can most profitably be grown, and the size at which the trees first begin to yield it. It then becomes possible, with due regard to the rate of growth of the trees from that age onwards, to determine the age at which the crop should be cut down and utilised, the ground being then re-occupied by a young crop, which in its turn will be cut at a like age. This age indicates the length of the "*Rotation*." But it will be readily understood that, if a crop of a certain fixed age is required annually, and if its volume or the area it

occupies is to be the same year after year, the entire crop of the wood from which it comes must be made up of a series of age-classes equal in number to the years of the rotation; and also that the age of these classes must run regularly up, without a break, from one year to the number of years in the rotation. To take a simple example:—Suppose it be desired to cut annually one acre of oak-coppice twenty years of age. To enable this to be done, there must be on the ground just before the cutting in any year, a series of twenty crops, each standing on an acre of ground, and running through all ages from one to twenty years. Under no other conditions can the desired yield be obtained; for if the crops be older than this scale indicates, some of them, when their turn to be cut arrives, will be above twenty years of age; and if they are younger, the converse will occur. Where such a series of age-classes exists, the classes standing on equal areas of similar productive power, and the ground being completely stocked, the forest is said to be *normal;* and if each annual felling-area be restocked as soon as the crop has been removed from it, the 20-acre wood will, in the absence of disturbing influences, yield in perpetuity an annual crop of one acre of oak-coppice twenty years of age. In other words, it will give a *Sustained Yield* of that amount.

The advantages of organising woods worked for profit on the lines above indicated cannot be questioned. In the absence of such organisation, it is not possible for the proprietor to be sure whether he is taking from the property more or less than the amount to which he is entitled. On the one hand—and such instances are common—he may refrain from legitimate cutting through fear of taking too much; and, on the other hand, acting in the most perfect good faith, and in complete ignorance that he is doing so, he may diminish the stock to a point at which the annual increment, or the amount of new growth put on each year is seriously lessened, while the producing power of the soil is at the same time greatly impaired. The latter is an even more common occurrence than the former; and this is attributable, in the majority of cases, to the absence of a working plan clearly indicating to the owner the fellings he is entitled to make. Instances are known in which proprietors hesitate to fell woods which are long past maturity, and have for many years past ceased to yield a fair increment, merely because they do not wish to expose themselves to remarks. But on any estate where the

woods are organised under a plan, suggestions of overcutting could not have the smallest force; and where such a plan exists the estate need not, through the well-founded sensitiveness of the proprietor, suffer loss occasioned by the woods standing after they have ceased to grow profitably. Then again, the organisation of woods with a more or less equal annual out-turn of well-known classes of produce, has a most favourable effect on the local markets, and renders possible the foundation in the neighbourhood of industrial undertakings connected with forest produce, which an uncertain supply of the raw material on which they depend would not encourage. Lastly, on the estate, every one concerned knows what is to be done, arrangements for work and sales can be made in advance, the workmen are more regularly employed, and mechanical means for transport can be effectively organised, with the result that work in all its branches is better and more cheaply performed. It may be added that the proprietor is likely to take a more lively interest in his woods if they are worked on a settled plan, which he can understand and see carried out, and if he is satisfied that they are being made to yield the maximum revenue derivable from the soil, than if they are managed in a casual, haphazard fashion, and render uncertain returns.

THE WORKING PLAN.

Situation, Geological and Climatic Conditions of the Estate.

The estate of Raith, the property of Mr Munro Ferguson, M.P., is situated on the north-eastern shore of the Firth of Forth, in the parishes of Auchterderran, Abbotshall, Kinghorn, and Kinglassie, which form part of the county of Fife. The woods to which the working plan relates are at distances varying from two to five miles from the sea at Kirkcaldy.

The region within which the woods lie belongs geologically to the Carboniferous system. The strata consist of a great series of sandstones and shales with accompanying limestone—these stratified rocks being invaded here and there by basalt. Overlying all comes a ragged sheet of boulder-clay or *till*, partially filling the hollows and depressions, and thinning off upon the slopes and acclivities. Towards the sea-coast, where the ground is low and flat, the *till* is concealed below bedded clays and sand, the latter generally occurring at the surface.[1] The area occupied

[1] The above description of the geological characteristics of the property was kindly furnished by Professor James Geikie.

by the woods is for the most part undulating and devoid of marked elevations or depressions; the altitude above sea-level ranges between 150 and 500 feet. The soil of 388½ acres consists of sandy or loamy clay of good to moderate depth; 260 acres are peaty soil, of which 60 acres are of inferior quality; there are 130 acres of peat-moss, and 30 acres of poor, rocky ground. It may be said that for the production of Scots fir and spruce, the soil is on an average fully up to Quality II. (second best out of five), according to Weise's scale.

The mean annual temperature, taken during a period of forty years at six places in Fife, averaging 155 feet above sea-level, is 46°·6, the lowest mean monthly temperature, 37°·5, occurring in the month of December. The mean temperatures during the months of March, April, and May are respectively 40°·0, 44°·5, and 49°·1. From observations taken during a continuous period of seven years at Nookton, which stands at an elevation of 80 feet above sea-level, and at a distance of two miles from the coast, it is seen that spring-frosts are of common occurrence up to the second week in May. Autumn-frosts are often experienced after the middle of September; indeed, they not infrequently commence earlier in that month, and frost in July was once recorded. The mean annual rainfall taken during a period of eighteen years at eight places, averaging 250 feet above sea-level, is 31·6 inches; it is well distributed. The winds prevailing in this part of the county of Fife blow from the south-west and west, easterly winds being also common, especially during the month of May.[1]

General Description of the Woods.

The total area included in the working circle consists of 808½ acres, made up of twenty-six woods, separated from each other by agricultural land. Of this area, 621 acres, or more than three-fourths, are stocked with a mixture of Scots fir (pine) and spruce as the main crop, to which, in a large number of cases, a varying proportion of hardwoods (deciduous trees), such as oak, beech, Scotch elm, plane (sycamore), poplar, birch, and others, has been added. Of the remainder, 41½ acres are stocked with Scots fir, for the most part mixed with hardwoods; and 28 acres carry spruce, also, in some cases, mixed with hardwoods; while the

[1] The paragraph relating to meteorology was compiled from documents furnished through the kindness of Dr Buchan.

crop on 71 acres consists of hardwoods as the main crop; and 47 acres are not yet stocked, but are to be planted during the coming season. The average ages of the crops forming these woods range from one year up to about eighty-five years.

Speaking generally, the younger woods, up to the age of sixteen years, which cover an area of 573¼ acres, are fairly well stocked, and in good condition; but the same cannot be said of the older woods (235¼ acres), which bear very thin and irregularly distributed crops of inferior quality. In consequence, without doubt, of too early isolation, the trees composing these thin crops are deficient in height, and taper rapidly from the butt; while, owing to the unrestricted development of side-branches, their timber is knotty; and, as they were given excessive growing-space in their youth, they then formed unduly wide annual rings, composed mainly of soft tissue. To frame a reliable estimate of the growing stock in these irregular woods, it would have been necessary to undertake an enumeration survey over their entire area, but circumstances did not appear to warrant this. Such a survey was, however, made of three plots, which were selected as being the best of their kind, and the following was the result:—

1. One acre of mixed spruce (⅔) and Scots fir (⅓) in Bankhead, average age fifty years, contained 359 trees, yielding, by quarter-girth measurement, 2455 cubic feet.

2. A similarly constituted crop of half an acre in Bairnsbridge, average age fifty-eight years, contained at the rate of 382 trees, measuring 3114 cubic feet to the acre.

3. An acre of mixed Scots fir (¾) and spruce (¼) in Bairnsbridge, average age fifty-eight years, carried 387 trees, measuring 2844 cubic feet.

The above figures may be said to represent something like one-half of a full stock; and it is probable that the older woods, taken together, do not, on an average, contain more than from one quarter to one-third of the timber that might be growing on them. From the above facts, it is evident that these woods are not now yielding to their owner anything like the annual increment, or annual growth of new wood, which he might reasonably expect to receive from the soil on which they stand; and also that the quality of the wood produced is inferior. In consequence of these drawbacks, which, though now irremediable, are due to avoidable causes, the woods do not occupy the ground

profitably; and it may be concluded that their removal should be carried out as soon as this can be effected with due regard to other considerations, and that the ground should then be restocked with a young crop, which, under different treatment, will yield a larger quantity and a better quality of timber.

Injuries to which the Woods are subject.

No very serious damage has been done by strong winds during recent years, except in Ballfield and Fostertonden, where a considerable portion of the crop was thrown down in 1893-94. In Bairnsbridge some trees were blown down at the same time.

In some places the young crops have suffered a good deal from spring-frosts, as in Sandalhall, Cardenden Colliery, Tullylumb and Torbain Moss. Here, and in Muirhead, the drainage should be seen to.

Planting work has been rendered difficult by a dense growth of weeds in Torbain Moss, Raithmuir, Sandalhall, Rough Park, and Muirhead; and immediate measures should be taken, which must be continued for a few years, to protect the young stock from damage and thus give it a fair start.

The young plantations have suffered considerably from attack by the Pine Weevils (*Hylobius abietis* and *Pissodes notatus*). Those which have been most injured by these pests are in Square Wood, Hyndloup, Tullylumb, Torbain Moss and Muirhead.

Ground game has caused much damage to the young stock in Hyndloup, Tullylumb, Torbain Moss and Muirhead; and the rabbits must be kept down if these plantations are to make progress.

Fires ignited by sparks from railway engines have done some harm in Clunie Strip; while Clunie Muir and Rough Park stand at considerable risk of similar injury, and precautionary measures in regard to them have been suggested in Appendix B.

Markets for the Produce.

The bulk of the timber of all species cut on the estate is sold, in the form of round logs, to local merchants, who convert the Scots fir and spruce into roofing-boards, scantlings, cask-staves, etc. The sales are usually conducted by auction, but timber is sometimes sold by private contract. Tops, down to a diameter of 6 inches, and branches are severed; the best parts of these are then cut into pit-wood or fence stakes, and *the whole of the refuse*

is cut into firewood to supply Raith House and local demands. The rates per (quarter-girth) cubic foot, obtained at temporary depots formed near the felling-areas, for the various kinds of timber, are now as follows :—Scots fir, from 4d. to 6d., according to size of log; spruce, from 3d. to 5d.; oak and ash, about 1s. 6d.; elm, 1s. 3d.; beech, 6d. to 10d., according to size of log; plane (sycamore), 2s. to 6s., according to size of log. Round, hand-pointed stakes for sheep-nets, about 2 inches to $2\frac{1}{2}$ inches in diameter, are sold at 7s. per hundred stakes; larch is preferred for this purpose, but straight clean poles of Scots fir, spruce, or hardwoods are also used. Firewood sawn into billets sells freely at 8s. per cart-load, delivered within a radius of two miles from the saw-mill; this price representing a clear profit of 2s. per cart-load. The timber used for estate purposes consists principally of fencing "stobs" (posts) of larch, and "bars" (rails) of Scots fir.

A 10 horse-power traction engine is employed to drag the logs to depot, and to saw up posts and rails for fencing.

The Coal-Mining Industry in Fife.

The Fife coal-mines, from which are raised annually about five million tons of coal, consume a yearly average of approximately the following amount of pit-wood, viz.:—

	Linear feet.	Equivalent in solid cubic feet ($\frac{1}{4}$-girth measurement).
Imported wood, almost entirely spruce and Scots fir, coming chiefly from Baltic ports, ...	23,750,000	1,484,375
Home-grown wood, chiefly Scots fir and spruce from the north of Scotland, ...	1,250,000	78,125
Totals, . . .	25,000,000	1,562,500

The description of wood preferred for the mines consists of :—

Round fir "props," which run from $2\frac{1}{2}$ feet to 6 feet in length; the most suitable diameter being 3 inches at the smaller end.

Round fir "bars," which vary in length from 6 feet to 9 feet; they should have a diameter of from 4 inches to 6 inches at the smaller end.

Sleepers, which measure from 2 feet 6 inches to 2 feet 9 inches in length, with a cross-section of 5 inches by $2\frac{1}{2}$ inches, and are sawn from butt-ends which are too thick for props or bars. By far the larger quantity of timber used is in the form of "props."

The wood delivered to the mines from the Raith Estate is, for the most part, beech, elm, and other hardwoods of rough quality, sawn out of tops and branches into pieces from $2\frac{1}{2}$ feet to 4 feet in length, and 3 inches by 3 inches in cross-section. The miners do not much like this class of wood, as it is comparatively heavy, and is difficult to handle on account of splinters. They prefer the imported wood, because, being better seasoned, it is lighter, it has a smoother surface and a more uniform thickness, it is more free from knots, and it is also stronger, on account of the narrowness of its annual rings. They prefer spruce, because that species excels Scots fir in most of the above qualities. For imported round spruce and Scots fir props and bars, delivered at the mines, the average rate now paid amounts to 4s. $1\frac{1}{2}$d. per hundred linear feet, which is equivalent to 8d. per (quarter-girth) cubic foot. Wood of the same species, brought for the most part from the north of Scotland by sea, in the form of pit-lengths cut from round poles, and partially squared with the axe, to reduce bulk and weight during transport, is paid for at an average rate of 3s. per hundred linear feet, delivered at the mines; this rate amounts to about 6d. per (quarter-girth) cubic foot, which would represent a price of 5d. in the Raith woods. This timber is not so well seasoned as that which is imported from abroad, and it is therefore heavier; it is also of a much rougher quality. For the rough sawn wood from the Raith Estate, the price now paid at the pit's mouth amounts to about 2s. 7d. per hundred linear feet, or about 5d. per (quarter-girth) cubic foot, which represents from 3d. to $3\frac{1}{2}$d. in the forest. A few years ago, the prices paid were higher than this.

This Working Circle to be devoted to the Production of Pit-Wood.

In view of the large local demand for pit-wood, it has been decided to devote this working circle of $808\frac{1}{2}$ acres to the production of that class of timber; and the ground will ultimately be stocked with crops of spruce, where it is suitable to that species, while elsewhere Scots fir will be grown. The rotation has been fixed at 40 years, at which age it is assumed

that the trees will have attained a diameter of $6\frac{1}{2}$ inches at a height of 4 feet 3 inches from the ground. As soon as the working circle has been brought into a *normal* condition,—that is to say, when the stock is complete, when each of the 40 age-classes occupies approximately an area of $20\frac{1}{5}$ acres, and when, consequently, each of the successive annual fellings will extend over that area—it is estimated that the average annual yield will amount to about 60,000 (quarter-girth) cubic feet of timber. This forms but an insignificant fraction of the million and a half cubic feet of pit-wood which are annually consumed in the coal-mines of Fife; and the market may therefore be looked upon as amply assured. But should a decrease in the local consumption of this class of produce be anticipated, it would be quite simple, at any time, to increase the length of the rotation, and to allow the crop to grow on for the production of sawn timber, for which there will always be a large demand in the country.

List of Woods and Detailed Description.

In Appendix A will be found a list of the woods comprised in the working circle, regarding which it should be explained that the figures 1, 2, or 3, indicating the Quality of each locality, have a merely relative signification; they are not intended to imply specific powers of production. The figures 1, 2, 3, or 4, in the column referring to the Density of the Growing Stock in the older woods, have, however, a somewhat more definite meaning. As it had been decided not to undertake a complete enumeration survey, Mr Macdonald formed a rapid estimate of the growing stock in each wood, which enabled the following classification to be adopted, namely:—

Density	No. 1	representing	a stock of	under 800	($\frac{1}{4}$-girth) cub. ft.	to the acre.
,,	No. 2	,,	from 800	to 1600	,,	,, ,,
,,	No. 3	,,	,, 1600	,, 2400	,,	,, ,,
,,	No. 4	,,	a stock of	over 2400	,,	,, ,,

This classification is considered sufficiently accurate for present purposes.

In the Detailed Description of the Woods, which will be found in Appendix B, certain facts are recorded relating to the locality in which each wood, or compartment of a wood, grows; they also contain a brief description of the growing stock; and they indicate special points in regard to the

suggested treatment, which are not of such general application as to find a place in the body of the Report.

Existing Age-Classes.

The subjoined Table shows the area now occupied by crops of various ages :—

Ages of Crops on the ground in 1898.	Acres.[1]	Totals.		Normal Distribution.	Excess or Deficit.
A. The Younger Woods.					
Bare ground,	47¼				
Birch, etc., to be restocked,	13				
1 year,	16¼				
2 years,	163¼				
3 ,,	2¾				
4 ,,	92¾				
5 ,,	62¾				
Total 5 years and under,	...	398			
9 years,	3¼				
10 ,,	15				
Total 6 to 10 years,	...	18¼			
I. Total 10 years and under,	...	...	416¼	202	+214¼
11 years,	2¾				
12 ,,	12½				
13 ,,	8¼				
14 ,,	70½				
Roads,	4½				
Total 11 to 15 years,	...	98½			
16 years,	58½				
Total 16 to 20 years,	...	58½			
II. Total 11 to 20 years,	...	...	157	202	−45
A. Total for Younger Woods,	...	...	573¼		
B. The Older Woods.					
25 years,	6½				
Total 21 to 25 years,	...	6½			
30 years,	8½				
Total 26 to 30 years,	...	8½			
III. Total 21 to 30 years,	...	...	15	202	−187
35 years,	6½				
Total 31 to 35 years,	...	6½			
36 years,	32				
40 ,,	4				
Total 36 to 40 years,	...	36			
45 years,	54¼				
50 ,,	24¾				
60 ,,	18¼				
65 ,,	29				
70 ,,	14				
80 ,,	36				
85 ,,	1½				
Total above 40 years,	...	177¾			
IV. Total above 30 years,	...	...	220¼	202½	+17¾
B. Total for Older Woods,	...	...	235¼		
Grand Total,	...	...	808½		

[1] The areas of the woods and their compartments were furnished by the Estate Office.

An inspection of the Table shows at once that the stock in the middle-age classes is deficient, especially in that ranging from the 21st to the 30th year, and that there is a correspondingly large excess in the younger classes, especially in that of 5 years and under. If the distribution were not thus abnormal, the crop on one-fortieth part (equal 20 acres) of the total area would be felled during the current year, and a similar area would be felled in every succeeding year, until the whole of the ground had been cut over. But existing conditions, as indicated in the Table, evidently render that plan impossible; for if it were followed, the older woods would all be felled during the first 11 years; and the oldest of the younger woods, having then attained an age of only 26 years, would not have developed sufficiently to fulfil the object of management. Hence it becomes necessary to spread the cutting of the older woods over an increased number of years, during which period the younger woods will have more nearly approached the desired age of 40 years. It has therefore been decided to extend the cutting of the older woods over the first half (20 years) of the rotation, and to leave the younger woods to be cut during the second half-rotation, at the commencement of which the oldest of them will be 35 years of age. It would of course have been permissible to increase this age by spreading the cutting of the older woods over a period longer than 20 years; but it was not considered necessary to do this. If, after the lapse of the first 10 years, it does not seem likely that the oldest of the younger woods will be fit for felling in the 21st year of the rotation, the annual cutting-area for the remainder of the older woods must then be reduced, so as to make those woods last longer.

It will be evident that under the arrangement herein proposed, the age-classes of the working circle will not be in a normal condition at the end of the first rotation. Indeed, they will not be normal even at the close of the second rotation; but they will then so nearly approach that condition that they may be treated as normal. The present irregular condition of the stock in regard to age-classes is not due to over-felling, but rather to the energy with which planting has been carried on during the last five years.

Annual Fellings in the Older Woods.

The total area of the twenty-two older woods is $235\frac{1}{4}$ acres;

and as they are all to be cut over within the space of 20 years, it follows that the average area available for each year's felling is slightly over $11\frac{1}{2}$ acres. But the density of the stock is very unequal, and inconvenient variations in the annual yield would result from dividing the woods into twenty equal annual felling-areas of that size. Hence, the figures in the 6th column of the subjoined Table (which represent the relative densities of the crops in the various woods[1]) have been made use of to enable the areas of the relatively poorly-stocked and relatively well-stocked ground to be, respectively, increased or reduced in inverse proportion to the density of the crops they carry; the annual yield has thus been more or less equalised. Then, as a precaution against the spread of attack by beetles, it has been arranged that fellings on contiguous areas shall not be made at shorter intervals than four years; for example, the fellings in No. 40, Dundonald Muir, will be made in the 3rd, 7th, 11th, 15th, and 19th years; and similarly for No. 21, Cardenden, No. 26, Bairnsbridge, and others. It has further been decided to avoid leaving small plots of detached woods standing after the main portion of them has been cut over. The Table of Fellings has been drawn up so as to give due weight to all of these considerations, which, it will readily be understood, do not admit of an exactly equal annual yield being provided. The arrangement proposed is that which appears the best under the circumstances, though it unavoidably involves considerable variations in the areas to be annually replanted.

[1] See p. 233.

Table of Annual Fellings—1st to 20th year.

The Older Woods—235¼ acres.

Average Annual Felling-Area—11½ acres.

Year of the Rotation.	Season in which to be felled.	Names of Woods, with Compartments.	Annual Felling-Areas.		Relative Density of Growing Stock. No. 4 best.	Average Age.	
			Total.	Detail.		In 1898.	When felled.
			Acres.	Acres.			
1st,	1898–99,	16 (*a*). Clunieden, . .	...	7	1	65	65
		7 (*b*). Fostertonden, .	...	7	2	70	70
		4 (*a*). Ballfield, . .	26½	12½	1	80	80
2nd,	1899–1900,	21 (*b*). Cardenden, .	...	7½	4	45	46
		34 (*d*). Haugh Brae, .	9	1½	2	60	61
3rd,	1900–1,	42. Gomorrah, . .	...	5½	2	60	62
		40 (*a*). Dundonald Muir,	11½	6	4	36	38
4th,	1901–2,	3 (*a*). Clunie Mains Strips,	...	2	2	80	83
		9 (*c*). Sandalhall, .	...	3½	2	80	83
		24. Cardenbarns, . .	...	5	1	60	63
		27 (*a*). Beaton's Wood, .	...	5	2	60	63
		29. Torbain Quarry Belt,	16¾	1¼	2	60	63
5th,	1902–3,	16 (*a*). Clunieden, . .	...	7	1	65	69
		7 (*b*). Fostertonden, .	...	7	2	70	74
		4 (*a*). Ballfield, . .	26½	12½	1	80	84
6th,	1903–4,	21 (*b*). Cardenden, .	7½	7½	4	45	50
7th,	1904–5,	10 (*c*). Begg Strips, .	...	3¾	1	50	56
		40 (*a*). Dundonald Muir,	10¼	6½	4	36	42
8th,	1905–6,	8. Fosterton Plantation,	...	6½	4	50	57
		22 (*b*). Sunnyside, .	11½	5	2	50	57
9th,	1906–7,	4 (*b*). Ballfield, . .	...	5½	1	80	88
		16 (*b*). Clunieden, . .	...	7½	2	65	77
		7 (*c*). Fostertonden, .	16¼	3¼	3	50	58
10th,	1907–8,	21 (*b*). Cardenden, .	7½	7½	4	45	54
11th,	1908–9,	40 (*a*). Dundonald Muir,	6½	6½	4	36	46
12th,	1909–10,	26. Bairnsbridge, . .	8¼	8¼	4	45	56
13th,	1910–11,	16 (*b*). Clunieden, . .	...	7½	2	65	77
		8. Fosterton Plantation,	13¾	6¼	4	50	62
14th,	1911–12,	21 (*b*). Cardenden, .	7½	7½	4	45	58
15th,	1912–13,	40 (*a*). Dundonald Muir,	6½	6½	4	36	50
16th,	1913–14,	26. Bairnsbridge, . .	8	8	4	45	60
17th,	1914–15,	23 (*b*). Tullylumb, .	...	4½	3	35	51
		36. Muirhead Quarry, .	...	2	2	35	51
		28. Bankhead, . .	10½	4	4	40	56
18th,	1915–16,	21 (*b*). Cardenden, .	8	8	4	45	62
19th,	1916–17,	40 (*a*). Dundonald Muir,	6½	6½	4	36	54
20th,	1917–18,	1 (*c*). Raithmuir, .	...	8½	2	30	49
		41. Dundonald Sq. Wood,	15	6½	2	25	44
		Total Acres,	235¼				

The question was considered whether, seeing that the average annual felling-area was only $11\frac{1}{2}$ acres, the fellings should be made biennially instead of annually, in which case, of course, the average felling-area would be 23 acres. But it was thought better to adhere to annual fellings; and this for several reasons, the chief of which is the great importance of providing pit-wood regularly for the mines, so that their owners may come to rely on Raith as a source of supply. Were it not for this consideration, the yield might be taken periodically instead of annually, the usual fellings being postponed for a year or two, as might be suggested by a temporary fall in prices. Similarly, the yield might be anticipated to take advantage of unusually high prices; but in the latter case there could be no more cutting until the felling account had been adjusted. It may here be added that should, unfortunately, any considerable number of trees be thrown by wind on ground not included in the felling-area of the year, or should unforeseen fellings have been made in consequence of injuries by fire or otherwise, a corresponding reduction in the area of the current fellings should be effected, in order to adjust the felling account. Fellings will always be commenced on the side opposite to that from which the prevailing strong winds blow; and successive annual cuttings will proceed against wind, so that, in any wood, the trees felled last will be those on the windward side. The fellings will thus proceed, as a general rule, from E. or N.E. to W. or S.W. But where the whole of a block is not felled in a single year, strips of wood will be left standing on all margins, and these will be removed with the fellings of the last year in that block.

In the case of woods stocked with conifers, the crops will be clean-felled; but where hardwoods form the main crop, or where trees of those species are found scattered through coniferous woods, such of them as are likely to improve sufficiently by remaining throughout a second rotation will be left standing. These trees will usually be isolated, and they will not interfere with the new crop, especially if it be of spruce; but where they stand in groups, so as to form too dense a cover, the ground under them will not be planted. (See Appendix B, No. 16, Clunieden, *b*.)

Fellings in the Younger Woods.

The total area of the younger woods is $573\frac{1}{4}$ acres; and since

it is proposed to fell them during the second half (20 years) of the rotation, the average annual felling-area during that period will be about $28\frac{1}{2}$ acres, or $8\frac{1}{2}$ acres above the general average of 20 acres, which will ultimately be adopted for the entire rotation. But, in view of the fact that five-sevenths of the area of these younger woods are in the classes up to 10 years of age, it will probably be desirable to fix an average felling-area below $28\frac{1}{2}$ acres for the early years of the second half-rotation, and to increase it subsequently to a figure proportionally higher than $28\frac{1}{2}$ acres. As it is not considered advisable at the present time to make detailed arrangements for a longer period than 20 years, no table of fellings for the younger woods, corresponding to that drawn up for the older woods, has been included in this report. Such a table must, however, be made before the expiry of the first 20 years of the rotation, due regard being had to the condition of development in which the various woods are then found, and to the necessity of avoiding too frequent fluctuations in the yield, as well as of separating the fellings on contiguous areas by an interval of years, as a precaution against attack by beetles.

It is thus seen that during the first rotation of 40 years the yield of the working circle will be a progressive one, beginning with the crop on a small average felling-area of poorly stocked woods, rising in the 21st year to that on a much larger and better stocked area, and attaining its maximum a few years later. That is due to the irregular nature of the present crop, and it cannot be avoided. The yield will of course come down more nearly to the general average of the crop on 20 acres after the end of the first rotation.

Planting and Sowing.

As before stated, the ground will ultimately be stocked with crops of spruce, where the conditions are favourable to that species, while elsewhere Scots fir will be grown; but in order to give additional value to the stock, a few larches will be added to the spruce or to the Scots fir, wherever the local conditions are suitable. When choosing between Scots fir and spruce, preference will be given to the latter species, because heavier crops of it can be grown than of Scots fir, while the mine-owners are at least equally willing to take it, if grown with narrow

annual rings, such as are produced in dense woods. As a general rule, the system of clean-felling and restocking with nursery plants will be followed; but direct sowing has been suggested in the case of Ballfield, on account of the shallow and rocky nature of the soil.

It is desirable to restock the ground immediately after the removal of the old crops, when it will be clear of weeds; and, in addition to this advantage, the exposure of the soil for an unnecessarily long time will be avoided, there will be no loss of yield through the ground lying fallow, and the stock will have the fullest opportunity of growing to the required size within the period of the rotation. Against attack by beetles, especially *Hylobius abietis* and *Pissodes notatus* (Pine Weevils), the precaution has been taken to separate fellings on contiguous areas by intervals of time, amounting to not less than four years; but where beetles appear, measures must be taken against them, such as extracting the stumps, which may be sold as firewood, or covering the stumps with earth immediately after felling, and trapping and collecting the insects. In this connection, as well as to save time and allow the new crop to grow up even-aged, it will be a matter of great importance to fill up vacancies promptly, so as to get the whole of the young crop as quickly as possible over the stage at which it is particularly liable to injury. If, in spite of the above measures, the attacks in the young plantations are found to be very severe, the ground may be burnt over immediately after felling, and a field crop raised before it is restocked. This usually has the effect of destroying or driving away the insects.

Spruce plants will be put out 4 feet apart (2700 plants to the acre); while, in the case of Scots fir, the planting distance may be $3\frac{1}{2}$ feet, or about 3550 plants to the acre. Where larch is introduced, it will be planted at intervals of about 25 feet, so as to give about 70 larch trees to the acre; and where this is done, the number of spruce or Scots fir, as the case may be, will of course be correspondingly reduced. The Japanese species of larch should be tried, though it has already been attacked by disease in some parts of Great Britain. Plants of all three species should have well-developed roots. The ordinary method of "notching" in the plants is applied with difficulty in some parts of the estate where the sod is very thick, and plants put in thus are often too deeply buried. Experiments

should be made to ascertain the method of planting that is best suited to the locality, having regard to the expense involved in its adoption.

Thinning.

As the stock in the older woods is already too light, no thinning of green trees will be needed in them. But, from time to time, dead and dying trees should be removed, so as to realise their value, and to reduce the risk from fire and from dangerous insects, whose breeding-places they form; in Cardenden (*b*) and Dundonald Muir work of this kind must soon be undertaken.

The general rule for thinning the younger woods and new plantations will be as follows:—The first thinning will be made as soon as the development of the crop has produced a number of dead, dying, and suppressed poles. These will then be removed, together with any others that may have become injured or misshapen. It is not yet possible to say precisely at what age the first thinning will become necessary; the oldest of the younger woods, planted 16 years ago, do not yet show signs of requiring it. They appear to have been planted at 3 feet intervals, and not to have been thinned, except in the case of Cardenden Colliery, where diseased larch, with some birch, were removed six years ago; and in Powguild, where some spruce and larch were taken out in 1894 and 1895; but it is probable that a good many deaths occurred, and that the vacancies thus caused were not effectively filled up. Thinnings of the above degree, which will reduce risk from fire and insects, should be repeated as often as may be found necessary—possibly every 3 to 5 years—until about 10 or 15 years before the wood is to be felled, *i.e.*, until about the 25th or 30th year in the case of crops that are to stand throughout the full rotation of 40 years, but up to an earlier year in the case of crops which, in the first rotation, are to be felled before that age. If, towards the conclusion of these thinnings, parts of the wood should be found where the growth has been so equal that but few of the individual trees have outstripped their neighbours, and where the even crop is consequently too dense and the growth in diameter too much retarded, a portion of the trees will be thinned out, in order to afford more growing space for those left. When the above group of thinnings has been carried out, it will probably be desirable to make a somewhat heavier thinning (A), in order to enable the trees

to develop their diameter-growth more rapidly. The object now in view will be to lead the trees to the attainment of the desired diameter before the time for their removal arrives, while maintaining as many of them on the ground as is possible, consistently with the fulfilment of this all-important condition. If it should appear that one such thinning will produce the desired effect, the crop may then be left until the time for felling arrives; otherwise, an additional thinning (B) will be made 3 or 4 years later. But the degree of the thinning (A) should not be increased with the object of avoiding the necessity for the thinning (B), to which there is no objection; for all thinnings should be cautiously made, and the crop must at all times be kept as dense as is consistent with the attainment of the desired dimensions. Should it be found necessary to thin, on an average, four times in each felling-area of 20 acres, then it would follow that, in addition to the fellings of the year, thinnings would be made annually in four other felling-areas, *i.e.*, over an area averaging 80 acres.

Where larch forms part of the crop, it will receive special attention, with a view to retaining as many as possible of these trees to the end of the rotation. When the time for felling arrives, all larch trees which promise to stand and develop profitably during a second rotation will be spared; when removed at 80 years of age, they will form a valuable element in the yield. It is hoped that by introducing larch, scattered at comparatively wide intervals in a crop of evergreen trees, a considerable portion of them may escape the disease, which will, at any rate, not spread so easily as if the crop contained a larger proportion of this species. Dead side-branches of Scots fir and larch may be knocked off during dry summer weather or during frost; they will be of small size. For spruce, however, it will probably be necessary to use a saw. In either case, dead branches must always be removed flush with the stem or not at all.

The mixture of Scots fir and spruce prevailing in the younger woods is one to be avoided in future. In nearly all crops thus constituted, the leading shoots of a large proportion of the spruce are now suffering severely from being rubbed by the upper side-branches of the Scots fir, which grow more rapidly in youth; and unless measures are at once taken to free the heads of the spruce, by lopping the side-branches of the Scots fir, the spruce

will in some places be lost. This is a matter requiring immediate attention.

Treated in the manner above suggested, the woods of this working circle will, without any doubt whatever, yield pit-wood of at least as good a quality as that which the mine-owners now import from abroad, and for which they pay at an average rate of 8d. per (quarter-girth) cubic foot at the pit's mouth.

Expected Yield and Financial Results.

Of the 808½ acres composing the working circle, 137 acres have been under cultivation, and, thus employed, are capable of yielding a nett annual rental of 9s. per acre; 479½ acres are suitable for rough grazing, yielding a nett annual revenue of 4s. per acre; while the remaining 192 acres are waste, yielding nothing if not stocked with trees. The average annual cash surplus derivable from the whole of this land, if not afforested, is slightly under 4s. per acre, which is a *maximum* figure.

The Older Woods.

Precise data have not been obtained as to the yield that may be expected from the older woods during the first 20 years of the rotation. But the rapid valuation made of these woods (see p. 233), which now average about 55 years in age, and will average about 65 years when they are cut down, leads to the belief that the 235¼ acres which they occupy will not, even after the crops have put on their annual increment during an average of 10 years, give a higher all-round final yield of more than 1500 or 1600 (quarter-girth) cubic feet of timber per acre, worth perhaps £30. There will be no further thinnings in these woods. There is no record of what the thinnings already made have yielded; but assuming them to have realised half the value of the final crop, and allowing £4 for the original planting and fencing, and 3s. an acre yearly for tending and management, rates and taxes, etc. over the whole area, then these woods will have produced a nett annual revenue at the rate of 9s. 4d. per acre, representing, with compound interest on all items, an annual soil rental of 1s. 5d. per acre over the entire area they occupy.

The Younger Woods and New Plantations.

It may be assumed that, at the age of 40 years, the stock

on one acre in the younger woods and new plantations will be as follows:—

Spruce—

Number of trees,	900
Mean height,	55 feet
Mean diameter at 4 feet 3 inches from the ground,	$6\frac{1}{2}$ inches

which represents a volume of 4000 (quarter-girth) cubic feet of wood, down to 3 inches in diameter.

Scots Fir—

Number of trees,	750
Mean height,	51 feet
Mean diameter,	$6\frac{1}{2}$ inches

representing a volume of nearly 3250 cubic feet.

If it be further assumed that the two species will occupy equal areas, the average volume of the annual final fellings over the entire working circle will amount to 3600 cubic feet per acre. An estimate, based on the above data, could be fully justified; but in order to provide for contingencies, and to be on the safe side, the figure has been reduced to 3000 (quarter-girth) cubic feet, amounting to 60,000 cubic feet per annum on a felling-area of $20\frac{1}{5}$ acres (taken as 20 acres).

It has been said (p. 232) that the rate now paid for imported spruce and Scots fir timber, delivered at the mines, amounts to 8d. per (quarter-girth) cubic foot; and that the corresponding rate for rougher timber of these species brought from the north of Scotland is 6d., which represents a nett price in the Raith woods of 5d. The value of high-class timber is much more likely to rise than to fall; and 7d. per (quarter-girth) cubic foot is a moderate estimate of the price that will readily be obtainable at the mines for the class of timber now to be grown; this represents a rate of 6d. per cubic foot in the woods. At that price, the value of the final fellings on an acre, at the age of 40 years, will amount to £75; and seeing that the market is amply secured, that poles thinned out of woods 25 years old and upwards will yield some pit-wood, while larch that has stood throughout two rotations will enhance the value of the stock to an important extent, and that all waste wood is saleable as fuel, the returns from these woods may be safely estimated as follows:—Allowing £75 as the value per acre of the final crop of

3000 cubic feet, £5 for the additional value of the larch, and £12 for thinnings, including fuel; providing for expenditure on planting and fencing at £5, and for tending, management, and payment of rates and taxes, etc. at 3s. per acre per annum over the entire area; the younger woods and new plantations will yield a nett annual revenue of slightly over £2 an acre. If this sum be reduced by 25 per cent., as a further allowance for unforeseen contingencies, we are left with an annual surplus of 30s. an acre, which, with compound interest on all items, represents an annual soil rental of 14s. 10d. over the whole area these woods occupy. The expected annual surplus is therefore more than three times that to be obtained from the older woods, and represents at least $7\frac{1}{2}$ times the average cash surplus derivable from the land if it had remained under cultivation and grazing. The normal annual felling-area of 20 acres should then, under the extremely favourable conditions prevailing at Raith, render a sustained yield of at least 60,000 (quarter-girth) cubic feet of pit-wood, having a nett annual value of not less than £1200. The returns during the second half of the first rotation, *i.e.*, from the 21st to the 40th year, will be on an average higher than this, because, although some of the crops will not have reached the full age of 40 years, the average felling-area during that period will be $28\frac{1}{2}$ acres as compared with $20\frac{1}{5}$ acres.

Wind-Breaks (Shelter-Belts).

Wind-breaks, or shelter-belts, have been recommended for the more exposed sides of several of the woods. Where possible, such belts should be at least 40 yards wide, and they should be worked in two strips, one being from 30 to 40 years younger than the other, so that at least one-half of the belt may always be young enough to offer an effectual screen against the wind. The outer edge of each strip might be formed of hardwoods, such as oak, beech, plane (sycamore), and Norway maple, the branches of which might be shortened so as to reduce leverage, and thus enable the trees to offer a firm resistance to the wind. With these might be planted Corsican pine and mountain pine; and behind the latter a line of spruces, which should be allowed to branch low and develop their roots, and which might be headed off when they attain a height such as to endanger their stability. The first requirement from a wind-break is that it should stand up; and the individual trees composing it must be

sacrificed to the extent necessary to enable it to do so. If they also yield some timber, that is an advantage. But the hardwood trees in the inner strip need not be lopped until the outer strip is about to be cut down; it will be better to allow them, while under protection by it, to develop their roots fully.

Control Books.

The work done each year, its cost, and the revenue from sales, should be recorded in such a way as to enable the results of management to be clearly seen, and to form a guide in future revisions of the Plan. The quantity and value of wood used for estate purposes should also be shown, and a due proportion of the cost of forest management on the estate should be charged against this working circle. With some modifications, the two forms suggested in Mr Hill's Working Plan of the High Meadow Woods are admirably suited for the above purpose. (See Appendices C and D.) The forest year may run from 1st September to 31st August. A diary should be kept to facilitate the making of entries in the Control Book at the end of each year.

Conclusion.

Mr George Prentice, Factor, has cordially co-operated in the preparation of the working plan, and has at all times readily supplied information required from the Estate Office. The author is glad to acknowledge the advantage he has gained from the advice of Dr Schlich, especially in regard to the estimate of the yield to be expected from the younger woods and new plantations.

The Plan has been accepted by the proprietor, and is now in operation.

APPENDICES.

APPENDIX A.—List of Woods comprised in the Pit-Wood Working Circle.

Serial No.	Name of Wood.	Compartment.	Acres.	Relative Quality of Locality No. 3 best.	Principal Species.	Mean Age in 1898.	Relative Density of Growing Stock in Older Woods. No. 4 best.	Sheets of the 25″ Ordnance Map on which the areas are shown.	Remarks.
1	Raithmuir,	*a*	70¼	1	Scots fir and spruce,	4	...	xxvii. 11.	
		b	4	2	Scots fir, spruce, Douglas fir,	12	...	xxvii. 11; xxvii. 15.	
		c	8½	2	Scots fir, spruce, birch,	30	2	Do. do.	
		d	7¾	2	Scots fir, alder, elm, poplar,	5	...	Do. do.	
2	Dogton Rough Field,	...	3	3	Spruce,	1	...	xxvii. 11; xxvii. 15.	
3	Clunie Mains Strips,	*a*	2	3	Chiefly oak,	80	2	xxvii. 15.	
		b	...	...	... ...	..	...	xxvii. 11; xxvii. 15.	2½ acres permanent wind-break (shelter-belt).
4	Ballfield,	*a*	25	1	Scots fir, spruce, birch,	80	1	xxvii. 14.	
		b	5½	1	Hardwoods, Scots fir, and spruce,	80	1	Do.	
5	Clunie Muir,	...	17	3	Scots fir, spruce,	16	...	xxvii. 15.	
6	Easter Fosterton,	...	3¼	2	Scots fir, spruce,	9	...	xxvii. 15.	
7	Fostertonden,	*a*	2¾	3	Scots fir, spruce, Douglas fir,	11	...	xxvii. 15.	
		b	14	3	Hardwoods and spruce,	70	2	Do.	
		c	3¼	3	Do. do.,	50	3	Do.	
8	Fosterton Plantation,	...	12¾	2	Scots fir, spruce, larch,	50	4	xxvii. 15.	
9	Sandalhall,	*a*	4½	2	Scots fir, spruce, plane, birch,	12	...	xxvii. 15; xxvii. 16.	
		b	13¼	2	Spruce,	1	...	Do. do.	
		c	3½	2	Scots fir and beech,	80	2	Do. do.	
10	Begg Strips,	*a*	...	...	... ...	...	...	xxvii. 15; xxxv. 3.	1½ acres permanent wind-break.
		b	...	...	... ...	...	...	Do. do.	1½ acres permanent wind-break.
		c	3¾	3	Scots fir,	50	1	xxvii. 16; xxxv. 4.	
		d	1¾	3	Scots fir, spruce, and hardwoods,	10	...	xxvii. 15.	
11	Begg Moss,	*a*	...	...	... .	...	...	xxxv. 3; xxxv. 4.	15½ acres of birch—not in Working Plan.
		b	8	2	Birch, with a few oaks,	10	...	xxxv. 3.	To be restocked with spruce in 1898-99.
		c	...	...	... .	...	...	Do.	3 acres—not in Working Plan.
12	Dothan Strips,	*a*	2½	3	Scots fir and spruce,	13	...	xxxv. 3.	
		b	16½	2	Not yet stocked,	...	...	xxxv. 2.	To be planted in 1898-99.
13	Muir Strips,	*a*	1¾	2	Scots fir and spruce,	10	...	xxvii. 15.	
		b	...	...	... ...	...	...	Do.	1½ acres permanent wind-break.
14	Clunie Strip,	...	5¾	3	Scots fir, spruce, and hardwoods,	13	...	xxvii. 14; xxvii. 15.	
15	Rough Park,	*a*	72	2	Scots fir and spruce,	2	...	xxvii. 14, 15; xxxv. 2.	
		b	...	...	... ...	...	...	xxvii. 14, 15; xxxv. 2, 3	16 acres of hardwoods—not in Working Plan.
16	Clunieden,	*a*	14	2	Scot firs and hardwoods,	65	1	xxvii. 15.	
		b	15	3	Hardwoods, with spruce and larch,	65	2	Do.	
17	Square Wood,	...	22½	2	Scots fir, spruce, and hardwoods,	4	...	xxxv. 2.	

	Roads,	...	$2\frac{3}{4}$	...	... ...	...	...	...	...	
20	Hyndloup,	...	$17\frac{1}{3}$	2	Scots fir, spruce, and hardwoods,	2	...	xxxv. 2.		
21	Cardenden,	*a*	36	3	Scots fir and spruce,	16	...	xxxv. 2; xxxv. 6		
		b	38	3	Do. do.,	45	4	Do. do.		
		c	$2\frac{3}{4}$	3	Spruce,	3	...	xxxv. 6.		
		d	2	3	Not yet stocked,	..	...	xxxv. 2.		To be planted in 1898-99.
22	Sunnyside,	*a*	...	...	... ...	...	...	xxxv. 2; xxxv. 3		$35\frac{1}{2}$ acres of hardwoods—not in Working Plan.
		b	5	2	Hardwoods,	50	2	xxxv. 2.		
		c	$1\frac{1}{2}$	2	Not yet stocked,	...	...	Do.		To be planted in 1898-99.
23	Tullylumb,	*a*	54	2	Scots fir and spruce,	5	...	xxxv. 2, 3, 6.		
		b	$4\frac{1}{2}$	2	Spruce,	35	3	xxxv. 6.		
		c	3	3	Not yet stocked,	...	...	xxxv. 2; xxxv. 6		To be planted in 1898-99.
24	Cardenbarns,	...	5	3	Hardwoods,	60	1	xxxv. 6.		
25	Torbain Moss,	...	$50\frac{1}{4}$	1	Scots fir and spruce,	2	...	xxxv. 2, 3, 6, 7.		5 acres, to be restocked in 1898-99.
26	Bairnsbridge,	...	$16\frac{1}{4}$	3	Scots fir and spruce,	45	4	xxxv. 6.		
27	Beaton's Wood,	*a*	5	3	Oak,	60	2	xxxv. 6.		
		b	4	3	Spruce,	12	...	Do		
28	Bankhead,	...	4	3	Scots fir and spruce,	40	4	xxxv. 6.		
29	Torbain Quarry Belt,	...	$1\frac{1}{4}$	2	Oak,	60	2	xxxv. 7.		
30	Torbain Quarry Park,	...	$1\frac{1}{2}$	3	Mixed plantation,	5	...	xxxv. 7.		
31	Shawsmill,	*a*	8	3	Scots fir and maple,	2	...	xxxv. 6		
		b	$3\frac{1}{2}$	3	Scots fir and beech,	2	...	Do.		
		c	9	2	Not yet stocked,	...	...	Do.		To be planted in 1898-99.
32	Shawsmill West Belts,	*a*	5	3	Scots fir and spruce, with hardwoods,	10	...	xxxv. 6.		
		b	$3\frac{1}{2}$	3	Do. do., do.,	10	...	xxxv. 6; xxxv. 10.		
33	Knockbathy,	...	$1\frac{1}{2}$	2	Scots fir and hardwoods,	85	2	xxxv. 10.		
34	Haugh Brae,	*a*	...	...	... ...	...	...	xxxv. 6; xxxv. 10.		$\frac{1}{4}$ acre hardwoods—not in Working Plan.
		b	...	...	... ...	...	...	xxxv. 6.		6 acres hardwoods—not in Working Plan.
		c	2	2	Crop felled in 1897,	...	...	Do.		To be restocked with Scots fir in 1898-99.
		d	$1\frac{1}{2}$	2	Hardwoods,	60	2	Do.		
35	Muirhead,	...	5	1	Scots fir, spruce, and hardwoods,	2	...	xxxv. 5; xxxv. 6.		
36	Muirhead Quarry,	...	2	2	Scots fir, spruce, and hardwoods,	35	2	xxxv. 5.		
37	Denburn,	...	2	3	Scots fir and spruce,	14	...	xxxv. 5; xxxv. 6.		
38	Powguild Strip,	..	3	3	Scots fir and spruce,	10	...	xxxv. 5.		
39	Powguild,	...	$38\frac{1}{2}$	3	Scots fir and spruce,	14	...	xxxv. 5		
	Roads,	...	2	...	... ...	...	...	... ...		
40	Dundonald Muir,	*a*	32	2	Scots fir and spruce,	36	4	xxxv. 5; xxxv. 6.		
		b	12	2	Spruce and Scots fir,	2	...	Do do.		
41	Dundonald Square Wood,	...	$6\frac{1}{2}$	2	Scots fir and spruce,	25	2	xxxv. 2.		
42	Gomorrah,	...	$5\frac{1}{2}$	3	Chiefly hardwoods,	60	2	xxxv. 6.		
43	Blackroad,	...	...	...	.. ..	...	..	xxxv. 2.		$7\frac{1}{4}$ acres permanent wind-break.
44	Bankhead Park,	...	$13\frac{1}{4}$	3	Not yet stocked,	...	...	xxxv. 6.		To be planted in 1898-99.
	Total,		$808\frac{1}{2}$							

A

APPENDIX B.

Description of the Woods.

Note.—Where a wood consists of two or more compartments, the description of the first compartment applies to the others, unless otherwise stated.

No. 1.—Raithmuir. 90 Acres.

Compartment.	Acres.	Conditions of Locality.	Crop. (The Age given is that in 1898.)	Suggestions for Treatment, and Remarks.
a	70¾	Raithmuir stands at an elevation of 200 feet to 300 feet. Ground almost level. Peat moss, with clay and sand subsoil, resting on sandstone. About one-third of the area drained in 1895, 1896, and 1897. Exposed to wind on west side. Quality 1.	Scots fir (pine), with some spruce, 7 years; crop very thin, vacancies filled up in 1897 with Scots fir. Average age now 4 years. There are many self-sown birch, especially on south side.	Nothing more can be done until the time for thinning arrives, except to shorten the upper side-branches of the Scots fir should they begin to injure the leading shoots of the spruce, as they do at present in some other woods, and to cut away the birch where this becomes necessary in the interest of the conifers. The birch on the south side should be dealt with at once. The wind-break (shelter-belt), commenced in 1897 on the west side, should be completed.
b	4	South-eastern portion of the wood. Gentle slope to south. Soil deeper and more permeable than that of (*a*). Quality 2.	Scots fir and spruce, with some Douglas. 12 years old.	The leading shoots of the spruce now require protection by shortening the branches of the Scots fir that are injuring them. It will be interesting to watch the progress of the Douglas in association with the Scots fir and spruce.

c	8½	To the west of compartment (*b*), and similar to it. Quality 2.	Very rough and incomplete crop of Scots fir, spruce, and birch. Age, 30 years.	May be felled at any time, and the ground may be restocked with spruce, larch being interplanted at intervals of 25 feet.
d	7¼	At south and west of (*b*). Similar to it, but somewhat wetter. Quality 2.	Plantation of Scots fir, 2 to 9 years old, average age 5 years; vacancies filled up in 1896 with hardwoods, principally alder, elm, and poplar.	Probably many of the hardwoods will be removed during thinnings, except in places where they may be allowed to stand in groups. A permanent wind-break should be established on the west side.

No. 2.—Dogton Rough Field. 3 Acres.

	3	Elevation, 300 feet. Lies to the east, and under shelter of No. 3—Clunie Mains (*b*). Almost level. Deep loamy clay. Quality 3.	Spruce planted 1898, and doing very well.	

No. 3.—Clunie Mains Strips. 2 Acres in Plan.

a	2	Elevation, 250 feet. An almost level strip, running east and west on the south of the road. Quality 3.	A thin crop of hardwoods of poor quality. 80 years old.	Remove inferior trees, and underplant with spruce. Grow beech at west end as a shelter.

No. 3.—Clunie Mains Strips—*continued.*

Compartment.	Acres.	Conditions of Locality.	Crop. (The Age given is that in 1898.)	Suggestions for Treatment, and Remarks.
b	2½	Strip running north and south to the east of the road.	Standards of low-crowned oaks have been underplanted with Scots fir and spruce, the result being anything but satisfactory.	Treat as a permanent wind-break in two strips. The eastern strip should be dealt with as soon as possible. Cut over the stock, saving and pruning the best of the standard oaks, and restock with oak, beech, and plane (sycamore) on the west side of the strip, with a row of spruce on the eastern margin. The western strip should be similarly dealt with after the eastern strip has grown sufficiently to afford shelter. This compartment will not be included in the Pit-Wood working circle.

No. 4—Ballfield. 30½ Acres.

a	25	Elevation, 300 feet to 450 feet. The higher or northern portion of the wood is fairly level, but has a gentle slope to west. Soil very shallow in places, and nowhere deep. Much exposed to dangerous winds from the north and west. Quality 1.	Scots fir and spruce, about 80 years old; but the crop has been cleared in many places by the wind, especially on the north and west sides. About one-half of the crop has thus gone. Spruce has done well, where it has resisted the wind. There are a few beech, plane, and elm.	The old crop may be felled at any time; groups of promising hardwoods being left where found. A belt, not less than 20 yards wide, along the north and west sides should be sown with beech, oak, and plane in patches. Within this belt, Scots fir may be similarly sown, with larch at wide intervals. A permanent wind-break is required on the west side.

b	5½	In the southern portion, the ground is for the most part steep and very rocky, having a southern exposure. Some more level and better ground towards the east, and in the southern strip. Quality 1.	The steep southern slope is thinly stocked with trees of little or no value. On the more level ground there is some fairly good spruce and Scots fir. Age, about 80 years.	The old crop may be felled at any time. Sow Scots fir in patches on the drier and more rocky ground; and raise spruce elsewhere, sowing it on the more shallow spots, and planting it where, as at the east end, the ground is covered with coarse grass. Larch will be introduced at wide intervals. A permanent wind-break is required on the west side.

No. 5.—Clunie Muir. 17 Acres.

	17	Elevation, 220 feet. Very gentle southern slope. Peat soil on stiff boulder clay. Good depth. Much exposed on south-east side to fire from railway. Exposed to wind on west and south sides. Quality 3.	Mixed plantation of Scots fir and spruce, 16 years old. Mixture uneven, the two species forming groups in places. Density satisfactory, but the struggle for existence has not yet resulted in the production of any noticeable quantity of dead, dying, or suppressed trees; neither is there any other indication that thinning will be necessary during the next few years.	Where the two species are not in groups, the Scots fir is injuring the leading shoots of the spruce, and this should be seen to at once. It is desirable to maintain the mixture in due proportion to the end of the rotation; and to effect this it will be necessary to visit the wood at short intervals, in order to relieve the spruce by shortening the branches of the Scots fir which threaten it. A belt of hardwoods should be raised along the railway line, as a protection against sparks from the engines. The first thinning will be made as soon as the growth of the crop has resulted in the production of a number of dead, dying, and suppressed poles (see p. 241).

No. 6.—Easter Fosterton. 3¾ Acres.

Compartment.	Acres.	Conditions of Locality.	Crop. (The Age given is that in 1898.)	Suggestions for Treatment, and Remarks.
	3¾	Elevation, 150 feet to 200 feet. Gentle slope to north-west. About a foot of loamy soil on sandy clay, resulting from the decomposition of underlying basalt rock. The lower portion, which was wet, was drained in 1897. Quality 2.	Irregular crop of mixed Scots fir and spruce, with poplar, ash, plane, and beech scattered through them. Age, 9 years.	The poplars, which made very rapid growth, were found to be seriously injuring the leading shoots of the conifers, and most of them were thinned out during the winter of 1897–98. The remainder should now be removed. The spruce requires protection against the Scots fir. It is probable that at the end of the present rotation, a portion of the planes, and some of the ash, may be left as standards throughout a second rotation.

No. 7.—Fostertonden. 20 Acres.

a	2¾	Elevation, 200 feet. Gentle northerly slope. On higher ground good depth of fresh humus on sandy clay. Wet peaty soil. Quality 3.	Scots fir and spruce, with some young plane, ash, elm, and Douglas. Age, 11 years. A few old standards of beech and plane, which are doing harm. Density irregular.	Protect spruce from Scots fir; nothing further indicated until the time of the first thinning.
b	14	The central portion of the wood. Quality 3.	A thin crop of hardwoods with some spruce and larch. Age, 70 years. Crop much damaged by north wind, and now yields practically no annual increment.	Cut away the old crop, except outer trees on north and south. Maintain a wind-break along the stream on the north; plant oak and plane there. Plant poplar on the low ground within the wind-break, and Scots fir elsewhere, a few larch being intermixed with it.

c	3¼	The eastern portion. Exposure north-east. Quality 3.	Resembles compartment (*b*), except that the crop is denser; but most of the trees are of very poor quality. Age, 50 years.	Thin out sufficiently for underplanting with spruce. For this purpose remove all inferior trees; and if the cover is then too heavy in places, leave groups of the old crop, which will not be underplanted. Larch may be intermixed in open places.

No. 8.—Fosterton Plantation. 12¾ Acres.

	12¾	Elevation, 250 feet, with very gentle slope to the north. About a foot of loamy soil over sandy clay, resulting from a decomposition of underlying basalt. Exposed to wind on west side. Quality 2.	Thin crop of mixed Scots fir and spruce; chiefly spruce at north end. There are also some larch and hardwoods, chiefly at the south end. Age, about 50 years. Larch much diseased.	The crop is making but little growth, and it should be cleared off as soon as possible, the ground being then restocked with spruce on the northern half and Scots fir on the southern half; larch may be interplanted at wide intervals. A permanent wind-break should be established on the western side.

No. 9.—Sandalhall. 21¼ Acres.

a	4½	Elevation, 250 feet to 300 feet. Level ground. Shallow black loam on white sandy clay. Inclined to be wet. Quality 2.	Spruce and Scots fir, with some oaks and planes 12 years old; also some self-sown birch, and some older planes, ash, and birch. The birch has done considerable injury to the conifers, and the spruce needs protection from the Scots fir. Hardwoods badly pruned.	Dress back or remove young birch where it is injuring the conifers; elsewhere it may grow in groups. Shorten the branches of the Scots fir where it injures spruce. Shorten the branches of the older birch, plane, and ash where they injure the conifers. The more valuable of the younger planes should be carefully pruned, close to the stem, up to the height that a man can reach.

No. 9.—SANDALHALL—*continued.*

Compartment.	Acres.	Conditions of Locality.	Crop. (The Age given is that in 1898.)	Suggestions for Treatment, and Remarks.
b	13¼	The ground was drained in 1897, but the crop is still liable to injury by frost. Quality 2.	Planted up with spruce (2 year–3 year plants) in 1898. About half an acre is occupied by young, naturally sown birch. There is a very strong growth of weeds, and the young plants will need protection until they have outgrown them.	Keep drains open. Protect young plants from weeds.
c	3½	A narrow strip running along north side of road, between it and the wood. Quality 2.	Very thin crop of Scots fir and hardwoods. Age, 80 years.	Leave selected trees on the south or outer side; cut away the rest as soon as possible, and plant up with spruce.

No. 10.—BEGG STRIPS. 5½ Acres in Plan.

a	1¼	Elevation, 300 feet to 350 feet. Gentle slope to north. A good depth of fresh loam on porous, sandy clay. Width of strip, which runs north and south, about 22 yards. Quality 3.	Very thin crop of hardwoods. About 50 years old.	Treat as a wind-break in two strips. Commence the inner (eastern) strip as soon as possible, keeping any outside trees that may be of use. This area will not come into the Pit-Wood working circle.

b	1¼	Width of strip about 22 yards. Quality 3.	Very thin crop of hardwoods. About 50 years old.	Treat as a wind-break in two strips. Commence the inner (eastern) strip as soon as possible, keeping any outside trees that may be of use. This area will not come into the Pit-Wood working circle.
c	3¾	Width of strip about 24 yards. Quality 3.	Carries nothing at present but a few Scots firs, 50 years old. There is an irregular hedge of ash on the west side.	Vacancies in the ash hedge should be filled up with oak, plane, or beech, and the ground stocked with Scots fir, larch being intermixed at wide intervals.
d	1¾	Width of strip about 17 yards. It runs east and west. Quality 3.	Scots fir, spruce, oak, ash, elm, plane. Age, 10 years. Spruce appears to be attacked by a fungus.	Prune the best of the oaks and planes carefully. When thinning is required, favour the best trees, without regard to species; under this treatment many of the hardwoods will disappear.

No. 11.—Begg Moss. 8 Acres in Plan.

a	15½	The eastern portion. Elevation, 300 feet to 350 feet. Level, except a strip to the north, which has a moderate slope to the south. Two feet of moss and peat resting on white sand. Quality 2.	For the most part thinly stocked with rough, self-sown birch, about 7 to 14 years old. Average age, 10 years.	The crop is of little present value. It may be allowed to stand for another eight years or so, when the trees may become more saleable. The ground should then be stocked with spruce for pit-props. Not included in the Pit-Wood working circle.

No. 11.—Begg Moss—*continued.*

Compartment.	Acres.	Conditions of Locality.	Crop. (The Age given is that in 1898.)	Suggestions for Treatment, and Remarks.
b	8	The western portion. Quality 2.	Like the eastern portion, but the birch crop is much thinner. There are some standards of birch, oak, and plane. Average age, 10 years.	Clear the ground as soon as possible, leaving only such oaks and planes as may stand throughout a pit-wood rotation, and replant the ground with spruce.
c	3	The slope on the north. Quality 2.	Until recently, carried a thin crop of oak. Is now bare.	Restock with oak, plane, and beech. This area will not enter into the Pit-Wood working circle.

No. 12.—Dothan Strips. 19 Acres.

a	2½	Elevation, 300 feet. Deep fresh loam on sandy clay. A strip about 50 yards wide, running north-east and south-west, with a moderate slope to north. Exposed to west wind. Quality 3.	Plantation of Scots fir and spruce, with some larch, plane, elm, and willow; and with numerous poplar at the north end. The hardwoods have been badly pruned, especially the oaks. Age, 13 years.	Spruce needs protection against the Scots fir. Where poplars are injuring the conifers, they should be removed, or their branches should be shortened, except at the north end, where a group of them may be retained.
b	16½	Elevation, 250 feet to 300 feet. Gentle slope to north. The higher half, shallow sandy clay, resulting from the decomposition of underlying basalt. The lower half has a deeper clay. Quality 2.	Ground not yet stocked.	Will be planted in 1898–99. The lower third with spruce, and the remainder with Scots fir.

No. 13.—Muir Strips. $1\frac{3}{4}$ Acres in Plan.

a	$1\frac{3}{4}$	Narrow strip on east side of public road from Greenhead to Clunie Bridge. Gentle slope to north. Elevation, 200 feet to 300 feet. Strong clay on whinstone. Quality 2.	Scots fir and spruce, 13 years old in the southern portion, 8 years old in the northern. Average age, 10 years. There are some larch at the extreme south. The Scots fir and spruce are for the most part in groups, and consequently the spruce does not suffer from the Scots fir. There are a few standards of oak and beech; the latter interfering much with the young crop.	The crop must grow on until the time for the first thinning arrives. At the end of the rotation the ground should be restocked with Scots fir.
b	$1\frac{3}{4}$	Similar to (*a*). Quality 2.	A thin crop of rough beech trees, 70 years old, with some valueless coppice.	The ground should be cleared and restocked as a permanent wind-break; it cannot be included in the Pit-Wood working circle.

No. 14.—Clunie Strip. $5\frac{3}{4}$ Acres.

	$5\frac{3}{4}$	Elevation, 200 feet. Undulating, with general moderate slope to north. Good deep soil, but somewhat wet in the lower parts. Lies on north side of railway, and there is great risk of fire. Quality 3.	Plantation of Scots fir and spruce, about 13 years old, with willows, poplars, and alders, chiefly in groups. In the eastern portion there are some rough standards of elm, ash, birch, and other species, the presence of which is a disadvantage, but which cannot now be removed. Fire from the engines has already burnt a patch in the western portion.	Protect the spruce from the Scots fir, and both conifers from the willows and poplars. Cut down the Scots fir near the railway, in the centre of the wood, and complete the belt of hardwoods alongside the line, in order to save the rest of the plantation. This belt will act also as a wind-break to protect the conifers.

No. 15.—Rough Park. 72 Acres in Plan.

Compartment.	Acres.	Conditions of Locality.	Crop. (The Age given is that in 1898.)	Suggestions for Treatment, and Remarks.
a	72	Elevation, 250 feet to 300 feet. Slight slope to north. Shallow, peaty soil, resting on hard, sandy clay. Wet along east side, and on north by railway. Drained in 1896. Much exposed to fire from railway engines. Quality 2.	Planted with Scots fir and spruce, 2 years old—about 6500 plants to the acre. A strip 15 feet wide, and 30 yards from the railway, has been kept ploughed, as a precaution against fire. There are two small groups of horse-chestnut and elm planted on the higher ground, about the middle of the plantation.	The young plants are, in places, being choked by a high growth of dense grass and weeds, and will require frequent and close attention for a few years, otherwise serious injury will result. A belt of hardwoods—willow, poplar, alder, birch—should be raised as soon as possible along the railway, as a protection from fire to the rest of the wood, which will otherwise stand at very great risk.
b	16	A strip 100 yards wide, running along the north side of the public road. Quality 2.	Planted two years ago with oak, elm, and plane in equal groups.	This area will not be included in the Pit-Wood working circle.

No. 16.—Clunieden. 29 Acres.

a	14	Elevation, 250 feet to 300 feet. The western, higher, and level portion, strong sandy clay, wet and exposed to frost. Quality 2.	Very open wood of Scots fir, spruce, larch, elm, oak, ash, plane, and beech. About 65 years old. The Scots fir have done well, but the hardwoods are falling off, many of them being stag-headed.	The proprietor wishes some of the old trees retained, but, with these exceptions, the crop will be cleared off and restocked with Scots fir as soon as possible. Where the shade is too dense for Scots fir, spruce may be planted. A permanent wind-break is required along the western side.

b	15	The ravine or Den portion running south-west to north-east and north, with somewhat steep sides. In places the soil is wet. Quality 3.	Chiefly hardwoods of the above kinds, with some very good spruce, and some good larch. The density is greater than in compartment (*a*), but it is much below what it should be. Age, 65 years.	Here, though many of the trees are healthy and making good growth, the annual increment per acre is much below what it should be, and the soil is not yielding nearly up to its full capacity. Under these circumstances, it is desirable to introduce a new crop as soon as possible; and this may be done by thinning sufficiently to enable spruce to be established as an undercrop. Inferior trees, of which there are many, will of course be taken; the best and most promising trees being left as standards. No tree should be left which is not expected to stand and improve for forty years. If, when a thinning of this degree has been made, groups of standards are found in places, these need not be underplanted. A portion of the ground might be stocked with pure Douglas fir.

No. 17.—Square Wood. 22½ Acres.

	22½	Elevation, 300 feet to 350 feet. Very gentle northerly slope. Soil on north side, raw peat on white sand; elsewhere thin sandy clay. Moist, inclining to wet. Quality 2.	The ground was planted six years ago with Scots fir, spruce, larch, silver fir, Austrian pine, and many species of hardwoods. This crop has for the most part failed, owing, it is said, to attack by weevils. Vacancies were filled up three years ago with Scots fir, which was planted unnecessarily closely, but promises well. Average age, 4 years.	The presence of the hardwoods, which are numerous in places, constitutes a difficulty. Probably, as time goes on, some groups of them will be formed, and outside these the hardwoods will be sacrificed in the interest of the Scots fir, which is required for pit-wood. A few larches might even now be introduced at wide intervals in suitable places. In consequence of the present density of the young stock, thinning will probably be necessary at a comparatively early age. The hardwoods should be maintained on the north and west sides, as a protection against wind.

No. 18.—Cardenden Colliery. 5½ Acres.

Compartment.	Acres.	Conditions of Locality.	Crop. (The Age given is that in 1898.)	Suggestions for Treatment, and Remarks.
	5½	Elevation, 200 feet. Low-lying, sloping gently to stream on the north. Light sandy loam of moderate depth. Moist to wet in places. Subject to frost. Quality 2.	Scots fir and spruce, with a few larch, Corsican pine, willow, poplar, birch, plane, oak, and elm. Crop too light, owing to over-thinning and want of drains. The willows, poplars, and birches have injured the conifers, and the Scots fir is injuring the spruce. Locality very unsuitable to larch, which is in an unhealthy condition. Age of crop, 16 years. Some diseased larch, and some birch which were doing harm, were taken out six years ago.	Protect the conifers against the hardwoods, by shortening the branches of the latter; and similarly protect the spruce against the Scots fir. It is now too late to put in additional plants. The drainage should be seen to. Some years must elapse before thinning will be necessary.

No. 19.—New Carden. 32½ Acres.

	32½	Elevation, 350 feet to 400 feet. Fairly level, with slight northerly slope. Moderately deep sandy clay over blue clay. 2½ acres are occupied by roads. Quality 2.	A mixed crop of Scots fir and spruce, with a few larch, oak, beech, and ash. There were originally many more larch than there are at present, most of this species having been cut out at 9 years of age, because it was badly diseased. The crop, which is now 14 years old, is growing rapidly.	The spruce must be protected against the Scots fir.

No. 20.—Hyndloup. 17½ Acres.

	17½	Elevation, 350 feet. Almost level. Thin loamy clay overlying a stiff wet clay, with sandstone below it. Moist. Quality 2.	A plantation of Scots fir and spruce, 4 years old, mostly destroyed by rabbits and by weevil. Was re-stocked two years ago with the same species. Except on the southern half of the west side, hardwoods, with larch, have been mixed with the main crop in belts, which are 12 yards wide, except on the south, where the belt is 12 to 30 yards wide.	The hardwoods will protect the conifers from the wind; and at the end of the present rotation, the best of them will probably be kept for a second rotation. The crop must be protected against further injury by rabbits.

No. 21.—Cardenden. 78¾ Acres.

a	36	A ravine or glen, running from south-east to north-west, and traversed by a stream of water. Elevation, 300 feet to 350 feet. Slopes on both sides steep. Sandy clay overlying sandstone; fairly deep at top, deep below; wet in places at bottom. Very much sheltered from wind. Compartment (*a*) is the lower or north-western portion of the glen. Quality 3.	A very irregular and mostly thin crop of Scots fir and spruce, with a few larch and hardwoods, and a few Menzies spruce alongside the road. Age, 16 years. Willow and poplar are injuring the conifers in places, and the spruce requires protection against the Scots fir.	The branches of the willow and poplar should be shortened where necessary, to protect the conifers, and the Scots fir should be similarly treated in the interest of the spruce. Except at the bottom of the valley, it is likely that most of the willows and poplars will be removed in thinning, and even there they will probably not be retained except where they form groups. The whole of the low ground might have been stocked with these species. The other scattered hardwoods must be treated on their merits as the crop grows on. The south side of the glen would be an excellent place to form a plantation of Douglas. The condition of the crop renders it unlikely that the first thinning will be undertaken for some years to come.

No. 21.—CARDENDEN—*continued.*

Compartment.	Acres.	Conditions of Locality.	Crop. (The Age given is that in 1898.)	Suggestions for Treatment, and Remarks.
b	38	The upper, or south-eastern portion of the glen, from Shawsmill to end of the Gomorrah strip. The local conditions resemble those of compartment (*a*). Quality 3.	Very irregular crop of Scots fir and spruce, with scattered plane, elm, ash, and oak. About 45 years old. Spruce prevails at the lower, and Scots fir at the higher levels. There is a good deal of dead, fallen wood on the ground, and a good many dead, dying, and suppressed trees, which might be removed with advantage.	The crop might be cleared off at any time, and the ground replanted with spruce, to which some larch might be added. Dead, dying, and suppressed trees should be removed.
c	$2\frac{3}{4}$	Strips cut out of compartment (*b*) for shooting purposes. Quality 3.	Planted with spruce in 1896.	
d	2	At extreme north-west end. Resembles compartment (*a*), but slope steeper.	Bare.	To be planted with Scots fir in 1898–99.

No. 22.—SUNNYSIDE. $6\frac{1}{2}$ Acres in Plan.

a	$35\frac{1}{2}$	Elevation, 400 feet to 450 feet. Gentle slope to north-west. Shallow, sandy loam on broken rock. Wet in lower portion. Quality 3.	The ground has been recently cleared, and about half of it has been stocked with hardwoods; the other half is to be similarly stocked next year.	The crop not being grown for pit-wood, this compartment cannot be included in the Pit-Wood working circle.

b	5	Southern exposure. Steep. Quality 2.	Stocked with ash, elm plane, beech, and oak, about 50 years old. Natural seedlings of ash are springing up in patches.	May be felled as soon as convenient, promising oaks or young planes being left as standards. The ground should then be planted up with Scots fir; but promising groups of natural ash seedlings may also be retained. Larch might be added in open places.
c	1½	On north-west side of wood. Almost level; otherwise similar to (*a*), but Quality 2.	Bare.	To be planted with Scots fir in 1898–99.

No. 23.—Tullylumb. 61½ Acres.

a	54	Elevation, 350 feet. Fairly level. Soil, about 18 inches of peaty loam lying on sand. Drains needed on east side. Liable to frost in wetter portions. Quality 2.	A plantation, chiefly of Scots fir, with a few spruce; 10 years old. Rabbits and weevils have done great damage, causing the crop to be everywhere very thin, and leaving considerable blanks in places. Blanks filled up this year with Scots fir. Average age, 5 years.	The drainage should be seen to. An effort should be made to protect the crop from damage by rabbits; and blanks should be speedily filled up until the crop is established. The northern portion should be dealt with at once.

No. 23.—TULLYLUMB—*continued*.

Compartment.	Acres.	Conditions of Locality.	Crop. (The Age given is that in 1898.)	Suggestions for Treatment, and Remarks.
b	4½	Elevation, 350 feet. Fairly level. Soil, about 18 inches of peaty loam lying on sand. Drains needed on east side. Liable to frost in wetter portions. Quality 2.	About 3 acres of spruce, 35 years old. Not very healthy-looking.	The patch of spruce might come out at any time, and the ground would then be restocked with Scots fir.
c	3	Resembles compartment (*b*), but Quality 3.	Bare.	To be stocked in 1898–99.

No. 24.—CARDENBARNS. 5 Acres.

	5	Elevation, 300 feet. Gentle northern slope. Soil, deep mossy loam, wet in lower parts. Quality 3.	A few standard oaks, about 60 years old, remain. A few Douglas firs were planted in 1898.	Remove all inferior oaks, and underplant with spruce, larch being mixed at wide intervals in open places, where the soil is not too wet. Should, in any part, the oaks remaining stand too thick for an undercrop of spruce, the group of oak will be left, and spruce will not be planted under it.

No. 25.—Torbain Moss. 50‡ Acres.

50‡	Elevation, 350 feet. Fairly level. Half-formed peat on white sand. Parts very wet, drains shallow, and water standing near surface. Drier parts covered with heather. Liable to spring and autumn frosts. Quality 1.	Thin crop of Scots fir, planted four years ago; much damaged by game, weevil, and wet soil. Planted up in 1898 with spruce. Young Scots fir doing fairly well, and spruce is likely to do better; but old Scots fir are standing at the south-west corner, and stumps of this species, found over the whole area, show that this tree can grow if it gets a start. The heavy growth of grass and heather has rendered restocking very difficult. Five acres of thin birch lie at the extreme south.	The crop should be protected from damage by rabbits, and blanks should be steadily filled up with spruce, until the crop is fully established. The heavy growth of weeds should not be allowed to interfere with the young growth. The drainage should be seen to. These 5 acres will be planted with spruce in 1898–99.

No. 26.—Bairnsbridge. 16‡ Acres.

16‡	Elevation, 350 feet. Fairly level ground, sloping gently to the north-west. Sandy loam, on clay overlying limestone. Moist, inclining to wet in places. Old drains should be cleared out. Some damage has been done by the west wind. Quality 3.	Mixed crop of Scots fir and spruce, about 45 years old. Crop much too thin; consequently the trees are branchy, and lack height. A wind-break has been formed on the west side.	The old crop should be removed as soon as practicable, and the ground should be restocked with spruce, some larch being added.

No. 27.—Beaton's Wood. 9 Acres.

Compartment.	Acres.	Conditions of Locality.	Crop. (The Age given is that in 1898.)	Suggestions for Treatment, and Remarks.
a and *b*	9	Elevation, 400 feet. Gentle slope to north. Soil, deep loamy clay. Quality 3.	Standard oaks about 60 years old, in groups, with some standards of beech, Scots fir, and larch. Many of these are low-crowned, spreading trees, with numerous dead branches. Area of the older crop, 5 acres. The intervals between the groups of standards have been filled with spruce and Scots fir, 12 years old, mostly in groups. There is a group of poplars next the road on the south side. Area of the younger crop, 4 acres.	Cut out inferior oak standards, and all standards of other species, and underplant with spruce, adding a few larch in the more open spaces. The poplars will be cut out with the young spruce.

No. 28.—Bankhead. 4 Acres.

	4	Elevation, 400 feet. Gentle slope to north. Fresh sandy loam of moderate depth, on clay overlying limestone. Western corner requires draining. Quality 3.	Irregular crop of low, branchy Scots fir and spruce, about 40 years old. Spruce more numerous on eastern, and Scots fir more numerous on western side. A few oaks are scattered through the crop.	The crop should be felled as soon as possible, and the ground should be restocked with spruce.

No. 29.—Torbain Quarry Belt. 1¼ Acres.

	1¼	Elevation, 450 feet. Gentle slope to north-west. Deep clay overlying whinstone. Quality 2.	Low-crowned standard oaks of very poor quality, 60 years old, with dying spruce, 14 years old, below. Soil appears to be unsuited to oak.	Preserve marginal trees, cut out the rest, and plant Scots fir.

No. 30.—Torbain Quarry Park. 1½ Acres.

	1½	Elevation, 450 feet. Deep, permeable clay. Gentle slope to north. Quality 3.	A plantation, aged 5, of mixed trees—larch, spruce, and hardwoods.	The crop must be treated on its merits, as the several species develop. It is probable that it will yield some pit-wood at 40 years.

No. 31.—Shawsmill. 20½ Acres.

"	8	Elevation, 350 feet to 400 feet, with slight slope to north. Deep loamy clay. Portion south-east of road generally level. Quality 3.	Stocked with Scots fir, 2 years old. Norway maple mixed with the Scots fir in the north-east corner.	A wind-break is necessary at the west side.

No. 31.—SHAWSMILL—*continued.*

Compartment.	Acres.	Conditions of Locality.	Crop. (The Age given is that in 1898.)	Suggestions for Treatment, and Remarks.
b	3½	Portion north-east of road almost level. Quality 3.	Similar to (*a*); but one-half stocked in 1897, the other half to be stocked in 1899. There is a group of about ¼ acre of beech near the old lime-kilns, which is not included in the area, but which will be serviceable as a wind-break.	
c	9	Elevation, 300 feet to 400 feet. Moderate slope to north. Sandy clay, of moderate depth, resting on limestone. Quality 2.	Ground not yet stocked.	Will be planted in 1898–99. About one-half of the ground with spruce, and the remainder with Scots fir; but some beech and oak will be planted on the west side for shelter.

No. 32.—SHAWSMILL WEST BELTS. 8½ Acres.

a	5	A strip, average width 55 yards, running from Shawsmill westwards to the road. Elevation, 350 feet to 400 feet. Slight slope to north. Strong clay. Quality 3.	Scots fir, with a few spruce, 10 years old, very thin crop, with standards of oak, ash, and beech, and in places a young, natural growth of alder.	Prune off lower branches of the oak, close to the stem. Shorten branches of the ash and beech where they interfere with the conifers. Preserve outer trees on north and west sides as shelter from the wind. The young alders should not be allowed to injure the conifers. Thinning will not be needed for several years.

b	3½	A continuation of the above, 30 yards wide, running south to join Knockbathy Wood. Quality 3.	Do. do.	At the end of the present rotation, this strip may be converted into a permanent wind-break.

No. 33.—Knockbathy. 1½ Acres.

	1½	The southern face. Quality 2.	Carries a very incomplete crop of inferior hardwoods — beech, elm, oak, and Scots fir. 85 years old.	Fell as soon as possible, and plant Scots fir.

No. 34.—Haugh Brae. 3½ Acres in Plan.

a	2¼	Western portion. Elevation, 450 feet to 500 feet, with gentle northern slope. A ridge running north-east and south-west, very much exposed to wind from the north. Thin sandy loam on disintegrated basalt. Quality 2.	A thin crop of beech, 5 years old, with standards of beech and Scots fir on the north and south edges, and a few in the middle.	The standards remaining in the middle of the crop might be got out as soon as possible; and the young stock might be strengthened by interplanting plane, where the soil is suitable, and adding a few larch. The southern slope should be stocked with plane and beech. This area will not be included in the Pit-Wood working circle.
b	6	Eastern portion. Gentle slope to north. Quality 2.	Similar to above, but there are some young larches also.	Interplant with plane and larch. This area will not be included in the Pit-Wood working circle.

No. 34.—Haugh Brae—*continued.*

Compartment.	Acres.	Conditions of Locality.	Crop. (The Age given is that in 1898.)	Suggestions for Treatment, and Remarks.
c	2	Eastern portion. Steep slope to south. The southern slope here is wider than in the western portion. Quality 2.	The crop of hardwoods has recently been removed.	Plant Scots fir.
d	1½	Do. do.	One and a half acres in the centre of compartment (*c*) is still standing. Aged 60 years.	May be cut at any time, and replanted with Scots fir.

No. 35.—Muirhead. 5 Acres.

	5	Elevation, 450 feet. Ground practically level. Soil, thin peat on white sand. Central part wet; drains require opening, and there is much coarse herbage. Quality 1.	Stocked in 1892 with Scots fir and spruce; also some birch, plane, ash, and beech. Owing to attack by rabbits and weevil, a small proportion only of this crop survives. The ground was replanted two years ago, with Scots fir on the east and west, and spruce in the wetter or central portion. The young plants in this portion are not doing well, and there is danger of their being choked by the herbage.	If by next autumn the worst portions of the young crop have not improved, vacancies should be filled up again. The coarse herbage must not be allowed to stifle the young plants, which will require protection until they have grown out of danger. Maintain hardwoods on south and west sides as a protection against wind.

No. 36.—Muirhead Quarry. 2 Acres.

	2	Elevation, 450 feet, on somewhat broken ground, the site of an old sandstone quarry. Soil of moderate depth. Quality 2.	A thin, poor crop of Scots fir and spruce, with some plane and ash.	The crop should be felled as soon as possible, and the ground should be restocked with spruce, and with larch at wide intervals.

No. 37.—Denburn. 2 Acres.

	2	Elevation, 350 feet to 400 feet. On steep bank of the burn with southern exposure. Soil deep in lower parts, moderately deep above. Quality 3.	Crop of Scots fir, larch, spruce, and some willows. About 14 years old. Larch and Scots fir poor and unhealthy. Spruce much better.	Protect the conifers from the willow, and the spruce from the Scots fir.

No. 38.—Powguild Strip. 3 Acres.

	3	Strip about 50 yards wide running nearly north and south. Elevation, 400 feet. Gentle slope towards north-west. About 12 inches to 15 inches of loamy clay, overlying a stiffer blue clay. Quality 3.	Scots fir, with some spruce, beech, poplar, and hornbeam. 10 years old. Poplar is doing some harm to the conifers; and the spruce is suffering from the Scots fir.	The poplars should be dressed back or removed where necessary; and the spruce should be protected from the Scots fir. At the end of this rotation, the strip should be converted into a permanent wind-break, when it will fall out of the Pit-Wood working circle.

No. 39.—Powguild. 40½ Acres.

Compartment.	Acres.	Conditions of Locality.	Crop. (The Age given is that in 1898.)	Suggestions for Treatment, and Remarks.
	40½	Elevation, 400 feet. Ground sloping gently to north-east. About 12 inches to 15 inches of loamy clay, overlying a stiffer blue clay. Two acres are occupied by roads. Quality 3.	Mixture of Scots fir and spruce, with a few birch, plane, and ash. Age, 14 years. The crop on the upper or western half is more regular than that on the eastern half. The Scots fir is injuring the leading shoots of the spruce. About five years ago, a number of spruces were removed and replanted in Dundonald Muir. Some suppressed larches were at the same time cut out.	Protect the spruce at once from the Scots fir. Maintain the hedge on the north and west sides, and maintain also the hardwoods on these sides. They will together act as a protection to the conifers against wind.

No. 40.—Dundonald Muir. 44 Acres.

Compartment.	Acres.	Conditions of Locality.	Crop. (The Age given is that in 1898.)	Suggestions for Treatment, and Remarks.
a	32	Elevation, 400 feet. Fairly level, with gentle slope to the north. Thin layer of black mouldy soil, overlying a moderate depth of yellow sand. Quality 2.	A thin crop of Scots fir and spruce, 36 years old. Stems uneven, branchy, misshapen, lacking height. Defects probably due largely to over-thinning. Crop not making much progress. A considerable quantity of dead wood, refuse from last thinnings, lying on the ground.	The crop should be cut over as soon as possible, and the ground should be restocked with spruce; larch should be added at wide intervals. The dead wood should be cleared out.

b	12	Do. do.	In 1893 the ground was thinly stocked with spruce, 4 feet to 5 feet high, transplanted from Powguild. These have made but little progress. Intervals planted up in 1896 with spruce, and in places with Scots fir. There are some beech and birch at the north-west side.	Nothing more can now be done at present.

No. 41.—Dundonald Square Wood. 6½ Acres.

	6½	Elevation, 350 feet. Ground fairly level; about a foot of clayey loam on strong wet clay. Quality 2.	Scots fir and spruce, for the most part about 30 years old, but in the central portion about 22 years old. Crop irregular, thin, and branchy. Average age, 25 years.	The older part might be cut at once; but it will be better to let it stand some eight or ten years longer, in order to allow the younger portion to grow a little more. The ground may then be restocked with Scots fir in the western half and spruce in the eastern half.

No. 42.—Gomorrah. 5½ Acres.

	5½	Elevation, 400 feet. A strip averaging 55 yards wide, running with a gentle slope from south-west to north-east. Soil fresh, deep, sandy loam. Quality 3.	Crop chiefly hardwoods—oak, elm, plane, ash, and beech, with a few larch and spruce. Age, about 60 years. Some Scots fir, about 25 years old, on south edge. Crop, generally speaking, thin, and many of the trees of very poor quality, but there are some fairly good oaks.	Leave trees on edges, lopping their low branches on the inside. Leave promising oaks and planes, pruning off their low branches close to the stem, and remove all other trees as soon as possible, as the ground is not now yielding a proper increment. Plant it with spruce, adding larch at wide intervals. A wind-break should be formed at the west end.

No. 43.—Blackroad. (Not in Plan.)

Compartment.	Acres.	Conditions of Locality.	Crop. (The Age given is that in 1898.)	Suggestions for Treatment, and Remarks.
	7¼	Elevation, 400 feet. Thin layer of soil over stiff clay. Would be improved by drainage. Exposed to west wind. Quality 1.	This is a mere belt, about 40 yards wide, which is required to act as a wind-break for the protection of New Carden. It carries a thin crop of short, branchy Scots fir, about 35 years old, mixed with a few spruce and hardwoods, chiefly ash and elm. In its present condition it forms a very inefficient wind-break.	Treat as a permanent wind-break. The eastern half may be taken in hand as soon as convenient. The area will not be included in the Pit-Wood working circle.

No. 44.—Bankhead Park. 13¼ Acres.

	13¼	Elevation, 450 feet. Moderately steep northerly slope. Exposed to west winds. Soil, moderately deep, stiffish clay, overlying limestone. Has been drained for field crops.	Bare.	To be stocked in 1898–99 with Scots fir in the lower half and spruce in the upper half. A fringe of hardwoods will be planted as a wind-break on the west side.

APPENDIX C.

Control Book (Form No. 1) for the Pit-Wood Working Circle of the Raith Estate.

Provisions of the Working Plan.					Work actually carried out.				Work carried out compared with provisions of Plan.		
Year for which prescribed.	Name of Wood.	Compartment Letter.	Acres.	Nature of Felling.	Year in which work done.	Name of Wood.	Compartment Letter.	Acres.	Acres. Excess.	Acres. Deficit.	Remarks.
1900–01	Dundonald Muir, .	*a*	6½	Clean felling.	1900–01	Dundonald Muir, .	*a*	6½	...	...	
1901–02	Begg Strip, . .	*c*	3	Clean felling.	1901–02	Begg Strip, . .	*c*	3	...	...	
	Gomorrah, . . .	...	5½	Do.		Gomorrah, . . .	...	5½	...	...	
	Tullylumb, . .	*b*	3	Do.		Tullylumb . .	*b*	3	...	...	
	Sandalhall, . .	*c*	3½	Do.		Sandalhall, . .	*c*	3½	...	...	
	Clunie Mains Strip, .	*a*	2	Do.		.. ..	...	...	...	2	Clunie Mains Strip postponed until next year.
1902–03	... ...	...	...	...	1902–03	Clunie Mains Strip, .	*a*	2	2	....	From last year.
,,	Cardenden, . .	*b*	7	Clean felling.	,,	Cardenden, . .	*b*	7	...	...	

APPENDIX D.

Control Book (Form No. 2) for the Pit-Wood Working Circle of the Raith Estate.

Year.	Site and Description of Work.	Result of Cuttings.					Other Works.					Value of Produce.			Cost of Work.			Remarks.
		Timber sold.	Timber used on Estate.	Pit-wood.		Fire-wood.	Planting or Sowing.	Fencing.	Road-making.	Draining.	Cleaning.							
		Cubic ft.	Cubic ft.	Linear feet.	Equivalent in cubic ft.	Cart-loads.	Acres.	Yards.	Chains.	Chains.	Acres.	£	s.	d.	£	s.	d.	
19— 19—	Clean-felling, 6½ acres in Dundonald (*a*), timber sold,	13,000	...	12,000	750	30	...	...	...	...	...	282	16	0	45	0	0	
	Timber used on estate,	...	1000	...	...	...	...	...	...	...	...	20	0	0	2	15	0	
	Thinning 20 acres in Powguild,	...	...	16,000	1000	10	...	...	...	...	...	26	0	0	8	0	0	
	Thinning 20 acres in Rough Park,	...	...	...	...	15	...	...	...	...	...	1	10	0	1	15	0	
	Dead wood removed from Cardenden (*a*),	...	...	...	...	10	...		...	...	...	...			...			Given away.
	Planting in Square Wood,	...	...	...	...	...	20	...	...	...	...	...			80	0	0	
	Fencing in Square Wood,	...	...	...	...	...	...	300	...	...	...	...			9	0	0	
	Cleaning in Sandalhall,	...	...	...	...	...	...	...	...	...	10	...			2	0	0	
	Roads made in Clunieden,	...	...	...	...	...	...	...	40	...	...	...			10	0	0	
	Draining in Torbain Moss,	...	...	...	...	...	...	...	...	100	...	...			3	10	0	
	Nursery Work,	...	...	...	...	...	...	...	...	...	...	...			20	0	0	
	Share of charges for management,	...	...	...	...	...	...	..	...	...	...	...			30	0	0	

XVI. *Recent Investigations in Prussia in Regard to the Quality of Timber.*[1] By Professor WILLIAM SOMERVILLE, M.A., D.Sc., D.Œc.

Since 1890 Professor Schwappach of Eberswalde, and Professors Martens and Rudeloff of the Technical Mechanical Experimental Institute of Charlottenburg, have been engaged upon a laborious investigation into the specific gravity and resistance to crushing or pressure of timbers grown in Prussia, which has furnished results that cannot fail to be of interest and value to foresters in this country. The timbers under experiment comprised Scotch Fir, Norway Spruce, Silver Fir, Weymouth Pine, and Beech. It was determined to confine attention only to resistance to pressure, or crushing lengthwise, as a test of quality; for it has been found that, of all tests, this is the one that can be most easily applied, and gives most reliable results.

The extensive character of the work may be gathered from the numbers of trees that were submitted to investigation :—

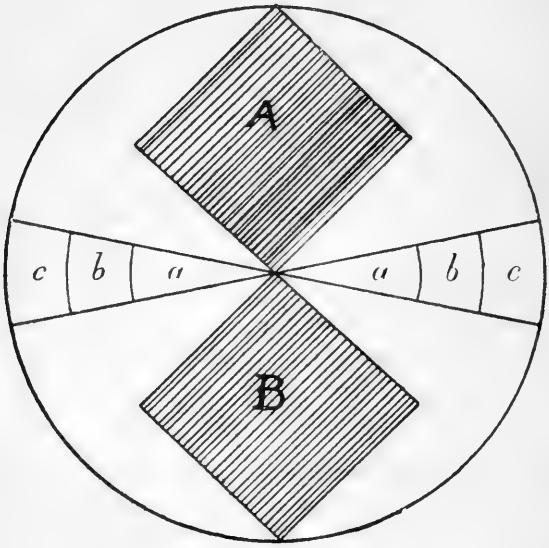
Scotch fir, ...	135
Norway spruce, . . .	60
Silver fir, ...	12
Weymouth pine, . . .	11
Beech, ...	44
Total,	262

Each tree examined was selected from amongst, at least, four hundred, and was always a stem whose diameter was exactly the average of all the others. The tree, having been felled, was marked into lengths, the measurement of the lowest length being 1 metre, while the others were generally four times as long. At these various distances complete sections of the stem were taken, and it was these sections, or discs, that furnished the material for the determinations. (A metre measures nearly 3 feet $3\frac{1}{2}$ inches.)

The accompanying figure shows the method of sampling the section. The stem having been cut through at any particular distance, the section thus made was marked in the manner indicated, the two portions A, B being intended for the pressure

[1] "Untersuchungen über Raumgewicht und Druckfestigkeit des Holzes wichtiger Waldbäume," by Dr Adam Schwappach. Berlin, Verlag von Springer, 1897 and 1898.

determinations, while those marked *a*, *b*, *c* were designed to be used for ascertaining the specific gravity. The portions to be used for determining the pressure were square on section, and, the side of the square having been ascertained, the stem was cut through at that distance from the first section, so that, when the shaded portions were ultimately sawn out in the laboratory, they formed true cubes. Seeing that the radius of the stem at any section was always taken as the length of the diagonal of the surface of the cube, the dimensions of the cube were always in direct relationship to the thickness of the tree. The portions



of timber with which the specific gravity was determined always corresponded to periods of growth of 30 years each; that is to say, *a* would comprise the wood formed before the 31st year, *b* the wood formed during the period from the beginning of the 31st to the end of the 60th years, and so on. This plan was first suggested by Prof. R. Hartig, and is now generally adopted in investigations similar to those under discussion. Evaporation of moisture between the forest and the laboratory was largely avoided by coating the sections with vaseline, and packing them in parchment paper. Before testing for shrinkage, the wood was steeped for 48 hours in water, so that its original volume was restored.

The specific gravity was determined in Friedrich's Xylometer, an instrument which gives readings to 1 c.cm. ($=\frac{1}{16}$ cub. in.). Before immersion in the xylometer, the dry wood was first coated with linseed oil, the object being to prevent absorption of water and consequent swelling, which would, of course, have interfered with the accuracy of the determination. Resistance to crushing was determined by Pohlmeyer's 100-ton testing machine, or, if this failed to crush the specimen, Hoppe's 500-ton machine was brought into requisition. Before testing, the wood was periodically weighed, and when two consecutive weighings gave the same figure, the specimen was said to be "air-dry," and in the desired condition for investigation. As further indicating the extensive character of the inquiry, it may be mentioned that the Scotch fir alone necessitated 4856 volumetric determinations, 2428 weighings, and 1247 pressure determinations, the tabulating of which gave employment to two calculators for six months.

The specific gravity of water is taken as 1, so that the specific gravity of timber, being generally less than that of water, is generally a fraction of 1. The specific gravity of a specimen of timber being given, one can at once calculate the weight of a cubic foot, by multiplying the weight of a cubic foot of water (62·5 lbs.) by the specific gravity of the timber in question. Thus the weight of a cubic foot of pine, whose specific gravity is ·6, is $62{\cdot}5 \times {\cdot}6 = 37\frac{1}{2}$ lbs. The resistance to crushing is stated by Prof. Schwappach in terms of a kilogram per square centimetre. I have, however, converted these terms into "pounds per square inch," by taking 1 kilo. = 2·2 lbs., and 1 square inch = 6·45 square centimetres.

The following is a short summary of the main conclusions that Prof. Schwappach and his colleagues have arrived at.

I. With the Scotch Fir.

The sp. gr. depends on (*a*) the quality of the situation; (*b*) its geographical position; (*c*) the height from the ground of the point from which the specimen is taken; (*d*) the age of the tree; and (*e*) the relative development of the spring and autumn wood.

The sp. gr. decreases more or less steadily as a tree is followed from the ground upwards, but it shows a tendency to increase

immediately underneath and within the crown. The average figures for 33 trees over 90 years old are here given.

Height on stem.	Average sp. gr.
1 metre	·577
4 ,,	·519
8 ,,	·466
12 ,,	·445
16 ,,	·435
20 ,,	·439
24 ,,	·444

These figures show that the sp. gr. falls rapidly up the height of 8 metres, and that the decrease is much less marked between this point and 16 metres. Higher up than this there is a slight recovery.

The sp. gr., in the case of timber grown on the better classes of soil, is at its maximum between the 30th and 60th rings, probably culminating about the 60th year.

Thus, in the case of 64 trees from Brandenburg :—

Limits of Age of Tree, in Years.	Sp. Gr. of the Wood between the Rings.						
	0–30	*31–60*	*61–90*	*91–120*	*121–150*	*151–180*	*181–210*
31– 60	·454	·486	...	..	...	...	...
61– 90	·490	·490	·486	...	...	...	...
91–120	·475	·498	·475	·467	...	...	...
121–150	·515	·520	·504	·484	·464	...	...
Over 150	·489	·524	·544	·512	·471	·441	·427

The effect of the improved sp. gr., under the influence of formation of duramen, is well seen in the column which refers to the wood of the 31st to the 60th rings, both inclusive. In the case of a tree 31–60 years old, there could, of course, be but little, if any, duramen in these rings, and the sp. gr. is a low one, namely, ·486. With trees up to 90 years of age there would be more pronounced formation of duramen in the 30 rings in question, and now the sp. gr. is ·490. In the case of still older trees (91–120 years), the duramen would be well formed in the 31st to 60th rings, so that the sp. gr. is now ·498, and rises in older trees to ·520 and ·524.

The condition of things is distinctly different in the case of trees grown on the poorer classes of soil. Here the heaviest wood is

always found in the portion comprising the 1st to the 30th rings, and steadily decreases as the section is followed towards its periphery. This variation in the sp. gr. of the wood from high and low class soils, doubtless stands in intimate relationship to the volume of the lumina of the cells. On poor soils growth is very slow in early youth, and therefore the cells are small and the wood is close-grained. Later on, when the shading of the ground is more complete, better growth results, the cells and their lumina becoming larger. On high-class soils growth is relatively faster in early youth, and slows down when crowding becomes severe.

The close relationship, though in inverse proportion, between rate of growth and sp. gr. in trees of the same age grown on soils of equal quality, is well illustrated in the case of 20 selected trees 30 years of age. Ten of these, from West Prussia, showed an average volume of 5·79 cubic feet and a sp. gr. of ·505, while the other ten, from Saxony, averaged 27·96 cubic feet with a sp. gr. of ·448. The slow-grown trees had thus a sp. gr. about 12 per cent. in excess of the others.

The close relationship between the quantity of autumn wood and the sp. gr. is clearly shown in these investigations. With scarcely an exception, the highest sp. gr. for any section corresponds with the highest percentage of autumn wood. There is, however, no general correspondence between ring-breadth and sp. gr., that is to say, a broad ring may or may not be lighter than a narrow ring, though, on the whole, it is no doubt lighter. The relative proportion of autumn wood to spring wood generally decreases as a stem is followed up, which partly accounts for the best wood being found in the bottom section. The figures for one tree may here be given :—

Height from Ground in Metres.	Rings formed between the Years.	Average breadth of Ring in Twenty-fifths of an Inch.	Per cent. of Ring occupied by Autumn Wood.	Sp. Gr.
1	0–30	6·6	37·3	·511
	31–60	3·8	47·7	·530
	61–90	2·9	49·1	·560
8	0–30	9·3	23·7	·434
	31–60	3·8	32·5	·477
	61–90	2·3	31·2	·477

In this connection Schwappach specifically states : — "Any influence, natural or cultural, that increases the percentage of

autumn wood increases the sp. gr., and, concurrently, the quality of the timber."

The latitude has considerable influence on the sp. gr. of timber, and, in the case of the Scotch fir, it may be said that heavier timber is produced in the north of Germany than in the south. This is in agreement with the accepted views of British foresters on the subject, who are well aware that Baltic pine is of higher quality than pine grown in, say, the south of England. As Hartig has pointed out, the rapid transition from winter to summer, that is characteristic of high latitudes, is unfavourable to the development of spring wood, so that, in timber from such regions, the autumn wood is relatively very abundant.

If Scotch fir timber grown in any particular district, but on different classes of soil, be examined, it will be found that the better the soil the heavier the timber. This presupposes, of course, that the forests in each case are of normal density, or otherwise the trees grown on the good soil would show so much more rapid growth that this factor might upset the influence of the quality of the situation *per se*. The worst timber of all was found to be that grown on peat.

As regards shrinkage, it was found that the wood of young trees shrinks more than that formed by old trees. Thus the average shrinkage of the timber of a 30-year old pine is about 15·7 %, whereas the wood formed between the 30th and 60th years of a 60-year old tree shrinks only to the extent of 11·1 %. Where, however, the degree of shrinkage of the wood in a complete section of a 60-year old tree is investigated, it is found that the wood of the inner 30 rings shrinks appreciably less than the wood of the outer 30 rings, a fact that is doubtless due to the formation of duramen in the centre of the tree. But for this, the inner wood of trees grown on good soil would shrink more than the outer. The variations in shrinkage in wood produced at different periods from 30 to 150 years are very small.

Resistance to crushing is influenced by factors similar to those that affect the sp. gr., though not always in the same way or to the same extent. Timber taken from near the base of a tree is usually more resistant to a vertical load than specimens taken higher up the stem, the power of resistance diminishing rapidly up to the height of 5 metres (about 16½ feet), and much more slowly afterwards; in fact, in a stem 25 metres long, it may be

said that the timber between the heights of 5 and 20 metres shows practically equal resistance.

Timber produced by old pines is much stronger than that of young trees. Thus, again taking the average of the Brandenburger stems grown on a good situation, we have the following figures :—

	Resistance to crushing in lbs. per square inch at the height of—		
	1 Metre.	9 Metres.	16 Metres.
Trees from 61–120 years, . .	7154	6256	5418
,, over 120 ,, . .	7921	7024	6256

It has already been pointed out that there is an intimate relationship between sp. gr. and the development of the autumn wood, and the same is true in regard to the strength of timber. Expressed as lbs. of pressure per square inch, an average of 10 stems shows that :—

When the % of autumn wood is under 30, the resistance is 5792
,, ,, ,, ,, 31–35 ,, ,, 6469
,, ,, ,, ,, 36–40 ,, ,, 7295
,, ,, ,, ,, over 40 ,, ,, 7959

Timber furnished by trees growing on the better classes of soil is distinctly stronger than that produced by poor soil.

The close relationship between sp. gr. and resistance to crushing is thus expressed by Prof. Schwappach :—

"1. The quality of the locality being constant, the sp. gr. that corresponds to a definite degree of pressure-resistance will be lower in the case of old trees than of young.

"2. The age being constant, the sp. gr. that corresponds to a definite degree of pressure-resistance will be lower in the case of timber from good than from poor soil.

"The converse is also the case, so that we may say :—

"3. The more favourable the conditions of growth, the lower may be the sp. gr. for any definite amount of resistance to pressure.

"And further:—

"4. For any definite sp. gr. the cell-walls do not exhibit uniform rigidity."

The limits of variation in the sp. gr. determinations of air-dry specimens of Scotch fir were found to be:—

(*a*) In the case of definite periods of growth, from ·778 to ·299, so that a cubic foot might weigh as much as 48·6 lbs., or as little as 18·7 lbs.

(*b*) In the case of complete transverse sections, from ·677 to ·326, the weight per cubic foot here varying between 42·3 lbs. and 20·4 lbs. The limits of variation in the determination of pressure in lbs. per square inch were found to be 10,049 and 3051.

Under these circumstances averages can be of little value, but Prof. Schwappach indicates an approximate average sp. gr. for whole stems of mature trees of ·500, and a pressure-resistance of about 7000 lbs. per square inch.

Comparing recent American work in timber physics, Prof. Schwappach comes to the conclusion that, in regard to pressure-resistance, good Scotch fir timber is equal to much of the so-called Pitch Pine of commerce. This is more particularly the case where the pitch pine is derived from *P. taeda*, Linn., and *P. mitis*, Mich., though Scotch fir does not come up to the strength of the timber of *P. cubensis*, Gries., or *P. australis*, Mich.[1]

II. With the Spruce.

In the case of this tree the heaviest wood was found to lie somewhat higher up (5 metres) than in the case of the Scotch fir. Except at that region of the stem the sp. gr. varies but little. The 60 stems investigated showed no constant relationship between the age of the tree and the sp. gr. of the timber. Some, in fact the majority, produced the lightest timber in youth, and showed a gradually improved quality as a higher age is reached; others showed lighter timber between the ages of 40 and 50 years than

[1] In the *Allgemeine Forst und Jagd-Zeitung* for November 1898, Mr B. C. Fernow maintains that Prof. Schwappach is claiming more for Prussian Scotch Fir than it deserves, and argues that the Prussian and American methods of sampling give results unfavourable to the American timbers. In the December issue Prof. Schwappach adheres to his original contention. An International Commission, under the joint presidency of Prof. Wijkander, of Gothenburg, and Prof. Schwappach, will, in 1899, deal with the whole subject of Timber Investigation.

either before or after that period; while in others the best timber of all was produced in early life, and a gradually deteriorating quality in the later stages. In this connection the determinating factor would appear to be the system adopted in regenerating or establishing the forest. If the forest has originated by planting on a clear-felled area, the young trees will show very rapid growth at an early stage, and such timber will be of low sp. gr. If, on the other hand, the wood has been renewed by natural seeding under a shelter-wood, the young trees will have made but slow growth in youth, and the timber will be heavy.

The spruce exhibits a much greater tendency to vary, both as regards sp. gr. and pressure-resistance, than the Scotch fir. Trees from the same forest frequently give most contradictory results, a fact that had previously been emphasised by R. Hartig. The sp. gr. of spruce timber from a first-class situation may be as high as that of good Scotch fir, though in the case of timber from poor soils there is a marked difference in the two trees in regard to this physical property. It is thus unsafe to attempt to generalise from investigations on a few stems, a very large amount of work being necessary to furnish a reliable average.

Shrinkage is most marked at a height of 4 metres (14 %), and gradually, though slowly, decreases towards the crown, where it amounts to 11–12 %.

Where the wood of sections from mature trees was examined, it was found that the central wood shrank least, and the outer wood most, though the difference is not more than 2 %, and generally even less. Resistance to pressure is at a maximum where the sp. gr. is highest; in fact, the general relationships between these two properties, that have already been indicated as holding good for the Scotch fir, have also been established for the spruce.

The limits of variation of sp. gr. in the case of definite periods of growth were found to be ·621 and ·261; while, in the case of complete sections, the variations were ·563 and ·371. Prof. Schwappach gives ·460 as the average sp. gr. for the whole timber of a spruce tree 100–120 years old (·500 for the Scotch fir); and an average pressure-resistance of 6500 lbs. per square inch (about 7000 lbs. for the Scotch fir), the limits being 8772 and 4657.

III. With the Silver Fir.

The twelve trees of this species submitted to investigation were all taken from two forests in Thüringia that had yielded

sixteen of the spruce trees. A strict comparison of the relative properties of these two species was thus rendered possible, and this constituted an important detail of the inquiry.

In the case of the silver fir the heaviest timber was found in the lowest section of the stem, a gradual fall in the sp. gr. occurring as the bole was followed up to the crown.

As regards age, it was found that the older the tree the heavier the timber (sp. gr. = ·395 for a tree 30 years old, ·416 for a tree 120 years old). Where sections of trees 120 years old were examined, the lightest timber was got near the centre (·395), the sp. gr. gradually rising as the periphery was approached (·424). The shrinkage was found to decrease slightly as the stem was followed towards the crown (12·1 % at 1 metre, 11·5 % at 17 metres), while it increased as the periphery of a section was approached (10·8 % within the 31st ring, 12·1 % between the 90th and 121st rings). The average per cent. of shrinkage for whole stems is put at 11·8.

Resistance to pressure agreed closely with the sp. gr. Thus, timber taken 4 metres or less from the ground withstood crushing better than timber situated higher up.

The limits of variation in sp. gr. in the case of the silver fir were found to be :—

(*a*) For definite periods of growth, . ·488 and ·315.
(*b*) For whole sections, . . . ·477 and ·354.

The limits of variation of resistance to pressure in lbs. per square inch of cross section were 8300 and 3915.

As an average for the whole stem of a mature tree, Prof. Schwappach suggests :—

Sp. gr. = ·410.
Resistance to pressure = 5675.

These figures indicate a lower technical quality for Thuringian silver fir than for ordinary spruce.

IV. With the Weymouth Pine.

The trees of this species submitted to investigation came from two plantations, about 100 years old, situated in Silesia.

As in the case of the Scotch fir, the highest sp. gr. was found in the lowest section of the stem (·391 at 1 metre, ·370 at 12

metres). The two species also agree in regard to the lightest timber being produced by young trees, the maximum being reached about the 60th year.

Where complete sections were examined, the sp. gr. was found to increase from the centre outwards (·333 within the 31st ring, ·382 between the 60th and 91st rings). This shows that the increase in sp. gr. in wood formed after, say, the 60th year is more than sufficient to counterbalance the increase in sp. gr. due to the formation of duramen.

In regard to variations in shrinkage, the timber of Weymouth pine agrees in general with the foregoing species, thus :—

Shrinkage at 1 metre	= 8·8 %.
,, 13 ,,	= 9·3 %.
Shrinkage of the inner 30 rings	= 7·9 %.
,, ,, outer 10 ,,	= 11·1 %.

The average shrinkage is put at 9·1 %, which is considerably less than that of the other conifers examined, and makes Weymouth pine specially suitable for certain purposes.

Resistance to pressure was greater in the lowest section than in any other.

The limits of variation in sp. gr. were found to be :—

(*a*) For definite periods of growth, . ·467 and ·322.
(*b*) For whole sections, . . . ·423 and ·327.

The average for the whole of the timber of mature trees is placed at ·370.

The limits of resistance to pressure in lbs. per square inch of section were 7746 and 4457, the average being 5960.

V. With the Beech.

Here, also, the heaviest wood was found near the base of the tree, a more or less gradual reduction in sp. gr. taking place as the stem was followed up to the crown.

When complete sections were examined, it was found that the sp. gr. decreased from the centre outwards. Thus, on the average, 34 trees showed that the wood comprised by the 1st to the 30th rings had a sp. gr. of ·705, that comprised by the 61st to the 90th rings a sp. gr. of ·663, while the sp. gr. of the wood of the 121st to the 150th rings was ·632.

The shrinkage rose and fell with the sp. gr., being 15·2 % where the sp. gr. was ·705, and 14·4 % where the sp. gr. was ·632 (see above). For general use a shrinkage of 15 % in beech timber may be taken as a sufficient approximation.

Resistance to pressure was found to be at a minimum at about two-thirds of the height of the tree, and at a maximum about 4 metres from the ground. In the case of this tree the points of maximum pressure-resistance and maximum sp. gr. do not quite coincide, though the variation is only insignificant. Prof. Schwappach says, "From the figures before us it would appear to be a matter of indifference, for practical purposes, which part of a beech tree is selected to furnish a beam of timber."

Resistance to pressure, however, varies much in trees of different ages, being at its maximum (about 8456 lbs. per sq. in.) in trees 80–85 years old, and at its minimum in trees of an age of 200–220 years (about 6610 lbs. per sq. in.).

The quality of the locality and the latitude of the situation were found to have but little influence on the strength of beech timber.

The limits of variation in the sp. gr. of beech timber were found to be :—

(*a*) For definite periods of growth, . ·795 and ·522.
(*b*) For whole sections, . . . ·749 and ·562.

As regards resistance to pressure, the limits were—a maximum of 12,713 lbs., and a minimum of 4825 lbs. per sq. in.

For well-grown trees the following averages may be taken :—

Sp. gr. = ·670.
Resistance to pressure = 7660 lbs. per sq. in.

One of the most satisfactory features of these investigations of Prof. Schwappach's is the closeness with which the results agree with those obtained by other workers, notably Prof. Robert Hartig.[1] The latter confined himself to determining specific gravities, but Schwappach's work shows that what holds true for this physical property will generally apply to pressure-resistance. This technical property of timber is but one of many, but it is the one that may be relied upon to give the most accurate results. If ordinary care be exercised in selecting the cubes to be operated

[1] For some of Hartig's results, see *Trans. High. and Ag. Soc.*, 1890, p. 26.

upon, knots may be largely or altogether avoided, whereas tests on the breaking, bending, flexibility, etc., of timber, necessitate the use of pieces of wood of such dimensions that the avoidance of knots is practically impossible. It is probably unnecessary to point out that pressure-resistances obtained with cubes selected with due regard to the avoidance of knots, will vary greatly from results that would be obtained with oblong blocks or beams, as, for instance, a pile or a pillar. But where the object is to compare the strength of different species of timber, or of timber grown under varying conditions, or taken from different parts of a stem, cubes selected on a definite system, such as that adopted by Prof. Schwappach, would appear to be best suited for the purpose. There is ample room for similar work on British timbers, and more particularly with the view of comparing their technical properties with those of imported timber; but we shall probably have to wait some time for its execution.

XVII. *Mr H. C. Hill on the Forest of Dean.* By Colonel BAILEY.

In July 1897 Mr H. C. Hill submitted to the Commissioners of Woods and Forests two reports relating to the management of the Forest of Dean; some points in these reports will be extracted in the following note:—

WORKING-PLAN REPORT FOR THE HIGH MEADOW WOODS.

These woods, covering an area of 3285 acres, were purchased by the Crown between the years 1817 and 1824. Regarding the composition and condition of the crop, it is stated that "while two-thirds of the area consisted of old woods, the remaining one-third, or 1000 acres, more or less, were planted between the years 1825 and 1850, and are now therefore aged from forty-seven to seventy-two years.

"The planted areas are still readily distinguishable by the regular rows of oaks, often of but mediocre or poor growth, and an underwood of hazel only, or of mixed ash and hazel. So far as is known, the original planting was done with a mixture of larch, Scots pine, and oak, and reports refer to a vigorous growth of the oak due to the larch and pine nurses, such as might have been looked for. That vigorous growth, however, was not long maintained, and one of two things happened. Either, with a view to more branching oaks, the nurses were removed too soon and the oaks isolated, or, what is perhaps more probable, the nurses were allowed to overtop the oaks and to dominate them for a time before being removed, and at the time of their removal the oaks were heavily thinned. This would well account for the stunted growth of the planted oaks in Marian's Wood, for instance. The proper course would have been to remove the larch and pine only gradually as they overtopped the oaks, and to have introduced an underwood of beech, instead of trusting to self-sown hazel, before thinning the oaks at all.

"The old woods are fairly complete, but they are irregular in their composition. Speaking generally, they are composed of oaks from middle-aged to mature, and some younger oaks, ash, and larch standing over a coppice of beech, hazel, ash, lime, wych elm, etc., in which many oaks have been planted, and recently some larch also."

On the subject of the past and present system of management,

Mr Hill writes that it "may be described as a periodic thinning out of the oak overwood, with which was combined the removal of larch and pines, and the cutting over of the underwood. From this latter, oaks and larch, and in recent years ash, cherry, and even a few beeches have been stored as standards. At the same time, oaks and larch have been freely planted in open spaces.

"The operations, however, have not been carried out over regular annual felling areas in any regular succession, nor do they seem to have been governed by any fixed rotation. It was considered desirable to cut over the underwood when the planted oaks were in danger of being smothered by it, and the thinning out of the oaks in the overwood was most conservatively limited to the removal of only unsound or over-mature trees, with the result that the best parts appear as high forest of old and middle-aged oaks over a coppiced underwood, poor in composition and growth, while elsewhere the overwood has been more freely cut, and the coppice is vigorous and well intermixed with seedlings of ash and oak, or planted oaks and larches.

"There has been an absence of a definite and clear method of treatment by which the development of the overwood or the coppice, as the case might be, would be the object aimed at either entirely or within certain limits. The operations have not gone on with regularity from year to year, or been carried out on the ground with order and sequence, with the results that the markets have been unevenly supplied, and the growing stock has been made irregular, to the detriment of its greatest production and most economical utilisation."

The ojbect of future management is thus set forth:—"With the demand for cordwood practically gone, and the capability of the woods to produce fine timber, it is considered that the aim in view should be the production of timber in greatest quantity of the kind and quality commanding highest prices. This object can best be attained by a high forest treatment, and the conversion of the woods from their present more or less 'coppice-with-standard' condition into 'high forest' has to be considered. It has been said that while two-thirds of the area consist of old, well-stocked woods, the remaining one-third is composed of incomplete oak plantations, aged from forty-seven to seventy-two years, with an underwood of hazel. While the original woods can be readily converted, the plantations are ill-suited for conversion to high forest, and since they are found chiefly grouped

together in the southern enclosures (known as Knockall's and Marian's), there is no difficulty in treating them separately from the larger group of original woodland."

Under the above circumstances, Mr Hill proposes to undertake the conversion of 2286 acres of the present coppice-with-standards into high forest, and to apply a more regular treatment—as coppice-with-standards—to the 999 acres comprised in the Knockall's and Marian's Woods. In both cases, the composition of the crops will be improved by planting after each cutting. Excluding Bircham Wood, 44 acres, the author divides 3241 acres into four working circles, two of which comprise 2242 acres under conversion to high forest, and two comprise the 999 acres to be worked as coppice-with-standards. He has formed this number of working circles with the objects of distributing the work, and the annual supply of produce, over four different localities; of securing the advantage of moderate-sized felling areas, which here will not exceed from 20 to 25 acres each; of facilitating, in the working circles under conversion, the selection of areas to grow on at once into high forest; and, lastly, of giving greater elasticity and freedom to future management when the conversion has been effected.

Two blocks, aggregating 678 acres, of the working circles under conversion have been set aside to grow on at once into high forest, and the remaining 1564 acres will for the present continue to be treated as coppice-with-standards, on a rotation of thirty-five years. It is proposed that, after the expiry of the first and of each succeeding period of thirty-five years, further areas shall be set aside to grow into high forest, until, in the course of time, the conversion of the whole of these two working circles has been gradually effected. The 678 acres now set aside will, in the meantime, have become fit for regeneration as high forest, and ultimately the rotation for these two working circles may be fixed at one hundred and fifty years.

The rotation for the two working circles to be treated permanently as coppice-with-standards, has, for the present, been reduced to twenty-five years, on account of the prevalence of hazel in the crop.

A felling is to be made annually in each of the four working circles, with an additional intermediate thinning in the areas set aside to grow into high forest.

Mr Hill thus forecasts the condition of the High Meadow

Woods after his proposals have had full effect:—"In the 'coppice-with-standards' working circles the underwood will be found massed together in similar aged groups, its composition being improved by planting, and the substitution of timber-growing species for hazel. The overwood will have been cleared of old branching trees past their prime, and in their places should be a more regularly distributed reserve of standards of younger age and more promising appearance.

"In the area under high forest will be found a complete wood of oak, ash, larch, and beech, aged from fifty to sixty years, surmounted by a valuable reserve of old well-grown oaks, one hundred and sixty to two hundred years old. Its regeneration and replacement by seedling oaks and beeches will probably be possible within the ensuing thirty years."

He gives a tabulated statement showing the fellings and intermediate cuttings to be undertaken during the first period of thirty-five years. He then offers suggestions regarding sowing and planting, the forest staff, and other matters; and he concludes his report with an estimate of the financial results of his proposals, and with the prescription of Control Books for the record of yearly work in each of the working circles. Detailed descriptions of the various blocks of forest are contained in an appendix.

Report on the Forest of Dean, with Suggestions for its Management.

After giving a general description of the forest, the author states that the main crop consists of oaks raised in plantations, over 10,833 acres of which the age of the trees ranges from eighty-one to eighty-eight years. Generally speaking, the oak forms a pure crop, but some other species are met with. The whole of the woods of the above age are said to be very open; they have all been more or less heavily thinned, and they are urgently in need of under-planting or under-sowing.

Regarding the past management of the forest, Mr Hill writes:—"Going back to the last century, it is recorded that in 1787 the forest carried a mixed crop of oak and beech in the proportion of two beeches to one oak, and this clearly indicates the conditions under which the fine oaks for which the forest was renowned were produced. They are identical with those under which, in the

present day, oaks of the finest size and quality are being grown and utilised in France and Germany, as well as in other parts of Europe, where it has always been recognised that oak only thrives after an early age (thirty-five to fifty years) and attains good dimensions when associated with some auxiliary species, which will aid in forming a complete leaf canopy, and by preserving the soil from the deteriorating influence of wind and sun, ensure the maintenance of its fertility. Lea Bailey, where beech was not exterminated, well exemplifies these conditions. The small value of beech as compared with oak, and its tendency to outgrow the oak and suppress it, probably explain the attempts to substitute woods of pure oak for the original mixed woods."

Elsewhere he observes that the effect of uncovering and exposing the ground has been to render the stiffer qualities of soil almost sterile, and to cause even the best soil to sink to the level of mediocrity.

The work of planting these woods was extremely well done, but in those days it was believed that closed forests became fit to be thrown open to common rights when the young trees had "grown up sufficiently." "At the same time, it was thought right to thin heavily. And the system of heavy thinnings, inaugurated in 1840 or 1850, was accepted as proper, became the custom, and was unfortunately pursued over a number of years, till the plantations were reduced to the condition of open park-like woods, with isolated branching hide-bound oaks of little or no promise as regards the production of timber of fine size and quality. The plantations were not only heavily thinned, but everything in the shape of underwood was cut out, with the result that the trees stood far apart, and the exposed soil became covered with a turf, fern, and brambles. The object in view was apparently to give to the oaks room to develop branches and produce crooked and curved timber for naval purposes. The fact that the fine timber which was then being felled had grown under quite different conditions, with 66 per cent. of beeches to complete the leaf canopy and maintain the soil's fertility, was lost sight of. The law of nature, under which pure woods of oak cease to thrive after the early stages of growth, was disregarded, and finally any natural filling up of the woods and completion of the leaf canopy was prevented in the majority of the enclosures by their being thrown open. Had an underwood of beech been introduced, the thinnings would have been justifiable; and had the leaf canopy

been allowed to become complete with oak *and beech*, the opening of the enclosures would not have resulted in such serious harm. It is an easy matter to point out, now that the results are apparent, the mistake that was made. In these days, too, we have the experiences of other nations in growing oak to guide us, as well as examples in the Forest of Dean itself, showing clearly the conditions which are favourable, and which it is desirable to establish. Fifty years ago there was the laudable ambition to grow a maximum quantity of crooked oak rather than the less valuable beech, and though there may have been the recognition of the light-loving nature of the oak, there was also the erroneous idea of admitting sunlight on the boles. On the whole, and not without some reason at the time, conditions essential for the growth of fine oak timber came to be overlooked."

Mr Hill thus discusses the future management of the forest:—

"If the Forest of Dean is to be maintained permanently as a forest, the chief object ought to be to place the 11,000 acres, which the Crown has the right to enclose, under favourable conditions of growth, in view to the establishment of a complete crop of mixed beech and oak in high forest, with scattered larch, chestnut, sycamore, and other trees. If this is done, the natural character of the famous forest will be restored and handed down to posterity, and the fine oak timber for which the forest is renowned may again be grown, and eventually harvested with other woods in the shape of a regular annual yield. The lower value of beech as compared with oak should in no way prevent its being grown in proper proportion, because it is only by the aid of the beech that fine oak can be grown, and the increased price commanded by the latter over that of oak grown in pure open woods will more than compensate for the low price of the beech."

. . . . . .

"With the exception of the Lining Wood of 80 acres and some parts where oak is making no growth, the whole of the woods will have to be tended on to a maturity, which they will not attain for some fifty or sixty years.

"In the oldest woods, where a naturally-grown underwood exists, as in Russells, Chestnuts, and Lea Bailey enclosures, rest only is required to allow it to grow up and complete the woods. The oaks are already too far apart, and for the next twenty years these may be allowed to grow on to a more useful girth. In the

small Acorn Patch, Yew Tree Brake, and parts of Park Hill, the underplanting of beech is recommended, but to be successful, strong three-year-old plants must be put out.

"In the fifty to fifty-six years old plantations there is some underwood coming naturally, but it is desirable to introduce beech generally by planting or sowing.

"In the twenty-five to forty years old plantations the sowing of beech mast will, as a rule, succeed, and an underwood once established, the overwood may be gradually thinned, so as to give to the oaks and larches that light which they demand to develop good crowns, but which must not be given by uncovering the soil.

"In the re-enclosed areas, which may aggregate 6335 acres before the limit is reached, and of which 660 acres have already been fenced in, it has been decided to cut out the worst of the oaks, reserving or storing the more promising to form a shelter-wood. Under this some natural growth of oak and ash may be expected to appear, and, if not allowed to be smothered by fern, it will survive. Larch, and oak, and chestnut, as well as sycamore and willow, have been freely planted."

. . . . . .

"Under the oaks, and generally where there are not natural seedlings or planted groups as above, beech should be thickly sown or planted. This work of fencing 6335 acres, cutting out the bad oaks, and planting, as now projected, will be heavy and costly, and it is thought that twenty years may well be given to its accomplishment."

. . . . . .

"The chief object is to restore the natural condition of the wood, as a complete mixed crop of oak and beech, and thus to secure a better development of the oaks. It may be urged that the oaks are not of sufficiently good shape and promise to ever furnish fine timber, and doubtless this is true to the extent that they will never develop such stems as were found in the old crop of the last century, but they will increase in girth and yield full-sized marketable timber, whereas now they would only give the less valuable undersized (flittern) wood and pit wood. It is advantageous, therefore, to keep them for themselves (*i.e.*, for their own sakes), while they will form a necessary shelter to the young beech, and favour the growth of the other plants in the openings.

"Arrangements should be made to re-close periodically, at

intervals, the equivalent of 300 acres a year, and to clear off inferior trees and plant as above."

The second work to be undertaken is the introduction of an underwood of beech or (exceptionally) of hornbeam, and possibly of spruce, in existing enclosures. Beech may be under-sown, with every prospect of success, in the 884 acres of woods, forty years old or younger, exclusive of the Lea Bailey enclosure, and also in some of the older woods; but elsewhere the beech must be planted.

"*Thirdly.* The Lining Wood of 80 acres, which contains mature oak, should be enclosed, and its natural regeneration undertaken. The wood has only to be slightly thinned by the removal of the oaks and beeches with the lowest crowns (except some young oaks in groups, which may be reserved to grow up with the new crop). Then, on an acorn crop appearing, the soil should be hoed up, and a crop of young oak will result. This should be rapidly uncovered by two or three successive fellings of old wood at intervals of three or four years, according to the state of the young crop. Some beech may be naturally produced with the oak, and, indeed, the young crop will be probably mixed from the beginning. In that case, care will be necessary to see that a sufficient number of oaks grow clear of the beech. Should the young crop be chiefly oak, it will be an advantage, as beech can be readily introduced twenty to thirty years later."

Fourthly. Certain areas where the oaks are not thriving should be cleared and replanted with conifers, preferably with spruce. Or, alternatively, these areas "might be cleared of all but the more promising growth, which might be kept in single trees or in groups of trees, and underplanted with spruce or beech. The cleared parts could be planted with Scots pine and small groups of larch. The latter are not likely to thrive in quantity or beyond a limited age, and therefore the main crop should be Scots pine."

Fifthly. Small blank areas in the forest, caused in most cases by fire, should be restocked.

Thinnings are not recommended until an underwood of beech has been established. "It will then be a simple matter, and a safe operation, to give more space to the oaks and larches, and remove any defective stems in the younger woods. Any holes made in the leaf canopy, which may not be quickly filled up by the crowns of the overwood, will be effectively closed by the

underwood of beech growing up in the place of the removed stems. Cleanings will be necessary in order to free the heads of the oaks, larches, sycamore, and chestnuts planted in the newly-enclosed areas. The first care will be to see that they are not smothered by the fern, and later they may be helped by cutting out any growth that may be overtopping them, and by a trimming of the epicormic and other branches of the trees in the shelter-wood that do not exceed 3 inches in diameter or form part of the crown."

Mr Hill concludes his report with suggestions regarding nurseries, roads, the organisation of the staff, and other matters. He gives an estimate of the financial results to be looked for, and recommends a form of Control Book for future use.

Detailed descriptions of the various blocks of forest are given in an appendix.

REPORTS BY THE HONORARY SCIENTISTS.

1. *Report on the Meteorology of Scotland for the Year ending 30th September* 1898. By R. C. Mossman, F.R.S.E., F.R.Met. Soc., Honorary Consulting Meteorologist.

The following condensed abstract of the meteorological conditions experienced throughout Scotland during the year under review has been compiled from the bi-daily observations made at sixty-seven stations reporting to the Scottish Meteorological Society. These observations have been reduced and otherwise corrected by Dr Buchan, and published in the form of an appendix to the Quarterly Returns of the Registrar-General for Scotland. Other sources of information, such as the monthly reports of the Meteorological Office, London, have also been utilised.

October 1897.—The weather of October was upon the whole very dry, with a high mean temperature, due to an excess of southerly winds. The mean temperature was 1°·6 above the average, the excess being largely due to the high day temperatures, brought about by the clear skies and strong solar radiation. Temperature, as compared with the average, was distributed over the country with remarkable uniformity; but was a little lower at stations near the east coast than at places facing the Atlantic. The mean rainfall was 2·47 inches, or 39 per cent. short of the average, being below the normal in all localities, although the deficit was very slight at some places in the extreme north-west and north of the country. Snow and sleet showers occurred in the north of Scotland on the 12th, but with this exception wintry weather was all but absent. Bright sunshine was in excess of the average all over the country, and especially so in the counties of Inverness and Perth.

November 1897.—The outstanding feature of the meteorology of November was its very high mean temperature, the highest yet recorded for November. The days were 3°·5 and the nights 4°·5 above the average, the nocturnal warmth being thus specially noticeable. The excess was most marked at inland places, where

it amounted to 5°·0 and more; but in Shetland the mean temperature was only one degree above the average. Throughout the month anti-cyclonic conditions prevailed; but the spell of tranquil conditions was broken by a severe gale from the west, veering to north-west, on the 28th and 29th, much damage being done by the high tides. Rainfall was below the average except in the Hebrides, but the deficit was not of a very pronounced character anywhere. The distribution of bright sunshine was very irregular, Stornoway and Glasgow being just the average; Fort Augustus, Fort William, and Braemar having a slight excess; and Aberdeen, Edinburgh, and Marchmont a defect. At the commencement of the month snow or sleet fell in the more northern districts.

December 1897.—Throughout December there was a marked excess of southerly winds, the mean temperature being thus in excess of the average, and the rainfall in many places double the average. Mean temperature was distributed over the country in a singularly unequal manner. "In the space enclosed within a line drawn through the Minch, Gairloch, Ballachulish, Kingussie, and the mouth of the Spey, the mean temperature was under the average, the deficiency being 1°·9 at Lairg, 1°·7 at Nairn, and 1°·0 at Fort William, Fort Augustus, Inverness, Dunrobin, and Gordon Castle. In every other part of Scotland it was above the average, the greatest excess being fully 2° in Shetland and Orkney, and to the south of the Forth and Clyde, where it was from a degree to a degree and a half in excess of the average." Rainfall was 35 per cent. above the average, but in some places in the north and east it was below the average, the greatest defect being 43 per cent. at Lairg. In many inland situations there was a great excess. Bright sunshine was just about normal taking the country as a whole, but there was a slight excess in some places.

January 1898.—The most remarkable feature of the weather of January was its phenomenally high mean temperature, the average of 44°·6 recorded in Edinburgh being the highest during one hundred and thirty-four years. All over Scotland there was a noticeable absence of snow and frost, the only snow reported falling in the extreme north on the 21st. At no place did the temperature fall below 22°·5, while no frost was recorded at fourteen of the stations. The mild weather was more pronounced at southern than at northern stations, and, what is rarely the case in winter, at inland than at coast stations. The mean rainfall was 20 per cent. below the average, but was distributed over the

country with great irregularity. Owing to the prevalence of strong west-south-west winds, the rainfall over the western parts of the country was greatly in excess of the average, but in that part of the country lying to the south of the Grampians there was a marked deficit. Bright sunshine was below the average very generally, but there were slight excesses at Strathpeffer Spa, Stornoway, Fort Augustus, and Braemar.

February 1898.—The weather of February was extremely changeable, with frequent snow showers during the first week, and also in the second half of the month. The mean temperature differed but little from the normal, but there was a slight excess in the south-west of the country. The mean rainfall was 27 per cent. above the average. There was a great deficiency from the South Esk in Forfarshire to the Tweed, but in the north and west there was a decided excess, more than double the average being precipitated in many localities. Over the west of the country generally the only fair days were from the 21st to the 24th. Sunshine was normal, but there was a great excess in the north-east, Aberdeen being the sunniest station in the British Isles. The excess was also well marked in the east, especially in the neighbourhood of Edinburgh. There was a deficit in the north and west, but the absence of sunshine was not of a very pronounced character anywhere.

March 1898.—Although the mean temperature of March was just the average, a good deal of cold and changeable weather was experienced, with frequent falls of snow and sleet. Nowhere over the country did the excess or defect of temperature amount to more than a degree. The mean rainfall was slightly under the average, taking the country as a whole, but varied greatly in different districts, there being a marked excess in the north-west. Only from one-fourth to one-half the average fell over wide areas south of the Grampians. An extremely heavy downfall took place over the West Highlands from the 16th to the 18th. Bright sunshine was just the average, and the percentage of the possible varied but little in different parts of the country.

April 1898.—The weather of April was chiefly remarkable for a high mean temperature and excess of rainfall, the month being the wettest April experienced since 1872. Southerly winds prevailed, with the result that the warm air from the Atlantic raised the mean temperature over the western districts, including the outlying Hebrides, to from 2° to 3° above the average. Over

the greater part of the country the excess of temperature was almost wholly occasioned by the unusual warmth of the nights. The mean rainfall was 68 per cent. in excess of the average, more than twice the normal quantity being recorded at Aberdeen, Braemar, and Ochtertyre. There was a slight deficiency at some places on the west coast, as also in Midlothian. There was a deficiency of sunshine over the country generally, the smallest amounts recorded being 22 per cent. of the possible at Edinburgh and Glasgow, Stornoway being the sunniest station, with 33 per cent. Gales were rather frequent for the time of year at the exposed northern stations.

May 1898.—The weather of May was characterised by a mean temperature slightly under the average, a mean rainfall a little above the average, and an average amount of sunshine. Temperature was just normal in the south-west from Ayrshire to Skye, but inland situations had a mean temperature two degrees below the average, the greatest defect being in east Inverness, and in Berwick, Roxburgh, and Peebles. On the 11th and 12th, the 16th, and even on the 31st, showers of snow and sleet were reported at some of the northern and north-eastern stations. Rainfall was very irregularly distributed over the country, being below the normal in the counties of Berwick, Fife, Galloway, Perthshire, and the south of Inverness-shire. At many places in the north, as well as in the extreme south, twice the normal quantity was precipitated, the northern stations being Kirkwall, Deerness, Thurso, Dunrobin, Tarbetness, and Perth. Bright sunshine was in excess at most of the northern and western stations, but slightly below the mean in the east and south-east, more particularly at coast stations. The percentage of possible ranged from 42 per cent. at Fort William to 32 per cent. at Edinburgh and Strathpeffer Spa. Over most of the country the values were fairly normal.

June 1898.—The weather of June was changeable and showery, the meteorology of the month being without feature, all the climatic elements, taking the country generally, approximating very closely to their normals. The mean temperature was about half a degree under the average, the greatest deficiency being one degree over places to the east of a line intersecting Kelso, Dundee, Aberlour, and Inverness. There was a slight excess, amounting to about a degree, in many of the inland counties. The mean rainfall was 7 per cent. less than the average, but was very irregularly dis-

tributed over the country, there being a decided excess in the Outer Hebrides, while only half the average fell "over a wide district, bounded on the west by a line drawn from Dundee through Kingussie to Cromarty." Bright sunshine was very generally below the average, the only place reporting an excess being Fort Augustus. Stornoway reported just the average.

July 1898.—Although the mean temperature was slightly under the average, the month was noteworthy as having the lowest mean humidity on record, while the rainfall was also exceptionally small. The north of the country was relatively much colder than the south, but in some districts there was a slight excess, amounting to half a degree. The mean rainfall was just half the normal, and in many places only one-quarter of the average fell, but in Orkney there was a slight excess. Strong winds were of rare occurrence, there being only one gale recorded, and that in the far north. Bright sunshine was in excess of the average, except in the Hebrides.

August 1898.—The characteristic features of the weather of August were a mean temperature a little less than a degree above the average, a rainfall 20 per cent. above the average, and a normal amount of sunshine. There was an excess of westerly winds, due to pressure being relatively higher at southern and eastern stations than at places in the north and west. The mean temperature was slightly below a degree above the average, the excess being greatest in south-western districts open to the Atlantic. The excess was more marked near the coast than at inland places. The rainfall was distributed over the country with great irregularity, being under the average "to the east of a line drawn from Dunrobin to Fort Augustus, Kingussie, Braemar, and Cupar, and in the counties of Berwick, Peebles, and Selkirk." At coast stations on the east there was a great deficiency. At all places open to the westerly winds, rainfall was above the mean.

September 1898.—The weather of September was characterised by an unusually high mean temperature, with a mean humidity slightly under the average, and a rainfall just the normal. The mean temperature was 3°·2 above the average, a value exceeded only by the Septembers of 1865, 1890, and 1895. The weather was eminently anti-cyclonic throughout, and it is to the dry atmospheric conditions, clear skies, and strong sunshine characteristic of anti-cyclonic conditions, that the high temperature is to

be attributed. The excess of temperature was greatest at inland and eastern stations, but the average was exceeded by only a degree in Shetland. The week ending 10th September was phenomenally warm, the nocturnal temperature, accompanied by great humidity, being a very noticeable feature. In the vicinity of Edinburgh this was the warmest week since June 1826. The mean rainfall was 5 per cent. above the average, being below the normal in Shetland, in Clydesdale, and at eastern stations from the Moray Firth to the Cheviots. Over the part of the country not embraced by the above districts the rainfall was in excess, which was greatest at Airds, Inveraray, and Dollar, where nearly double the normal quantity was collected. Bright sunshine was very generally in excess of the normal.

Abstract of Meteorological Observations made at Sixty-seven Stations of the Scottish Meteorological Society for the Year ending 30th September 1898, *and compared with the Average of the Forty Years* 1856–1895.

	Temperature.		Rainfall.		Sunshine.	
	Mean Temp.	Diff. from Average.	Total Inches.	Diff. from Average.	Total Hours.	Diff. from Average.
	°	°				
October 1897,	48·0	+1·6	2·47	−1·58	103	− 4
November ,,	44·6	+4·0	3·24	−0·42	38	−34
December ,,	38·6	+0·8	5·37	+1·40	35	−21
January 1898,	42·9	+5·8	3·14	−0·76	36	−18
February ,,	38·2	−0·2	3·90	+0·84	75	− 7
March ,,	39·6	+0·2	2·27	−0·53	114	− 4
April ,,	45·6	+1·5	3·61	+1·47	107	−48
May ,,	47·7	−1·3	2·62	+0·34	175	−12
June ,,	54·4	−0·4	2·32	−0·16	170	−44
July ,,	56·5	−0·6	1·52	−1·65	181	+10
August ,,	57·3	+0·7	4·36	+0·73	140	−15
September ,,	56·0	+3·2	3·73	+0·19	126	− 2
Year, . .	47·4	+1·3	38·55	−0·13	1300	−199

2. *Report by* WILLIAM SOMERVILLE, M.A., D.Œc., D.Sc., F.R.S.E., F.L.S., Hon. Consulting Cryptogamist.

During the past year several inquiries have reached me, but these, with one exception, had reference to damage induced by insects, and were passed on to the Hon. Entomologist. The only

case of fungoid disease was brought to my notice by Mr Alexander M'Rae, of Co. Kilkenny, and proved to be the "Cluster Cup" of the Hawthorn (*Roestelia lacerata*). This interesting fungus resembles Rust of Wheat, in that it requires two species of host-plant whereon to complete its development (Heterœcious Parasitism), the alternation of generations in this case being between the Hawthorn and the Juniper. The cluster cups of the Hawthorn occupy swollen patches of the shoots, leaves, and fruit, and on bursting emit numerous yellowish spores. The parasite is very common, but cannot be said to be of much economic importance. Removal of infected parts would certainly be desirable in the case of "specimen" trees, such as the Red Hawthorn on which Mr M'Rae found the diseased shoots.

3. *Report by* R. Stewart MacDougall, M.A., D.Sc., Honorary Consulting Entomologist.

Interest in entomology among the members of the Royal Scottish Arboricultural Society seems to be on the increase, for this has been my busiest year, queries about insects and their work having been received from England, Scotland, Ireland, and Wales. In addition to other insects, I have sent replies relating to the work of the following species:—

Scots Fir. — *Pissodes notatus, Pissodes pini, Bostrichus bidens, Bostrichus lineatus, Tomicus acuminatus, Hylesinus palliatus, Hylesinus ater, Hylesinus piniperda, Sirex juvencus.*

Spruce.—*Hylesinus palliatus, Bostrichus lineatus, Hylobius abietis.*

Spruce Cones.—*Phycis abietella.*

Larch. — *Hylesinus palliatus, Bostrichus lineatus, Sirex gigas.*

Oak. — *Xyleborus Saxesenii, Cynips Kollari, Tortrix viridana.*

Ash. — *Hylesinus fraxini, Hylesinus crenatus, Sphinx ligustri.*

Beech.—*Ptilinus pectiniformis.*

Birch.—*Cossus ligniperda.*

Pear.—*Diplosis pyrivora.*

Holly.—*Phytomyza ilicis.*

Following my usual custom, I choose out for more detailed notice such of the pests as were complained about.

Goës tigrina (De Geer).

This is an interesting case, which exemplifies the helpfulness of the entomologist in detecting swindles.

Mr David Glen, forester to Lord Sefton, advised a friend, who had bought some timber as English-grown oak, that his purchase consisted really of "American" oak. One of the logs on being split showed much insect injury, the wood being traversed by large tunnels which rendered part of it useless. A specimen of the timber, with a large beetle present in it, was sent to me from Croxteth by Mr Glen. The beetle, which was alive in the log, and which as grub had bored the tunnels, was a large, handsome Longicorn. It proved on examination to be *Goës tigrina*, a North American species. As this beetle is not found in our country, it was clear that the buyer of the timber had not got the English oak he bargained for.

Pissodes notatus,

the Small Brown Pine Weevil, is injurious both as imago and grub, but chiefly as the latter. The mature weevil in its feeding pierces the bark with its proboscis, so that a badly-attacked young pine looks as if a person had taken a needle and made a number of little punctures with it on stem and branches. The proboscis pierces through to the cambium of the stem, and into the outermost part of the youngest wood. In healthy pines little bead-like drops of resin issue from the punctures. The grub tunnels in the bark, and between the bark and the wood, and where the bark is thin the outermost part of the youngest wood may be also gnawed away.

The favourite breeding-places are young pines from three or four to eight years of age, but trees in the pole stage are also frequented. Scots fir, Austrian pine, Corsican pine, and Weymouth pine are all used as host-plants. In exceptional cases spruce and larch may be attacked.

The female lays her eggs in holes in the bark, several, it may be, together; and as the grubs when they hatch bore in different directions, the tunnels may have a star-like pattern. A trail of brown bore-dust remains behind to map out the path of the larva. The full-fed larva gnaws out a hole in the splint-wood, and in this hollowed-out bed, protected by a cover of sawdust

and wood-chips, the pupation stage is passed. A favourite place for the beds is immediately below the whorl of branches, where, in an infested plant, one is almost always sure to find several clustered together. When the beetles are ready to escape, they bore a circular hole through bedcover and bark.

In the *Transactions* for 1896 I stated that the contradictory statements concerning the generation of *P. notatus* might have their explanation in the long life of the individual beetles, and that perhaps *notatus* would have to be added "to the not very large list of insects which possess the power of recopulation and repeated egg-laying." This suspicion has been fully verified, and, as a result of experiments conducted at the Royal Botanic Garden, extending over three years,[1] I have proved the following :—

(1) The *Pissodes* have a remarkably long life in the imago stage. This long life is characteristic of both sexes.

(2) Copulation and egg-laying are not single acts which, once accomplished, terminate the life of the individual, but both may be often repeated. The same individuals, which have paired and bred in one season, may, after hibernation, still further proceed to a new season's reproduction.

(3) Hibernation takes place in the month of November, and ends in March or April, according to the season.

(4) Egg-laying takes place in all months, from April till September inclusive.

(5) As adult beetles may be met with during all this period, the length of time necessary for individual development loses some of the significance it up till now has possessed in relation to exterminative measures, because a comparatively limited flight-period being disproved, corresponding limited and definite swarm-periods can no longer be relied on.

(6) Still, limiting our view to one cycle and the earliest laid eggs of that cycle, the generation is typically a yearly one.

(7) There may, however, be three generations in two years.

(8) As the first imagos issuing in the summer, as a result of eggs laid earlier in the same year, are not immediately able to proceed to an efficient copulation, but

[1] For an account of these experiments, see the *Forstlich-naturwissenchaftlichen Zeitschrift*, May and June parts, 1898.

require some time for ripening, even in a year favourable as regards temperature and weather conditions, there is little likelihood of there being two generations in a calendar year.

On these conclusions we found the following preventive and remedial measures:—

A great means the forester has in proceeding against this pest, once it has got to work, is the preparation of catch-trees or decoy-stems. These will be sickly plants or trees left here and there in nursery or plantation, or plants can be artificially weakened and left standing, or an older tree can be cut down and allowed to lie as a breeding-place. In consequence of the long-continued life and egg-laying, such trap-plants must be arranged, and visited and renewed, at intervals throughout the whole year, from March till October inclusive.

These catch-trees or traps must be barked or removed before the enclosed brood has reached maturity, and their contents, in the shape of larvæ or pupæ, destroyed. My experience is that, where ripe larvæ have been exposed to the light and weather by a removal of the bed-coverings, they rarely complete their development, yet it is safer not to give them the opportunity. Where the barked stems are not removed, special care must be taken that beds deep in the wood are not overlooked, but their contents destroyed. (This must specially be attended to in the case of *P. pini*, whose beds can be found deep in the alburnum.)

As thin twigs may be used for breeding in, these, if not removed and burnt, must be slit up for the destruction of enclosed grubs or pupæ. Their yielding to pressure, here and there, will be a guide to their having been tunnelled.

I am certain, from my experiments, that where *notatus* is plentiful (and in such cases perfectly healthy plants can be attacked and will succumb), collecting the imagos would prove very serviceable. This measure could be certainly adopted in nurseries with good results. The beetles would require careful looking for, however, owing to their protective coloration; but favourite places for them are below the whorls, at the bases of the bifoliar spurs, and lying between the buds. I have pointed out that imagos may be found during many months, and new imago issue also, yet the intervention of winter will give rise to a certain seeming periodicity of imago appearance. Collecting,

then, will probably be most successful in the spring time, when the over-wintered beetles and earliest-issuing renew or proceed to their egg-laying, and also from August onwards, when escape will be at its height.

Where the beetles have not yet got a footing, a timely and vigorous rooting out of all suppressed or sickly pines will go far to prevent injurious attack.

As guides denoting attack we may mention :—

(*a*) The bead-like drops of resin that issue from the wounded bark.

(*b*) The drooping of the plants, with a reddening of the needles.

(*c*) The little proboscis punctures.

(*d*) In young or smooth-barked parts, on the finger being passed over the bark, little risings may be felt, or little ridges may be seen. These mark the places of larval tunnels or pupa beds.

In another experiment I have proved that *notatus* breeds also in pine cones.[1]

P. pini chooses for its egg-laying grown stems. At present I am experimenting with this beetle, and so far have indication that it is characterised by the long life and egg-laying of *notatus*.

Wood-Wasps.

Judging from the specimens sent and correspondence in the *North British Agriculturist*, observance of wood-wasps has been more frequent than usual. Wood-wasps are among the largest and most striking of Hymenoptera. They belong to the family *Uroceridæ*, characterised in the case of the females by a well-marked ovipositor. The two species of forest importance in our country are *Sirex gigas*, the giant wood-wasp, which attacks spruce, silver fir, larch, and rarely pine; and *Sirex juvencus*, the Steel-blue Wood-Wasp, which lays chiefly in pine but also in larch. These are thus distinguished :

Sirex gigas.—Female may reach a length of $1\frac{1}{2}$ inch, but is often smaller, specimens having been taken as small as a little over half an inch. The head and body are black, except the first two and the last three segments of the abdomen, which are yellow. The abdomen ends in a spine, below which is the conspicuous projecting ovipositor, consisting of a boring apparatus

[1] See *Transactions of the Royal Physical Society*, 1898.

enclosed in two horny side sheaths. The male is smaller, and has the rings of the abdomen reddish-yellow, except the first and the last, which are black.

This year I have had *S. gigas* females sent to me from the following places:—Inchture, by Mr Gillespie, from a silver fir; Yorkshire, in larch; and two specimens from Edinburgh, one caught flying about in the street, and the other in a room which it had entered by an open window. These specimens were got in August and September. I also got specimens of attacked spruce from Perthshire and Fife.

Sirex juvencus.—While in this insect, as in the last, there are variations in colour, the female is typically blue, with reddish legs, while the smaller male has rings, four to seven of the abdomen yellowish-red. The size varies from $\frac{1}{2}$ inch to $1\frac{1}{2}$ inch, and the spread of wing from $\frac{3}{4}$ to 2 inches. Specimens of *juvencus* which I bred out from a pine log received this year from Mr Clark of Haddo gave the following measurements:—Males, $\frac{3}{4}$ inch, $\frac{7}{8}$ inch, 1 inch, $1\frac{1}{8}$ inch; female, measured to tip of ovipositor, $1\frac{3}{8}$ inch.

Now and again doubt is thrown on the fact of *juvencus* being a British insect, but while it is certainly imported in timber, there is no doubt whatever that *juvencus* breeds in Britain. In last year's *Transactions* it was reported from Dunraven (Glamorganshire) and Innerleithen. I have records in my notes of its capture from two localities in Midlothian, viz., Cramond and Roslin; while this year Mr Clark has taken many specimens at Haddo, Aberdeen, and Mr Leven has sent it to me from St Quinox, Ayr. Mr Philip notes a capture in County Galway. In her "Manual of Injurious Insects," Miss Ormerod reports it from Gilgarron, near Whitehaven.

An extremely interesting find is that of Mr Mitchell's at Dunraven. Last year Mr Mitchell sent to me an Ichneumon Fly with the following note:—"I found it apparently sending its ovipositor into the bark of a larch post which contained *Sirex* larvæ." This Ichneumon was *Rhyssa persuasoria*, a most handsome insect, which is parasitic on *Sirex juvencus* larvæ. *Rhyssa* bores with its long ovipositor into a tree where the wood-wasp larvæ are at work, and lays an egg in the tunnel of the wood-wasp. When the *Rhyssa* grub hatches, it proceeds to feed on the grub of the wood-wasp, which is thus destroyed. The ovipositor of *Rhyssa* is very long, and sometimes this Ichneumon

is captured fixed to the tree, from which it has been unable to withdraw its ovipositor.

The Dunraven specimens of *juvencus* were from an Austrian pine, and the Haddo specimens from a large dead Scots fir felled about January 1897.

The life-history of the *Sirex* species is as follows :—The female, by her long and strong ovipositor, bores a hole through the bark into the alburnum or sapwood of standing sickly trees or blown or felled timber. This she does very quickly. Mr Mitchell, who kept some *juvencus* in captivity, watched them boring and laying their eggs. In some notes sent on to me he describes his observations :—"On closely examining the bark, and still better the timber under the bark, the holes made by the ovipositor are easily found. They are usually single or in groups of two or three, and have a small raised collar round them, the result of the accumulation of bore-dust between the bark and the wood. They are sometimes as much as $\frac{1}{2}$ inch deep, including $\frac{1}{8}$ inch of bark. The usual depth for the most successful hatching is about $\frac{1}{4}$ inch or slightly over, *i.e.*, as deep as the second or third layer of wood. The wood-wasp about to deposit first wanders all over the log, the point of the ovipositor in its sheath dragging against the bark, and the antennæ working vigorously until a suitable place is found. The actual operation of boring takes about four minutes. When the borer is full down there is a halt for a moment, and a heaving sort of movement, during which, presumably, the egg is passed. The insect, in the six or seven days of its life, makes from a hundred to about one hundred and fifty borings."

At each boring one egg is laid, from which comes a whitish grub, which, when full grown, measures over an inch in length. It is round, and has three pairs of very small thoracic feet, and strong, biting jaws. A spine projecting from the last segment is also characteristic. This spine, and the cylindrical shape of the larva, will serve to distinguish it from the larvæ of the *Cerambycidæ*, or "long-horned" beetles, which are somewhat flattened and have no spine.

The hatched out grub, "after following the same layer of wood for about three-eighths to three-quarters of an inch, increasing rapidly in bulk meanwhile, then turns inwards towards the centre of the tree," and later on curves out again towards the surface, so as not to leave too great a thickness of wood to be bored through by the imago when ready to escape. As the larva

progresses, the part of the tunnel behind is left stuffed with bore-meal. When full-fed, the grub pupates in a chamber at the end of its tunnel, and when the wood-wasp is fully developed it gnaws the circular hole by which it emerges. If too great a thickness of wood separates the adult wood-wasp from the outside, the insect dies. In my specimens, in several instances, the adults ate their way out through half an inch of wood (indeed, I am inclined to believe that this is a fair average); but on splitting the pine log in November (all my specimens having issued in August from the log kept in the open air) I found two dead *juvencus* at a depth of 1 inch. The flight-time of the adults is from July on to August and September. Wood split in the winter, however, has revealed living adults, which might probably have issued in the next spring.

There is a lack of experimental evidence as to the length of time elapsing from the egg-laying till the appearance of the adult insect. It seems certain, however, that the generation is never less than two years, and it certainly is often longer, there being cases on record where the adult wasps have issued from worked timber forming floors, etc.

The larvæ are known to have bitten through lead piping. It is related that at the time of the Crimean War, bullets were found to have been pierced by larvæ which had emerged from the unseasoned wood of the ammunition-boxes; and Blandford tells of the boring of *S. gigas* grubs from the timber supports into the lead chambers of sulphuric acid works, with a loss of acid.

Preventive and Remedial Measures.—For egg-laying sickly grown trees are chosen, or such as have been accidentally wounded. These should be uprooted and removed. I am sorry to say that it is not very uncommon to find trees lying in the wood with many exit-holes showing all down the stem, whence scores of wood-wasps have issued to their work of destruction. Attacked stems are often rendered useless for technical purposes, the wood being quite honeycombed with larval galleries. Felled barked trees allowed to lie are also used as breeding-places.

Diplosis pyrivora (Riley), the Pear Midge.

This insect, the *Cecidomyia nigra* of Meigen, appears unfortunately to be spreading in Britain. In the month of June I received some pears sent by Mr A. C. Forbes, Bowood,

Wilts, attacked by a pest which had "destroyed the greater part of the crop in the gardens." On dissecting the pears, which were about the size of marbles, and rotten, I found many larvæ of the pear-midge. The life-history is as follows:—The adult midges issue from their cocoons in the soil early in the year, from, in some cases, the end of January on to April and even later. The females lay their white eggs in little masses inside the blossom of the pear, usually before the flower expands, the blossom being pierced for the purpose by means of the ovipositor. Schmidberger, quoted in the *Journal of the Board of Agriculture* for September, thus describes the process of egg-laying:—"I found the first gall-midge in the act of laying its eggs in the blossom; this was on the 12th of April. It had fixed itself almost perpendicularly in the middle of a single blossom, and having pierced the petal with its long ovipositor, it laid its eggs in the anther of the still closed blossom. The eggs are whitish, longish, pointed on one side, transparent, and from ten to twelve in number." The eggs quickly give up their maggots, which proceed to feed on the pear. The number of maggots inside the attacked pear varies. In twelve pears picked at random from Mr Forbes's specimens, the numbers were 16, 21, 28, 5, 9, 15, 19, 15, 17, 23, 16, 10. In the case of the smaller numbers, some of the maggots had already left the pears. As a result of their feeding, the pears grow no bigger than small marbles, and their interior is quite rotten. The shrivelled, misshapen character is a guide to the attack. The full-fed larvæ leave the pears while these still remain on the tree, or they fall to the ground with the pears which they leave later. From a second supply of pears which Mr Forbes kindly sent at my request near the end of June, the maggots were leaving in hundreds, and very interesting it was to see them skipping about as they lay on my table. This active movement is characteristic of certain species of *Cecidomyidæ*, and may be well seen in the case of the maggots of *C. tiliæ*, which are found inside the galls so common on twigs and flowers of the Lime. Having left the pears, the larvæ enter the soil, where they are supposed to lie for some considerable time before pupation, which takes place in a thin cocoon. The adults appear in the next spring.

Description of Midge.—One-tenth of an inch long, and blackish in colour. The antennæ are brown coloured and very long. The legs are also long. The females, besides having longer antennæ

than the males, have a conspicuous ovipositor. The larvæ are legless, and have fourteen segments; they are yellowish in colour, and have on their under-surface, at the head end, the brownish so-called "breast-bone" or "anchor process," thought to aid the insects in feeding.

Remedial Measures.—The insect can cause great losses. In the letter acquainting me with the attack, it was mentioned that seldom was a full crop of pears got because of the pest. There is this to encourage growers, however, that where proceeded against vigorously success can follow. Such a case is reported by Professor J. B. Smith, of New Jersey, who, in a report in 1894, mentions severe attacks, but writes in 1897 that, in the previous badly attacked localities, the pest seems to have been stamped out. Dr Smith, as a result of experiments, recommends treating "the ground below the trees with a heavy top dressing of kainit, one ton to the acre, applied between the middle and end of June." This, applied immediately after rain, and before the larvæ have made their cocoons, will cause their death. The same authority recommends ploughing the infested ground, say in July, so that the maggots which escape crushing will be buried too deeply for the future midge to make its way above ground. If circumstances render this measure impracticable, the principle of burying the grubs should not be lost sight of. The pear midge can only be satisfactorily combated when, as larva or pupa, in the ground. Picking up and picking off the infested fruit would be an extremely useful measure. The attacked pears can be known by their withered, discoloured, and cracked appearance.

The foregoing embodies most of what is known about *Diplosis*, but anyone wishing to read further can consult *The Entomologist*, vol. xxi., for an article on *Diplosis*, by R. H. Meade, Esq.; Bulletin 99 of the New Jersey Agricultural College, by Dr J. B. Smith; Miss Ormerod's "Handbook of Orchard and Bush Fruit Insects." This is Miss Ormerod's latest book, and I cordially recommend it to members. It is published by Messrs Simpkin, Marshall, & Co., price 3s. 6d. See also *Journal of the Board of Agriculture*, September 1898.

In concluding this Report, I wish to thank Mr Clark, Mr Mitchell, and Mr Forbes for sending me material which I wrote for, and also Mr Mackenzie of Mortonhall, who twice very kindly sent me some fresh pine logs for an experiment, which I may give some account of, in the next year's *Transactions*.

NOTES AND QUERIES.

The Deterioration of Wire Fences.

Fifty years ago wire fencing was almost unknown, now it has become an absolute necessity, and may be styled the fence of the period—to the almost utter neglect of hedges and stone dykes. What has no doubt tended to the general adoption of wire fencing is its comparative simplicity and being easily erected, and few now care to wait ten years on a hedge growing.

What I wish to direct attention to more particularly is the injurious effects caused to wire fencing by using barbed wire. As is well known, barbed wire is generally used as a top or second wire, to prevent stock from over-reaching or rubbing against the fence. And though the huntsman abhors it, still it cannot be denied that barbed wire is a great advantage in protecting wire fences from destruction by cattle. Nevertheless, paradoxical as it may appear, this very barbed wire not only renders a fence more effective, but also tends to hasten its decay.

Hitherto barbed wire has been manufactured in a somewhat imperfect manner, on account of the barbs being cut from wire *after* being galvanised, thus exposing a large amount of *un*galvanised surface to oxidation, which sets up galvanic action, and the rapid decomposition of the zinc coating, and the general deterioration of the wire. This not only affects the barbed wire itself, but all the wires immediately under, and the results are very apparent where old ungalvanised wire fences have been re-erected with a barbed wire on the top—the drip from the barbed wire causing rapid oxidation and decay of the under wires. As a further proof of this, it may be noted that in some instances, according to the direction of the line of fence and the trend of the prevailing winds, some of the wires may be comparatively free from oxidation, while in others it is very apparent, according as the drip has fallen on the upper or lower portion of the fence; and these effects are rendered still more

conspicuous if in close proximity to the sea air; and I have no hesitation in saying that a vast extent of old *un*galvanised wire fences, the wires of which were comparatively good, have been rendered useless in consequence of the injurious effects referred to. The only way to obviate this is to have the wires all galvanised, and to have the barbed wire galvanised *after* the barbs are twisted into the strands, and thus render the wire free from oxidation as far as possible. This would probably make the wire a little more expensive, but the extra cost would be infinitesimal when compared with the advantages from having a properly galvanised wire.

The subject is of vital importance to all connected with estate management, and is worthy of more attention than it has yet received.

JAMES KAY, Wood Manager, Bute.

Additional Note by Mr Kay:—

I understand that a newly patented method of galvanising has recently been adopted at the works of the Sharon Hill Galvanising Company, Darby, Pa. A most interesting paper on the process was read by Mr George Reese at a meeting of the Franklin Institute about twelve months ago. Unfortunately the paper is too lengthy to be here reproduced, and I simply give the following extracts:—

"The process is effected by what is termed a centrifugal separator and the galvanising bath. The chief advantages of this method are that it is only necessary to subject an entire bundle of wire for a few seconds of time to the action of the centrifugal separators instead of drawing a small number of strands through wipers at the slow speed of not more than one foot per second, as in the old wiping process. The bundles are finished as fast as they can be raised to the proper temperature and coated in the galvanising bath, hence the tonnage output is enormously increased.

"Among the new articles produced by this method is barbed wire, which is galvanised *after* it has been twisted into shape and formed into bundles. When wire is galvanised *before* being barbed and twisted, much of the coating cracks and peels off, and the points of the barbs, where they are not coated, become blunt by rusting. This new article can not only be produced much

more cheaply, but is also more durable, and, as the points of the barbs are completely coated, it retains its efficiency much longer than by the old method." JAMES KAY.

MANAGEMENT OF BIRCH SEED.

Professor Schwappach has very kindly sent me an account of the system that he follows with regard to the raising of young birches; and as the information is sure to be of interest and value to members of the Society, I append a translation:—

"The seed must be gathered and sown as soon it is ripe, which, in this district, occurs in the beginning of August. The seed-bed must be prepared on moist, but not wet, open soil. The seed is sown broadcast, and, having been very lightly covered with sand, is firmly rolled. The slightest excess of covering will prevent germination. The bed is then kept sufficiently moist by a covering of sparred frames or branches, though, if the weather is very dry, watering may be necessary. When the tiny seedlings appear in a few weeks, the covering must be removed. Late in autumn the bed should be lightly covered with spruce leaves to protect the plants against frost.

"Since I began to practise this system, I have never failed to obtain satisfactory results." WILLIAM SOMERVILLE.

Phoma pithya, A FUNGUS ON THE DOUGLAS FIR.

A Note read by GEORGE LEVEN, Forester, St Quinox, Ayrshire, at the Annual Meeting held in January 1898.

The Douglas fir is generally believed to be free from disease in this country, and it has been planted largely on some estates as a probable successor to the larch. I cannot speak of its qualities as a timber tree, but undoubtedly it is liable to attack by at least one fungus, which affects it in some respects as *Peziza Wilkommii* does the larch. I am unable to quote an authority on this disease, although I understand it has been observed on the Continent, and with your permission I will give my own observations on it.

The specimens now exhibited will illustrate my remarks. You will observe some of them are quite dead, while the others are of an unhealthy colour. The fungus had destroyed the cortical tissues, in the former case, right round the stem, while above and below this compressed part the cambium had been actively engaged, for at least one growing season, trying to heal over the wound, but had failed to do so, with the result that death ensued. In the case of the unhealthy plants, the fungus has only destroyed the cortical tissues on a part of the circumference of the stem, while a callus has been formed round the wounded part. This is one point of resemblance to the larch disease, and a further point is that the original point of attack seems to be at the junction of a branch with the main stem.

One other specimen has the leaders destroyed, and I am inclined to believe that this is due to an entirely different fungus (*Botrytis Douglasii?*). In nurseries, when this happens, it is usually attributed to frost, but I question if it is not oftener due to this fungus, as I have seen sheltered and unsheltered plants alike lose their leaders. I have seen the Douglas fir quite hardy 700 feet above sea-level in the inland counties, while it loses its leading shoots readily 70 feet above sea-level near the seaboard, even in sheltered localities. The moist climate in the latter case favours the development of the fungus, while the drier air inland keeps it in check.

We have planted a large number of Douglas fir each of the last three seasons, and fully 10 per cent. of them have been cleared out because of fungoid disease. If there is much of this in this country (and there may be more than we are aware of), something might now be done to stamp it out; and even if it may be classed among the "interesting observations" just now, thirty years hence it may prove "a widespread calamity," as Professor Gayer says of *Hysterium pinastri* in Germany, which began with an attack on two-year seedling Scots pine, and, after the above lapse of time, is attacking Scots pine of nearly all ages.

[See the remarks of the Society's Honorary Cryptogamist on this subject, pp. 191, 192 of this Volume.]

ROYAL
SCOTTISH ARBORICULTURAL SOCIETY.

EXCURSION TO THE UPPER FORTH AND LOCH LOMOND DISTRICT.

FIRST DAY.

The Council of the Society having arranged to hold the Nineteenth Annual Excursion in the romantic and well-wooded district lying between Stirling and Loch Lomond, a large number of the members and their friends came from all parts of the country to join in it. For the first time in the annals of the Excursions, a distinguished representative of German Forestry was present, in the person of Professor Adam Schwappach, of the Forestry Academy, Eberswalde, Prussia, who was most cordially welcomed by the members, many of whom were delighted to renew their acquaintance formed with the Professor in the German forests, through which he had conducted them with such marked success during the Excursion of last year. The rendezvous for the start was the ancient royal burgh of Stirling; the main body of the Excursionists arriving there from Edinburgh *via* the Forth Bridge, in saloon carriages specially provided for the Excursion by the North British Railway Company. When the whole party had mustered at Stirling, it was found to exceed one hundred in number; and every member was supplied with a handy itinerary and map of the district to be traversed. Among others present were:—Charles Adamson, Leven; Professor Bayley Balfour, Edinburgh; Robert Baxter, Dalkeith Park; David Brown, Chevet Park, Yorks; R. Brown, Castle Craig, Dolphinton; Charles Buchanan, Penicuik; Richard Cairns, Balruddery, Dundee; Mungo Chapman, St Ninians,

Stirling; Wm. Clark, Edinburgh; James Cook, Arniston; Bernard Cowan, South Shields; W. S. Curr, Ninewar; Alex. Dingwall, Perth; A. Douglas, Baldersby Park, Thirsk; Robert Douglas, Edinburgh; Malcolm Dunn, Dalkeith; Wm. Erskine, Oaklands, Trinity; D. T. Fish, Edinburgh; Robert Forbes, Kennet, Alloa; F. Foreman, Eskbank; James Forgan, Bonskeid, Pitlochry; George Fraser, Edinburgh; Simon Fraser, Luss; R. B. Fyffe, Lindertis; Robert Galloway, 5 St Andrew Square, Edinburgh, *Secretary;* Wm. M. Gilbert, Edinburgh; G. H. Gorrie, Dalkeith; Wm. P. Hay, Loanhead; Robert Henderson, Penicuik; Wm. Henderson, Balbirnie; George Jack, Dalkeith; James Kay, Bute; D. P. Laird, Edinburgh; George Innes Macdonald, Elgin; A. M'Gregor, Penicuik; Wm. Mackenzie, Novar; George Mackinnon, Melville Castle; Wm. Mackinnon, Edinburgh; D. L. Mackintosh, Ballikinrain, Balfron; John T. M'Laren, Polmaise, Stirling; Wm. M'Laren, Altyre; William Malloch, Perth; Henry Methven, Edinburgh; John Methven, Edinburgh; John Methven, Blythswood; John Michie, Balmoral; Alex. Milne, Edinburgh; J. K. Milne, Lasswade; Wm. Milne, Foulden, Berwick; Malcolm Morgan, Crieff; John Murdoch, Dalkeith; W. C. Orkney, Moncreiffe; A. D. Page, Culzean; Walter Page, Myregornie, Kirkcaldy; George Paxton, Kilmarnock; Henry Philp, jun., Dunfermline; John Philp, Dunfermline; Alex. Pitcaithley, Scone; W. Priest, Eglinton Castle Gardens; Wm. Proudfoot, Raith; A. D. Richardson, Edinburgh; Thomas Ritchie, Callander; James Robertson, Panmure, Carnoustie; James Rodger, Scone; Edmund Sang, Kirkcaldy; Professor Schwappach, Eberswalde, Prussia; John Scott, Gordon Castle, Fochabers; A. Simpson, Alloa Park; Andrew Slater, Haystoun, Peebles; Dr W. G. Smith, Edinburgh; James Tait, Penicuik; M. Temple, Carron House, Falkirk; D. Thomson, Dunfermline; Wilson Tomlinson, Clumber Park, Worksop; James Waddell, Leven; Robert Wallace, Leith; John Watson, Leith; James Watt, Carlisle; James William Watt, Carlisle; James Welsh, Edinburgh; William White, Loanhead; Alex. Williamson, Edinburgh; and George Williamson, Leven.

After breakfast in the Station Hotel, the party mounted half-a-dozen well appointed breaks, and left Stirling soon after 9 o'clock. The Excursion was favoured by excellent weather, and although there was a sharp autumn feeling in the air, the drive through such an interesting country was much enjoyed. The route lay

over the Forth by Stirling Bridge, and through the rustic village of Causewayhead, nestling in the shadow of the precipitous Abbey Craig, crowned by the Wallace Monument standing out conspicuously in the clear sky.

AIRTHREY CASTLE.

A drive of about two miles brought the party to the beautiful estate of Airthrey, the property of Donald Graham, Esq., lying snugly at the southern base of the Ochil hills, and well sheltered by fine thriving plantations. The handsome castellated mansion, erected in 1791 from a design by Adam, stands on a fine site in a charmingly wooded park, and commands superb views of the richest landscape in Scotland. It was the chief seat of the Abercrombie family for about a century, and came into possession of the present owner a few years ago. The estate is famed for its Mineral Wells, springing out of the hill immediately above the fashionable watering-place, the Bridge of Allan, much resorted to from all parts of the country for the benefit of its mild and salubrious climate.

The party entered the park by the South Lodge, and drove along the main avenue to the Castle, a lovely winding lake lying on the right, and the Ochils rising abruptly on the left, with their slopes well clothed with woods. Some very fine old trees were noted in passing; more especially the beeches, oaks, limes, and sycamores, many of which seemed fully a couple of centuries old. Near the Castle were noticed a number of fine thriving young silver firs, and numerous grand examples of broad-leaved trees, many of them growing in groups of three, and presenting a rich massive appearance. On approaching the Castle the party were met by Mr Dempster, the factor on the estate, Mr Murray, the forester, and Mr Rutherford, the gardener, who gave them a hearty welcome, and acted as their guides through the policies and woodlands. To the north in front of the Castle, some fine sycamores and beeches attracted attention. Several of these grand trees were measured, and one of the largest sycamores, which rose to a height of about 75 feet, was found to girth 9 feet 3 inches at 5 feet up. Another splendid sycamore standing near girthed 8 feet 6 inches, and had a clean cylindrical bole of about 40 feet in length. A fine group of old limes was pointed out, standing a little east of the Castle, which were said to have been trans-

planted when of a large size, as an experiment, about one hundred years ago; and their vigorous aspect at this period betokened the success of the experiment.

Turning off sharp to the left up the hill on the way to the Hermitage Wood, the largest oak tree on the estate was seen and much admired. Its massive trunk girthed 11 feet at 5 feet up, and its stately head rose aloft to a height of fully 80 feet. On entering the Hermitage Wood, it was seen to be planted chiefly with larch, ash, and sycamore. The plantation was formed twenty-five years ago, and has been twice thinned, the last thinning being done about four years ago. The hardwoods have thriven well, and promise to yield fine timber when they reach maturity. The larches have also grown well where not affected with "blister," but unfortunately on the southern slope of the hill they are badly infested with the disease, and a number perish every year from its attack. On reaching the summit of the hill a magnificent view was obtained over the valley of the Forth, extending as far as the eye could reach from Ben Lomond to North Berwick Law.

Descending the hill by a steep winding path through fine thriving plantations, the party again mounted the carriages, and after awarding a cordial vote of thanks, proposed by Mr John Methven, of Edinburgh, to the proprietor and to his representatives for their kindness, resumed the journey by driving back to the South Lodge.

KEIR.

Leaving Airthrey behind, and passing through the Bridge of Allan, beautifully situated at the southern base of the Ochils, Keir, the next place to be visited, was soon reached, and the policies entered through a handsome gateway. Here the party were met by Mr Young, factor to Archibald Stirling, Esq., the proprietor of Keir, and by Mr M'Millan, forester, and Mr Lunt, gardener, who spared themselves no trouble in order to show the members all that was possible in the time allowed for the inspection of this most interesting estate, which has been for many generations in the possession of the Stirlings of Keir. After driving for some distance along the grand avenue, a halt was called at the foot of a steep hill, and a visit paid to an ancient burial-place in a sequestered spot, closely screened from view by yews, cypresses, and other evergreens, appropriate to such a quiet

resting-place. Returning to the avenue, the party walked up the hill, admiring on all sides the thriving condition of the trees and shrubs, strong evidence that their requirements were fully met in the soil and climate at Keir.

Arriving at the stately mansion through a fine lime-tree avenue, the artistic taste and skill of the late Sir William Stirling Maxwell, Bart., were revealed on every side. Spacious terraces and flower-gardens surround the mansion, and the extensive ornamental grounds are noted for their wealth of choice trees and shrubs, especially those of the coniferous family, and the great skill displayed in their arrangement—the art of the landscape gardener being exhibited in some of its choicest aspects.

Proceeding through the grounds, notice was particularly taken of the use to which *Cupressus sempervirens* was put in the decoration of the front of the mansion-house. It was trained up between the windows, from the ground to the top of the wall, in closely cropped columns, about 2 feet in diameter, and formed a unique ornamental feature. Near the mansion-house were seen some beautiful specimens of *Cupressus macrocarpa*, 55 feet high, and among other examples of the newer conifers specially noted were *Abies Pinsapo*, 30 to 35 feet high; *A. Nordmanniana*, 15 feet high; *Cryptomeria Japonica*, 40 feet in height, and with a spread of branches of 25 feet in diameter; *Abies nobilis*, 60 feet high; *Pinus insignis*, 50 feet high; and a *Wellingtonia*, 45 feet high. Among the older trees were a hoary Spanish chestnut, supposed to be five hundred years old, and 15 feet in circumference, and two "original" larches, 12 feet 9 inches and 11 feet 6 inches in girth—the latter being 80 feet high. A number of fine oaks were also met with. Everything seemed to grow well in this well-sheltered spot; and on the admirable condition in which the gardens were found—extending as they do to something like 45 acres—Mr Lunt was warmly complimented. In the course of the walk the members halted at a spot called "The Globe," shaded by beeches, through openings in which the most charming views of the surrounding country can be seen, the prospects embracing Ben Lomond, Stirling Castle, the Wallace Monument, and the river Forth.

While driving along the road to Doune, the party left their carriages to visit the Keir nurseries, which are about 2 acres in extent, and have been quite recently established. There Mr James Watt, J.P., Carlisle, in a few well-chosen words, moved

a hearty vote of thanks to Mr Stirling for his kindness in allowing the Society to visit his estate, and to the officials already named, who had so efficiently shown the party its beauties, and most interesting arboreal features.

DOUNE CASTLE.

Passing through an interesting country for a few miles, and through the village of Doune, noted for its "trysts" or stock fairs, Doune Castle was reached, and the party were there met by Mr M'Lachlan, factor to the Earl of Moray, and an interesting visit of inspection was made to the ancient and royal pile.

In the words of Scott: "This noble ruin holds a commanding station on the banks of the river Teith, and has been one of the largest castles in Scotland. Murdoch, Duke of Albany, the founder of this stately pile, was beheaded on the Castlehill of Stirling, from which he might see the towers of Doune, the monument of his fallen greatness."

After the death of Albany the Castle became royal property, and subsequently passed into the hands of the Earl of Moray, half-brother of Queen Mary, and still belongs to his successor in the earldom, who bears the title of Baron Doune. The Baron's Hall has recently been restored, and the ruined pile put into tasteful order. The extensive Perthshire estates of the Earl of Moray extend from this to Loch Katrine, covering an area of about 40,000 acres of an exceedingly picturesque country, much of which is richly clothed with plantations and natural woods, especially in the Trossachs district, where the oak coppice woods are a prominent feature. Afterwards, in the Woodside Hotel, near the Castle, the company were hospitably entertained to lunch by the Earl of Moray. Mr M'Lachlan presided.

Professor Bayley Balfour proposed the health of the Earl of Moray. He was sure they would all join him in a hearty vote of thanks to the Earl of Moray for the way he had entertained them there that day. The interest of the Earls of Moray in arboriculture was not a new thing; and they welcomed the interest which the present Earl had shown in the Society by his hospitable reception of them on this occasion. In the last century, one of the Earls of Moray was a great tree-planter both at Darnaway and at Doune, and a number of the trees they had

seen that day in the neighbourhood of the old Castle were probably the result of his labours. He hoped the present Earl would continue to show an interest in the affairs of the Arboricultural Society. They had also to thank Mr M'Lachlan for all the trouble he had taken in carrying out in so admirable a manner the Earl's wishes concerning the entertainment of the Society.

The toast was received with great enthusiasm.

Mr M'Lachlan in reply, said the Earl of Moray desired him to say how sorry he was that he was not able to be present on that interesting occasion. He had to go north on business; but His Lordship desired him to state that he should be pleased at all times to assist in promoting the interests of the Arboricultural Society. Since he came into the title and estates, the Earl of Moray had shown a lively interest in everything connected with the advancement of the country. He was sure His Lordship would be much pleased to hear what an excellent company had been there on that occasion, and how everything had gone off in such a satisfactory way.

BLAIR DRUMMOND.

The splendidly-wooded parks of Blair Drummond, lying pleasantly along the shores of the Teith, to which the party next repaired, were found well worthy of a visit. Under the genial leadership of the factor, Mr Ballingall, who has been on the property for forty years, the company spent a delightful couple of hours. The number of big trees to which attention was directed was remarkable. The oaks and beeches were especially noteworthy. One of a long line of old beeches by the Teith was 15 feet 3 inches in circumference; but two larger than that were taped nearer the house, and gave respectively a girth of 16 feet and 18 feet 9 inches. The latter, standing in the park, had a magnificent spread of branches 33 yards across. The largest of a series of oaks measured was 16 feet 10 inches in girth; it had a clean bole of 25 feet, and its height was said to be over 100 feet. Forty years ago, when Mr Ballingall came to the estate, this oak measured 14 feet 6 inches, so that in the period in question it has added 2 feet 4 inches to its girth, and it still shows signs of vigorous growth.

A grand sycamore measured was 19 feet in circumference at

5 feet up. A black Italian poplar was 100 feet high, and had a clean bole of 50 feet to the first branches. Its girth at 3 feet up was 14 feet 7 inches. An oak alongside of it was 15 feet 5 inches in circumference, and on the slope near the house was one of the finest oaks met with—a splendidly-grown tree, about 100 feet in height and 11 feet 3 inches in girth. An interesting clump of trees was shown, which had been planted by the celebrated Benjamin Franklin when he came to Keir to visit Lord Kaimes in the end of last century. The clump consists of an oak, an elm, two sycamores, and a laburnum.

The planting of many of the older trees was said to have taken place about the year 1717; and Lord Kames, one of the ancestors of the present proprietor, Colonel Home Drummond Murray, had also a hand in improving the estate. On a mound, commanding a wide extent of country, is an obelisk, now greatly hidden by trees, erected by this celebrated Lord, with a curious inscription worth quoting—"For his neighbours as well as for himself was this obelisk erected by Henry Home. Graft benevolence on self-esteem, and the fruit will be delicious." In the shrubberies, pushing their way vigorously, were seen several specimens of the Japanese larch, *Larix leptolepis*, a recent introduction to this country, which gives promise of becoming an excellent forest tree, and superseding European larch, *L. europæa*, which in so many places suffers so much from disease.

From the neighbourhood of the obelisk just referred to, there was pointed out a splendid wood of Scots fir, which was planted seventy or eighty years ago by the great-grandfather of the present proprietor. They looked a straight-stemmed and healthy race, with the sun shining on their red bark.

Before leaving, Mr M. Dunn, Dalkeith, proposed a vote of thanks to Colonel Home Drummond Murray, and to Mr Ballingall, and Mr King, forester, for their courtesy to the Society.

LANRICK CASTLE.

A smart drive of half an hour along the banks of the Teith brought the party to Lanrick Castle, where the proprietor, Sir Robert Jardine, Bart., entertained them to a very acceptable tea. The great arboricultural feature of the well-kept policies was the beautiful specimens of the Albert firs, *Abies Albertiana*, which

were found in a state of great perfection. What added additional pleasure to their inspection was that they were shown to the company by Mr Begg, the gardener who reared them from seed brought from America in 1861. One grove of them on the north side of the Teith was particularly attractive. The trees, ranging from 58 to 62 feet—one had shot up to 67—were clothed to the very ground with the freshest foliage, and the drooping habit of several of them lent them additional grace. The greatest girth of any of these trees was 5 feet 9 inches, and with one exception these Albert firs were all over 5 feet in circumference. A Douglas fir planted at the same time was 57 feet high and 7 feet in circumference.

The respective heights and girths of the Albert firs measured were—(1) 67 feet high, 5 feet 2 inches in girth at 4 feet up, the height at which they were all measured; (2) 62 feet high, and 4 feet 10 inches in girth; (3) 58 feet high, and 4 feet 10 inches in girth; (4) 60 feet high, and 5 feet 9 inches in girth; (5) 58 feet high, and 5 feet 4 inches in girth; (6) 62 feet high, and 4 feet 10 inches in girth; (7) 62 feet high, and 5 feet 7 inches in girth. A good Menzies fir was 65 feet high, and 7 feet in girth. Thanks were voted to Mr Begg, and to Mr Dinwoodie, the forester, for their services, and to Sir Robert Jardine for his kindness in opening his grounds to the Society.

The Dinner.

The party reached Callander at 8 o'clock, and immediately thereafter sat down to dinner in the Dreadnought Hotel. Professor Bayley Balfour presided, and had on his right Mr M'Michael, the town-clerk of the burgh, and on his left Professor Schwappach. The croupier was Mr Malcolm Dunn, *Convener* of the Excursion Committee.

There was a pleasing exchange of compliments between the chairman and the German guest, and in the speeches that were made in the course of the evening, reference was made anew to the necessity of the Government taking up the question of afforesting the waste lands of the country, and of establishing experimental forest areas.

Professor Bayley Balfour said they might take the fact of Professor Schwappach's presence there as a recognition on the

part of those who were experts in forestry, that the Royal Scottish Arboricultural Society was working for the same ends as they were doing in Germany.

Professor SCHWAPPACH expressed his great admiration of the noble parks and beautiful trees they had seen, but gave it as his opinion that from the point of view of the commonwealth, the forest trees should be grown on different principles than that generally adopted in Scotland. He also thanked the Society in a very cordial manner for the hearty and hospitable reception they had given to him.

Provost MURDOCH, Dalkeith, proposed the toast of the Magistrates and Council of Callander, which was replied to by the Town-clerk, who in turn submitted the toast of the Royal Scottish Arboricultural Society.

"The Owners of Estates visited" was proposed by Mr M. DUNN, and replied to by Mr Lunt, Keir. "Our Friends" was proposed by Mr BUCHANAN, and responded to by Mr MUNRO, Penicuik. "Kindred Societies" was given by Mr A. MILNE, and replied to by Mr Cowan, South Shields; while the "Press" was proposed by Mr KAY, Rothesay, and replied to by Mr W. M. Gilbert of the *Scotsman*.

SECOND DAY.

CALLANDER.

To accomplish the programme for this day, it was necessary to make an early start from Callander; and to obtain a view of the objects of interest in the vicinity of this charming summer resort, the members had to be astir betimes.

The lofty Ben Ledi, purpled in heather, presented a splendid view in the bright rays of the morning sun, as groups of the members perambulated the town and its neighbourhood before breakfast. A pleasant hour was thus spent in visiting two interesting antiquities—Tom Mac-chessaig, a curious mound on the north bank of the Teith, and close to the old kirk and burying-ground, and the "Roman Camp," also on the bank of

the river at the other end of the town—and in viewing Callander Crags, wooded nearly to their summit, the romantic Pass of Leny, and the Falls of Bracklin. Breakfasting at 7 o'clock, all were ready to start at the appointed hour, and mounted the carriages prompt at 7.30 A.M. for a twelve miles drive to Loch Katrine, through classic Scottish scenery.

LOCH KATRINE.

The route from Callander to the point of destination at Buchanan Castle in the afternoon, lay through a country over which the great Wizard of the North has cast a magic spell in "Rob Roy" and "The Lady of the Lake." The whole district is mainly owned by the Earl of Moray, the Earl of Ancaster, and the Duke of Montrose; and from a forestry point of view is noted for the wide extent of the natural coppice woods, chiefly of oak, and numerous plantations on the rugged hill-sides, and in the romantic glens intersecting the district in all directions.

After leaving Callander and passing the bridge of Leny, at the mouth of the Pass of Leny, richly clothed with natural oak and hazel, the road sweeps round the base of Ben Ledi, and runs for some miles through the estate of the Earl of Moray, which joins the Earl of Ancaster's estate in the Pass of the Trossachs. On such a lovely morning the grandeur of the Highland landscape was seen at its best, culminating in the unrivalled scenery of the Trossachs, which has been said by an eminent authority to "beggar all description." Passing Ben Ledi, "Samson's Putting Stone" was seen high on the mountain on the right; while on the left were observed Bocastle with its ancient ruined fort; Coilantogle Ford, Loch Vennachar ("lake of fair valley"), with the Wood of Lamentation on its north bank, Lanrick mead, "Duncraggan's Huts," the Brig o' Turk, Loch Achray ("a lovely loch"), and on through the richly-wooded Pass of the Trossachs ("bristled territory"), with Ben A'an and Ben Venue to right and left,—

> "Mountains that like giants stand, to sentinel enchanted land,"

with

> "Crags, knolls, and mounds, confusedly hurl'd,
> The fragments of an earlier world."

Of the scenery of the Trossachs and the approach to Loch Katrine, Sir Walter's oft quoted lines admirably describe it:—

"Boon Nature scatter'd, free and wild,
Each plant or flower, the mountain's child.
Here eglantine embalm'd the air,
Hawthorn and hazel mingled there;
The primrose pale, the violet flower,
Found in each cliff a narrow bower;
Foxglove and nightshade, side by side,
Emblems of punishment and pride,
Group'd their dark hues with every stain
The weather-beaten crags retain.
With boughs that quak'd at every breath
Grey birch and aspen wept beneath;
Aloft, the ash and warrior oak
Cast anchor in the rifted rock;
And, higher yet, the pine tree hung
His shatter'd trunk, and frequent flung,
Where seem'd the cliffs to meet on high,
His bow athwart the narrow'd sky.
Highest of all, where white peaks glanced,
Where glist'ning streamers waved and danced,
The wanderer's eye could barely view
The summer heaven's delicious blue;
So wondrous wild, the whole might seem
The scenery of a fairy dream."

For some miles the route lay through natural copse interspersed with plantations of mixed woods, showing everywhere how well adapted the district is for forestry operations on an extensive and well-organised scale. Larch, Scots fir, and spruce all presented a healthy and thriving aspect, and the hardwood trees—such as oak and birch, which are indigenous; ash, elm, and sycamore—were growing with vigour in the deeper and richer soils of the lower parts of the country.

The rustic pier at the foot of Loch Katrine was reached about 9 o'clock, and the party at once stepped on board "The Lady of the Lake" steamer, which was in waiting to take them to Stronachlachar pier, about seven miles distant on the left shore of the loch. The waters of the loch were clear, cool, and sparkling in the bright morning sunshine, as "The Lady of the Lake" steamed away from the pretty rustic pier, and stood out into the middle of the bay, affording the party a splendid view of the bewitching Highland scenery. Towering high on the left

were the rugged, copse-clad steeps of Ben Venue. There were seen on the side of the rugged Ben, Coir-nan-Uriskin, or the Goblins' Cave, where the bold Sir Roderick Dhu had "stood leaning on his heavy sword" listening to Fair Ellen's "angel voice" singing the plaintive "Ave Maria"; and higher up still "the wild Pass of Beal-nam-bo," or "Pass of Cattle," described by Scott as "a most magnificent glade overhung with aged birches, the whole scene composing the most sublime piece of scenery that imagination can conceive." Tacking to the right between Ellen's Isle and the "Silvery Strand," a fine view was obtained from the deck of the steamer of both those famous and lovely spots as the "Lady of the Lake" steamed slowly past. Heading to the left, a straight run was made up the Lake to Stronachlachar in glorious summer weather; Ben Lomond towering high on the left with its massive rounded crest; and the sharp rugged peaks of the Arrochar hills rising right ahead.

Arriving at Stronachlachar Pier, carriages were in waiting to take the party across the hills to Loch Lomond, a distance of about five miles. The route lay through the heart of the MacGregors' country, with Loch Arklet sparkling in the sunshine on the left, under the shade of "the mighty Ben Lomond." A little beyond the loch one of Rob Roy's houses, and Helen MacGregor's birthplace were seen; and while descending the steep Pass of Inversnaid, the ruined fort was noticed in which General Wolfe, the hero of Quebec, once commanded in troublous days. The descent to Loch Lomond at Inversnaid was steep, and rather trying to the nervous on the top of a high coach; but the scenery was grand, and fears were forgotten on board the capacious lake steamer, where the party were soon seated to an acceptable luncheon after their early start and long journey through the fresh highland air.

Loch Lomond is about 22 miles long, and 5 miles broad at the widest part, and contains thirty islands, some of them of considerable size, others mere islets, and mostly well-wooded. The total area is 21,000 acres, and the surface of the loch is but 23 feet above sea-level. It has a depth of only a few fathoms over the greater part of the south or widest portion; but between Inversnaid and Tarbet, the bottom sinks to 105 fathoms, and at that great depth the water is said to maintain a steady temperature of 42° Fahr. all the year round. It is locally famed for three wonders—"Waves without wind, fish without fin, and a floating

island." A peculiar swell of the loch after a storm accounts for the first; and the second is said to be a species of viper which swims from island to island; while the third is supposed to have been an ancient crannoge, or floating habitation, or island, which has long ago grounded, or entirely disappeared. From its large size and beautiful scenery, Loch Lomond is styled the "Queen of Scottish Lakes," and well deserves the title.

From the deck of the steamer, as she left Inversnaid, a good view of the beautiful waterfall formed by the Arklet was seen on the left. Tarbert, the landing-place for Loch Long, lay on the right, and on the opposite side, but about a mile further on, was observed Rob Roy's cave, immediately under Ben Lomond. Rowardennan is the landing-place for those who wish to climb the lofty Ben. Further down on the right, amid rich woodlands, Luss was seen; and opposite it Inch-Lonaig—the Island of Yew Trees—which for some generations past has been used as a deer park by the Colquhouns of Luss, and still contains many very fine old yews. It is said that the trees were first planted by Robert the Bruce, for the purpose of supplying bows for his archers. Keeping the islands on the right, Balmaha Pier was soon reached, where the party disembarked. On a promontory due south of the pier Ross Priory was pointed out, where Sir Walter Scott wrote "Rob Roy."

Previous to landing at Balmaha, the company were photographed in a group on the deck of the steamer. Afterwards, forming up on the deck, they sang "Auld Lang Syne," and then said good-bye to Professor Schwappach, who, with Professor Bayley Balfour, set out by the West Highland Railway for a trip in the Highlands.

BALMAHA.

A visit was paid, by means of row-boats from Balmaha, to "the Isle of Nuns, or of Old Women"—Inch-Cailliach,—of which Scott says: "A most beautiful island. . . . The church belonging to the former nunnery was long used as a place of worship for the parish of Buchanan, but scarce any vestiges of it now remains." The old burying-ground around the church was for centuries the last resting-place of the Clan Alpine, as well as of numerous Buchanans, Grahams, and other local septs.

"The shaft and limbs were rods of yew,
Whose parents in Inch-Cailliach wave
Their shadows o'er Clan Alpine's grave,
And answering Lomond's breezes deep,
Soothe many a chieftain's endless sleep."

There grew the wood from which was made "Clan Alpine's Fiery Cross" of Scott's "Lady of the Lake." The island is now richly wooded, the greater part being covered with very fine oak coppice.

At Balmaha the party were courteously invited by Mr Turnbull, of Messrs Turnbull & Co., Glasgow, to visit the Pyrolignous Acid Works, which have been going at the side of the loch for more than a hundred years. The invitation was gladly accepted, and here, to their great delight, the Foresters found a chemical factory distilling valuable substances from peeled oak coppice wood, which abounds in the district, but which of late has fallen so much in value. The wood is brought in sailing smacks from the coppices on the shores of Loch Lomond, and stored here for use. After being cut into suitable lengths, it is put into ovens and heated to the distillation point, when it gives off fumes which are condensed and become pyrolignous acid. This, purified by lime, gives a wood spirit which is used in the manufacture of methylated spirits. The remainder of the material becomes in turn acetate of lime and acetate of soda. From the latter, acetic acid is made, and from the acid comes an acetone which is now largely employed in the manufacture of smokeless powder. The charcoal, no longer of use for gunpowder, is ground down and sold for a variety of purposes. After a considerable time spent in the inspection of those most interesting works, Mr Turnbull hospitably entertained the party to refreshments.

BUCHANAN CASTLE.

The party now set out for Buchanan Castle, the chief arboricultural feature of the day's proceedings, under the guidance of Mr Murray, private secretary to the Duke of Montrose; Mr M'Callum, forester on the Buchanan estates; and Mr Crosbie, gardener. Those gentlemen, who had met and welcomed the Arborists on landing at Balmaha, courteously acted as their guides during the afternoon, a duty which they performed in

the most pleasant and satisfactory manner. On the way the Montrose Homes for Sick Children, erected and generously maintained by the Duchess of Montrose, attracted much attention from their pretty, comfortable, cosy appearance, the *beau-ideal* of a health-restoring home to a sickly child. The kirk and manse of Buchanan were passed, and the home nurseries, full of a fine healthy stock of both forest and ornamental trees and shrubs, were inspected.

Near the Castle the party were received and cordially welcomed by their Graces, the Duke and Duchess of Montrose, and hospitably entertained by them to luncheon in a large marquee erected on the lawn. Afterwards the party were courteously shown over the Castle by His Grace, who conducted them to the top of the stately square tower, whence a most magnificent view of the splendid landscape, amidst which it stands, was obtained. The Castle, which is stored with valuable family heirlooms and rich works of art, is a handsome modern structure in the Scottish Baronial style, standing on a commanding site, surrounded by noble woodlands and parks extending to about 1500 acres.

With His Grace leading them, the party proceeded to make a closer survey of the beautiful grounds, and the numerous handsome trees and shrubs with which they are richly adorned. On the south front of the Castle, and close to the walls, the Tasmanian "Blue Gum," *Eucalyptus globulus*, has been freely planted, and had a charming effect, although, as His Grace informed the party, it was more on account of its valuable sanitary properties than its beautiful appearance that he had planted it so near to the Castle. The vigorous and healthy look of those rather tender exotics spoke volumes for the salubrity of the climate and the capacity of the soil at Buchanan for the sustenance of tree life. Further evidence of this was seen all over this noble domain, in which hardy trees and shrubs grow with great luxuriance, and many grand specimens have attained to a large size and stately proportions.

On the lawn between the Castle and the gardens were seen many fine specimens of the newer Coniferæ, including very handsome and thriving examples of *Abies nobilis, A. Nordmanniana, A. Pinsapo, A. cephalonica, A. concolor, A. Douglasii, A. Menziesii; Thuja gigantea; Cupressus Lawsoniana, C. Nutkœnsis, C. macrocarpa; Pinus cembra, P. monticola; Cedrus*

deodora, C. atlantica; Wellingtonia gigantea, and numerous others, all thriving and forming very ornamental subjects.

In an interesting walk through the wood in the Douglas Glen, and through the shrubberies, the immense height of all the trees was a subject of general remark. Great interest was taken in the Douglas firs, which have been planted in large numbers, and are now a feature of the woodlands. In one part of the park the party inspected a plantation of 6 acres solely composed of Douglas firs, which, planted thirty-eight years ago, have now attained to an average height of 70 feet. One of the largest gave a girth of 6 feet 6 inches at 5 feet up, and all over they stood about forty trees to the acre. Several grand individual Douglas firs were measured, and were much admired. One of these, with a fine silvery tint, was 9 feet 9 inches in girth; another, opposite the stables, was 12 feet 7 inches in circumference, and 90 feet high; and a third was 11 feet 4 inches in girth, and 95 feet high, all girthed at 5 feet up. In the same locality were an ancient yew 12 feet in girth at 3 feet up, and a great oak 17 feet in girth at 5 feet up. Numerous other fine trees were seen during the walk through those splendid policies, in which, besides the Coniferæ already mentioned, the larch, Scots fir, spruce, and silver fir thrive splendidly, as well as the ordinary broad-leaved trees, the oak, ash, beech, elm, lime, and sycamore, all exhibiting great vigour, and furnishing many notable specimens.

Visiting the gardens under the charge of Mr Crosbie, extending to about 10 acres, they were found replete with all the appliances for meeting the wants of the ducal family. The hothouses were full of excellent grapes, peaches, and other hothouse fruits, plants and flowers of all kinds in first-rate condition for the purposes they had to serve. The kitchen-garden exhibited skilful management, resulting in abundant crops of fruit and vegetables. In a neatly laid out garden in front of the greenhouses was seen the original plant of the Buchanan Royal Lady Fern, *Athyrium Filix-fœmina Victoriæ,* now a veteran plant of about half a century old.

Assembling in a group in the pretty flower-garden, with two handsome specimens of the Chilian pine, *Araucaria imbricata,* as a background, the party were photographed by Mr Paxton, of Kilmarnock, a member of the Society, and a noted amateur photographer. Before the company parted here, to make their way to the railway station at Drymen, Mr Dunn gave appropriate

expression to the feeling of every member who had participated in the inspection of the noble domain in regard to the kindness of the Duke of Montrose, and a ringing cheer was raised for His Grace before the party left his charming territory.

On the way through the domain to the station, Mr M'Callum pointed out two grand specimens of park beeches, fully 100 feet high, and with boles girthing respectively 17 feet and 13 feet at 5 feet from the ground. A fine example of the Abele, or white poplar, was also noticed, which girthed 13 feet in the stem, and stood about 70 feet high.

Reaching Drymen station, the party returned from there, *via* Stirling to Edinburgh, in the saloon carriages furnished by the North British Railway Company, and thus concluded the Excursion of 1896. Favoured by good weather, the two days' Excursion, admirably arranged by the *Secretary*, Mr Robert Galloway, was a great success.

EXCURSION TO ARNISTON, MIDLOTHIAN.

19th SEPTEMBER 1896.

By the kind permission of Robert Dundas, Esq. of Arniston, the members of the Royal Scottish Arboricultural Society had the opportunity, on Saturday, September the 19th, to inspect the rich arboreal treasures in the demesne and woods on the Arniston estate. Owing to the late period of the season at which the Excursion was arranged, only a short notice could be given to the members, who, however, turned out in good numbers to represent the Society, and to take part in the most interesting inspection of the splendid trees and woodlands at Arniston in the afternoon.

Leaving the Waverley Station at 1.25 P.M., under the guidance of the *Secretary*, the party travelled by rail to Gorebridge, picking up a number of members at the stations on the way. On arriving at Gorebridge, the party were met and heartily welcomed by Mr

James Cook, landsteward on the estate, who officiated as leader for the afternoon, and performed his duties in such an admirable manner as to leave nothing further to be desired on the part of the visitors. The introductions over, Mr Cook at once marshalled the party and led them off on what proved to be a long and highly interesting walk through the extensive and beautiful policies. From start to finish the interest never for a moment flagged, in spite of several heavy showers which would have damped, if not extinguished, the ardour of the most enthusiastic arborist amidst scenes of less attractiveness.

Among those present were—Messrs Charles Buchanan and Robert Henderson, Penicuik; George Mackinnon, J. K. Milne, and John Tod, Lasswade; John Williamson, Loanhead; Robert Baxter, Malcolm Dunn, George Jack, and John Murdoch, Dalkeith; John Watson, Peter Loney, William Mackinnon, D. Young, *North British Agriculturist*, David T. Fish, G. H. Burrells, Frank Machray, and the *Secretary*, Robert Galloway, from Edinburgh; Thomas Simpson, Duddingston; Mungo Temple, Carron House, Stirlingshire; and George Williamson, Leven, Fife.

The family of Dundas is one of the oldest and most distinguished of the county families in Scotland. A branch of the family acquired the lands of Arniston by purchase, and founded the family of Dundas of Arniston in the year 1571, and the estate has been held in unbroken succession by the family to the present time. At first the estate consisted only of the Mains of Arniston, but now extends to upwards of 10,000 broad acres in Midlothian, about 1000 acres being covered with plantations and woodlands. Lying at a considerable altitude on the northern slope of the Moorfoot Hills, it was naturally cold and exposed, but the vast improvements which have been carried out, with great skill and intelligence, have converted it into one of the most fertile and best cultivated estates to be found in the upper districts of the Lothians.

Entering the policies by the lodge near to the station at Gorebridge, the party walked for some distance down the valley of the Gore Water, a tributary of the South Esk, noting on either hand many well-grown trees, prominent among which were some fine examples of the black Italian poplar. The valley traversed was, till about a generation ago, the site of one of the largest manufactories of gunpowder in Scotland; and the extensive ruins of

dams, powder mills and stores, and works for the protection of the neighbourhood, in the unfortunate event of an explosion, were objects of much attraction.

Turning up a ravine to the left, and passing through an arch beneath the public highway, near to the Lion and Elephant Gate, the principal entrance to Arniston domain, the party found themselves within the extensive park, which stretches away for about 2 miles to the southwest. Gaining the main drive, from the Lion and Elephant Gate to the Mansion-house, at a spot overhanging the valley of the South Esk, a beautiful view was got of the richly-wooded glen, with the river, pure and limpid, rippling over the rocky bottom, deep in its verdant bosom. Standing a little back, on the left, from the drive, a fine thriving grove of Oaks was pointed out; which, it was said, were raised from acorns obtained from the Duke of Portland's estate in Sherwood Forest, and the plantation has been named the "Portland Grove." Near the grove, but on the opposite side of the drive, are two mounds a little distance apart, known as "Dead Man's Land," which are supposed to be ancient burial places, but are now covered with sturdy oaks, apparently some centuries old, and possessing very little of the free growth and fine clean stems of the Portland oaks. Two veteran oaks were noticed on the right close to the drive, where they probably have stood for ages, and looked like enduring for generations to come.

Nearing the vicinity of the Mansion-house, some of the oldest trees still extant on the estate were met with; and the dendrometer and tape-measure were immediately requisitioned. The first to be measured was a grand old Ash tree, once a stately object, but now bearing marks of storm and decay. At 5 feet up the stem girthed 15 feet, and still carried a fair head of branches. This tree had formed one in an avenue. A little farther on were seen some more ashes of nearly equal girth, and numerous grand sycamores, which were much admired. One of the largest sycamores was girthed, and found to be 16 feet 3 inches, at 5 feet up, with a crown rising to a height of over 100 feet.

About 60 yards off in the park, on the right, stood a venerable oak, which was said to be the oldest oak at Arniston, and once marked the boundary of the policies in that direction in olden time. It is still a very picturesque object, and like all others of the fine old trees about Arniston is tended with the greatest care. It girthed 10 feet in the stem, and still exhibits a fair amount

of vitality, and, if the elements spare it, it may remain a notable landmark for ages to come.

The party next proceeded by the east avenue to inspect the "Wilderness," a special feature of landscape decoration in vogue two centuries ago, of which the most eminent exponent was Le Notre, the distinguished French landscape gardener, who laid out Versailles for Louis XIV., about the middle of the seventeenth century. The Wilderness at Arniston dates from towards the end of that century, and is laid out immediately to the south of the mansion; the avenues and straight lines of trees radiating in all directions from the centre of the house, and giving most charming views of the landscape and distant objects from the windows. Much of the original design has long ago disappeared, but the main lines are still in evidence—in spite of the interference of "Capability Brown," and the ravages of time—and afford a splendid example of the excellent taste, and an indication of the carefully-planned details of the landscape gardener of two hundred years ago. Stately limes, beeches, and elms compose the main features of the Wilderness; and in less numbers are seen fine specimens of oak, ash, Spanish and Horse chestnuts, cedars of Lebanon, Scots fir, larch, and Silver fir; as well as trees of lowlier stature, like the holly, yew, and arbor-vitæ; of which evergreens the hedges and dividing lines were usually formed. These latter have entirely disappeared, only their ancient lines being marked here and there by a grand old holly or yew. The effect, however, according to our modern ideas and tastes, is rather heightened than spoilt by the clearance of the undergrowth of trimly-clipped yew hedges and other minor details.

The measuring of the girths of the numerous gigantic trees growing here was seen to be an almost endless job, and only a few of the more prominent could be noted. First, a stately old Silver fir, standing on the lawn, near the front of the mansion, was a feature of great interest, as it was supposed to be one of the earliest introduced to Scotland. It was still a fine tree, although the hand of time and stormy winds were telling upon it. Several splendid examples of Scots fir were noted, one of which girthed 10 feet 6 inches, at 5 feet up, and stood at least 100 feet high. On the west of the lawn stood a stately beech, about 112 feet in height, with a smooth cylindrical bole which girthed 11 feet. A little to the westward, near the brow of the

Esk valley, a grand specimen of larch was measured, and showed a girth of 12 feet, at 5 feet up, with nearly 50 feet of a clean bole to the first branch. This grand tree leaned considerably off the perpendicular, but was in vigorous health, and could not be easily matched, as a timber tree, in this country. A number of other splendid larches, with clean stems 60 to 70 feet in length, were observed in the grounds and on other parts of the estate, all well-grown and generally free from blemish of any kind. The opinion was freely expressed that the district was peculiarly well-adapted for the growth of this most profitable of forest trees. Some of the finest larches in the Wilderness were found by the dendromoter to be about 120 feet high, and were computed to contain between 200 to 250 cubic feet of timber, exclusive of top-wood and branches.

In the grounds just outside the Wilderness, a group of oaks and poplars, planted by Mr Dundas about forty-five years ago as an experiment, were pointed out as an example of the rate of growth of each species. An average oak—*Quercus robur pedunculata*—had a stem-girth of 4 feet 6 inches, at 5 feet up; stood about 50 feet high, and contained about 12 cubic feet of timber; while a poplar, *Populus monilifera*, or the "Black Italian Poplar," had a height of about 100 feet, a girth at 5 feet up of 9 feet 6 inches, a clean bole of 45 feet, and was estimated to contain about 90 cubic feet of timber. The difference in value between oak and poplar timber, compared with their rate of growth as there shown, formed a nice problem for discussion, the prevailing opinion leaning towards "quick returns."

A short walk along the ridge between the Esk and the garden glens, brought the party to the rustic Moss House, standing on the extreme point of the ridge and overlooking a landscape of rare beauty, with a lovely stretch of the richly-wooded glen of the South Esk, lying immediately in front and far below. Towering conspicuously amid the greenery of the glen, were some very tall and shapely Norway spruces, of a peculiarly fastigiate habit, and thickly clothed from base to apex with compact branches, the trees standing erect like gigantic emerald pillars. Along the slopes of the glen, and in its sheltered nooks, were seen many fine healthy examples of the rarer coniferæ, indicating by their vigour, depth of colour, and well-furnished branches, the happy circumstances in which they grow, and promising at an early period to rival, and perhaps excel the Norway spruces in stature

and beauty. Rhododendrons form a principal part of the undergrowth, and in their season of flowering must produce a rich and pleasing display, especially near the Moss House, where some of the finest hybrids have been introduced and are thriving well.

Descending from the coign of vantage at the Moss House by a winding path to the bottom of the glen, a stately specimen of Norway spruce was measured, and the stem found to girth 8 feet 8 inches at 5 feet up, the dendrometer indicating a height of 110 feet, and the branches having an average diameter of 15 feet, from the ground right up to within less than 20 feet of the apex. Vigorous young specimens of conifers were seen on all sides, among which the beautiful silvery variety of *Abies nobilis* was specially noticed, as being one of the most vigorous and fastest growers, and many of the specimens were bearing on their upper branches, with the characteristic precocity of the species, a heavy crop of the conspicuous cones.

Crossing the Garden Burn by a rustic stone bridge, erected in place of another swept away by a heavy flood in September 1891, the walk was followed up the side of the South Esk, which is also spanned a little higher up by a substantial rustic stone bridge, giving access to Temple hamlet and its venerable parish kirk, rich in its memories of the Knights Templars of the Middle Ages. In passing along the bottom of the glen, it was noticed that a considerable area had been planted with rhododendrons within the past few years, and from the progress they had made, they would soon add a pleasing feature to the scene, with a rich display of flowers in their season. A fine specimen of the Douglas fir, thirty-five years old, was found to girth 7 feet 6 inches at 5 feet up, and to be nearly 80 feet in height. Near the rustic bridge over the Esk was seen a beautiful specimen of the best variety of the copper beech. From that point up the glen, for nearly 200 yards, to the boundary of the policies at Temple bridge, was a striking plantation of conifers, consisting chiefly of arborvitæs and cypresses, among which predominated *Thuja gigantea* and *Cupressus Lawsoniana*, with lesser numbers of *Abies Albertiana, A. nobilis, Pinus cembra, Thujopsis borealis, Wellingtonia gigantea*, and several others, all healthy and thriving, and exhibiting in a marked degree the erect fastigiate habit displayed by so many of the conifers in this glen.

Turning to the left, and taking the walk along the brow of the valley, the party soon reached the Garden Glen, where, close to

the walk, was seen a handsome young specimen of *Abies nobilis* that had lost its leading shoot twelve years ago, when about 5 feet high. A side shoot was then tied up to the broken stem by Mr Dundas, and it has so completely taken the place of the original shoot that it was impossible to identify the exact point from which the side shoot had sprung. The tree has now a shapely stem fully 25 feet in height. A fine tree of *Abies Albertiana*, in the bottom of the ravine, was thriving luxuriantly, and upwards of 50 feet high; while an *Abies Pinsapo*, near the top of the bank, was a beautiful example of a slower-growing conifer, about 15 feet in height, and 10 feet in diameter of branches.

Approaching the gardens, the party were met and heartily welcomed by Mr Colin M'Taggart, who has been gardener at Arniston for about thirty years. Under his guidance the visitors inspected the flower-garden, lawn, and shrubberies, all in a perfect state of keeping, and displaying much skill and taste in their management. Among the first objects on the lawn to attract attention was a grand old specimen of the Cedar of Lebanon, with a wide-spreading, umbrageous head overhanging the pretty burn that wimples, as clear as crystal, through the lawns, and loses itself beneath the shrubs in the glen. The massive stem of the cedar girthed 17 feet at 5 feet up, and the branches were bearing numerous cones nearing their full size. Should these cones ripen fertile seeds at this high altitude, over 500 feet above sea-level, it will be a notable instance of the beneficial influences of the past fine season. Another grand old cedar stood at the opposite end of the lawn—a taller tree, about 65 feet high—with a fine stem of lesser girth, and also bearing cones on its upper branches. Numerous other fine trees and clumps of choice shrubs adorned this lovely spot, where the party would have lingered long had time permitted. After a glimpse at the tastefully arranged flower-garden, and a hurried run through the well-stocked and admirably-kept hothouses and kitchen-garden, in which the grapes, apricots, and hardy flowers were specially admired, the party had to make off with Mr Cook for a further inspection of the extensive policies.

In a few minutes the south avenue was entered, beneath as stately rows of magnificent beech trees as ever graced the approach to a family mansion of modern times. They were considered to be a grand example of the skill and taste of the school of land-

scape gardening founded by Le Notre, and their vigorous health at the end of a couple of centuries, which bears token of the care displayed in their management, may carry them safely on for generations. On the west side of the avenue the trees have evidently been pollarded in their youth, and from their stout, short trunks, about 8 feet high, they throw up numerous massive limbs to an average height of about 90 feet, which form grandly umbrageous heads. One of the largest, and, counting from the south entrance gate, the third tree in the row, girthed 14 feet of stem at 5 feet up, and threw aloft eight giant limbs thickly canopied with healthy foliage. The trees in the row on the opposite, or east side of the avenue, have been allowed to grow naturally, and have formed shapely boles of considerable length, carrying well-balanced heads of branches, thickly clothed with foliage. The stem of the second tree from the gate girthed 12 feet 2 inches at 5 feet up, with about 25 feet of a clean, straight bole to the first branch. Altogether, that avenue, when once seen, was not likely to be forgotten.

A little distance outside the south entrance, the estate saw-mill and timber-yard were seen, but time would not permit a lengthened inspection, and the party retraced their steps along the south drive towards the mansion, near which, in the park on the right, a fine old walnut was seen, about 50 feet high, with a stem girthing 12 feet, but hollow and decaying in the centre. What attracted most attention from the party was the heavy crop of walnuts which the old tree was bearing, and speculation was rife among them as to whether the nuts would ripen this season at such a high altitude. A gigantic beech, with a remarkably twisted bole, of about 10 feet in girth and 40 feet in length, was estimated to be 117 feet high; and a fine old cedar, with a wide-spreading head, much damaged by storms, and girthing 14 feet 6 inches at the usual point 5 feet from the ground, was the last of the grand trees around the mansion to be inspected.

The company were then invited to enter the mansion, where they were cordially received by Mr Dundas in the library. In the course of a most interesting speech welcoming the party to Arniston, Mr Dundas gave a brief history of the family, and the efforts each generation had made to adorn their ancestral home and beautify the landscape around it; the first of the great improvements, including the laying out of the grand avenues, being begun as far back as the year 1668, by Robert Dundas,

second Lord Arniston. Mr Dundas also kindly exhibited a series of beautifully-executed old plans, showing the embelishments proposed and the extent to which they were carried out by several generations of the Arniston family, lucidly explaining to the party the various details, and pointing out, through the windows of the room in which they were examining the plans, the lines of the great avenues and the leading features of the landscape as depicted on the plans. Needless to say, every word spoken was listened to with rapt attention, and everyone felt deeply grateful for the reminiscences and historical incidents so graciously placed before them by the learned and highly-esteemed proprietor of stately Arniston.

Leading the way to the dining-room, Mr Dundas hospitably entertained the company to tea, to which, after their long walk through the policies, they did ample justice. Tendering their most grateful thanks to Mr Dundas, and bidding him good-bye, the company, on reaching the open air, raised a ringing cheer for the Laird of Arniston and his fireside, and with refreshed vigour set to work to complete the inspection of the remainder of the policies and woodlands before darkness set in. Striking into the spacious East Avenue, extending to a total length of 2 miles, it was found to have a width of about 30 paces between the lines of trees, with a smooth, well-made road, about 12 feet wide, in the centre. It may be here noted in passing that all the roads and drives in the extensive policies were seen to be in the same clean, orderly condition, with a hard smooth surface falling slightly to the side to cast the rain, and in the best condition for carrying the traffic. Reverting to the East Avenue, the first portion nearest the mansion, comprised a row of handsome old lime trees on the left, with stout trunks and well-clothed shapely heads towering to a great height, and forming the *beau-ideal* of avenue trees. On the right, the avenue was formed of huge elms, many of them sadly damaged by storms or natural decay, and presenting a rough and irregular aspect, in contrast to their graceful confreres across the avenue. Passing the Home Farm, the trees forming the avenue change to oaks, chestnuts, and sycamores of a later date than the elms and limes; and anon beautiful lines of young lime trees are seen forming the avenue on both sides, until the East Entrance Gate is reached. Here the policies were left behind, and the party started to examine the plantations extending for about 2 miles to the Carlisle road, but their inspection was much

marred by a heavy downpour of rain, which sent many of the party to seek shelter where they could easiest find it. Enough of the plantations were, however, seen to show that they were in excellent condition, and full of a fine regular crop of timber, mostly oaks and other hardwoods, with here and there some fine thrifty larch, spruce, and Scots fir. The foresters among the party declared that they would have preferred to have seen the ground well stocked with a crop of larch, considering the splendid manner in which the samples they saw were thriving. The lowering skies and the shades of evening brought the party back to the East Gate, where before parting with them, the warmest thanks of the members were cordially tendered by Mr Buchanan to Mr Cook and Mr M'Taggart, for their courtesy and invaluable services during the afternoon. A smart walk of about 2 miles brought the party again to Gorebridge Station, whence they reached their homes by train in due time, all thoroughly satisfied with the afternoon's work, and grateful to Mr Galloway, the *Secretary*, for the completeness of the arrangements he had made for their comfort and convenience in the limited time.

Royal Scottish Arboricultural Society.

PATRON—HER MOST GRACIOUS MAJESTY THE QUEEN.

1.—FORMER PRESIDENTS.

YEAR.

1854. JAMES BROWN, Deputy-Surveyor of the Royal Forest of Dean.
1855. Ditto, Wood Commissioner to the Earl of Seafield.
1856. Ditto, ditto.
1857. The Right Hon. THE EARL OF DUCIE.
1858. The Right Hon. the EARL OF STAIR.
1859. Sir JOHN HALL, Bart. of Dunglass.
1860. His Grace THE DUKE of ATHOLE.
1861. JOHN J. CHALMERS of Aldbar.
1862. The Right Hon. THE EARL OF AIRLIE.
1863. The Right Hon. T. F. KENNEDY.
1864. ROBERT HUTCHISON of Carlowrie, F.R.S.E.
1865. Ditto, ditto.
1866. Ditto, ditto.
1867. Ditto, ditto.
1868. Ditto, ditto.
1869. Ditto, ditto.
1870. Ditto, ditto.
1871. Ditto, ditto.
1872. HUGH CLEGHORN, M.D., LL.D., F.R.S.E., of Stravithie.
1873. Ditto, ditto.
1874. JOHN HUTTON BALFOUR, M.D., M.A., F.R.SS. L. & E., Professor of Botany in the University of Edinburgh.
1875. Ditto, ditto.
1876. The Right Hon. W. P. ADAM of Blairadam, M.P.
1877. Ditto, ditto.
1878. Ditto, ditto.
1879. The Most Hon. THE MARQUIS OF LOTHIAN, K.T.
1880. Ditto, ditto.
1881. Ditto, ditto.
1882. ALEXANDER DICKSON, M.D., F.R.S.E., of Hartree, Regius Professor of Botany in the University of Edinburgh.
1883. HUGH CLEGHORN, M.D., LL.D., F.R.S.E., of Stravithie.
1884. Ditto, ditto.
1885. Ditto, ditto.

YEAR

1886. Sir HERBERT EUSTACE MAXWELL, Bart. of Monreith, M.P.
1887. Ditto, ditto.
1888. The Right Hon. THE EARL OF HOPETOUN, Hopetoun House, South Queensferry.
1889. His Excellency The Right Hon. THE EARL OF HOPETOUN, Governor of Victoria, Australia.
1890. ISAAC BAYLEY BALFOUR, M.D., Sc.D., F.R.S., Professor of Botany in the University of Edinburgh.
1891. Ditto, ditto.
1892. Ditto, ditto.
1893. Ditto, ditto.
1894. R. C. MUNRO FERGUSON, M.P., of Raith and Novar, Raith House, Kirkcaldy, Fife.
1895. Ditto, ditto.
1896. Ditto, ditto.

2.—LIST OF MEMBERS.

Corrected to December 1896.

HONORARY MEMBERS.

Date of Election.

1873. BRANDIS, Sir Dietrich, K.C.S.I., Ph.D., *Ex*-Inspector General of Forests in India, Bonn, Germany.
1886. CAMPBELL, Sir James, Bart. of Aberuchill, Redhill, Lydney, Gloucestershire.
1886. HOOKER, Sir Joseph D., M.D., K.C.S.I., The Camp, Sunningdale, Berks.
1886. JACK, Edward, St John, New Brunswick.
1886. JOHORE, The Maharajah of, Johore, Malay Peninsula.
1894. LOGAN, Charles B., W.S., Commissioner to the Countess Dowager of Seafield, Coulnakyle, Grantown, Strathspey.
1869. LOTHIAN, The Most Hon. the Marquis of, K.T., Newbattle Abbey, Dalkeith (also a *Life* Member by composition).
1886. LUBBOCK, Sir John, Bart., M.P., D.C.L., High Elms, Down, Kent.
1886. MICHAEL, General, C.S.I., Bangor Lodge, Ascot, Berkshire.
1889. SARGENT, Professor C. S., Director of the Arnold Arboretum, Harvard College, Brookline, Massachusetts, U.S.A.
1889. SCHLICH, Dr William, Professor of Forestry in the Engineering College for India, Coopers Hill, Surrey.
1895. SCHWAPPACH, Dr Adam, Professor of Forestry, Eberswalde, Prussia.
1886. SOUTHEY, Hon. Robert, Cape Town, Cape Colony.
1881. TEMPLE, Sir Richard, Bart., G.C.S.I., The Nash, Worcestershire.
1886. TOKAI, Tokio, Japan.

Date of Election.

LIFE MEMBERS.

1875. Acland, Sir Thomas Dyke, Bart., M.P., of Killerton, Exeter, Devon.
1883. Adam, Sir Charles Elphinstone, Bart. of Blairadam, 3 New Square, Lincoln's Inn, London, W.C.
1874. Addington, The Right Hon. Lord, Addington Manor, Winslow, Bucks.
1883. Alexander, John, Florence House, Cinnamon Gardens, Colombo, Ceylon.
1883. Athole, His Grace the Duke of, K.T., Blair Castle, Blair Athole.
1887. Bailey, Colonel F., R.E., Lecturer on Forestry, Edinburgh University, 7 Drummond Place, Edinburgh.
1896. Baird, J. G. A., M.P., of Adamton, 89 Eaton Square, London, S.W.
1884. Balfour of Burleigh, The Right Hon. Lord, Secretary for Scotland, Kennet House, Alloa.
1886. Balfour, Edward, of Balbirnie, Markinch, Fife.
1877. Balfour, Isaac Bayley, Sc.D., M.D., F.L.S., Professor of Botany, Edinburgh.
1896. Balvaird, The Hon. Lord, Scone Palace, Perth.
1866. Barrie, James, Forester, Stevenstone, Torrington, North Devon.
1877. Barry, John W., of Fyling Hall, Fylingdales, Scarborough, Yorks.
1884. Bates, Cadwallader John, Langley Castle, Northumberland.
1871. Bell, William, of Gribdae, Kirkcudbright.
1877. Bolckow, C. F. H., of Brackenhoe, Middlesboro'-on-Tees.
1857. Borthwick, Wm., Forester, Dunnichen, Forfar.
1896. Brown, Rev. W. Wallace, Minister of Alness, Ross-shire.
1867. Bruce, Thomas Rae, Old Garroch, New Galloway.
1873. Brydon, John, Forester, Rothes, Elgin.
1879. Buccleuch, His Grace the Duke of, K.T., Dalkeith Park, Dalkeith.
1879. Buchanan, Charles, Overseer, Penicuik Estate, Penicuik.
1896. Carmichael, Sir Thos. D. Gibson, Bart., M.P., of Castlecraig, Dolphinton, Peeblesshire.
1895. Carruthers, Alex. Currie, Solicitor, 7 Howe Street, Edinburgh.
1882. Chowler, Christopher, Gamekeeper, Dalkeith Park, Dalkeith.
1890. Christie, John, of Cowden, Dollar, Clackmannanshire.
1883. Christie, William, Nurseryman, Fochabers.
1877. Clay, J. Spender, Ford Manor, Lingfield, Surrey.
1872. Clerk, Sir George D., Bart. of Penicuik, Midlothian.
1879. *Colquhoun, Andrew, 75 Buchanan Street, Glasgow.*
1876. Cowan, Charles W., of Logan House, Valleyfield, Penicuik.
1892. Cowan, George, 1 Gillsland Road, Edinburgh.
1875. Craig, Wm., M.D., C.M., F.R.S.E., 71 Bruntsfield Place, Edinburgh.
1865. Cross, David G., Forester, Kylisk, Nenagh, Ireland.
1880. Curr, Henry, Factor, Pitkellony House, Muthill, Perthshire.
1884. Currie, Sir Donald, K.C.M.G., M.P., of Garth Castle, Aberfeldy.
1867. Dalgleish, John G., of Ardnamurchan, Brankston Grange, Stirling.
1876. Dalgleish, Laurence, of Dalbeath, Rutland Square, Edinburgh.
1877. Dewar, Daniel, Forester, Beaufort Castle, Beauly, Inverness.

Date of Election.

1896. Douglas, Alex., The Gardens, Baldersby Park, Thirsk, Yorkshire.
1883. Dundas, Charles H., of Dunira, Dalchonzie, Crieff, Perthshire.
1872. Dundas, Robert, of Arniston, Gorebridge, Midlothian.
1895. Dundas, Captain Robert, Yr. of Arniston, Kirkhill, Gorebridge.
1867. Dunn, Malcolm, The Palace Gardens, Dalkeith.
1875. Eastwood, James, The Gardens, Bryn-y-Neuadd, Bangor, Wales.
1876. Edwards, William Peacock, S.S.C., 21 Hill Street, Edinburgh.
1881. Elliot, Walter, Manager, Ardtornish, Morvern, Oban, Argyle.
1879. Falconer, Dr John, St Ann's, Lasswade, Midlothian.
1888. Ferguson, R. C. Munro, M.P., of Raith and Novar, Raith, Fife.
1869. Fish, David T., 12 Fettes Row, Edinburgh.
1874. Fitzwilliam, The Right Hon. the Earl, K.G., Wentworth, Rotherham, Yorkshire.
1885. Fleming, J. B., "Beaconsfield," Kelvinside, Glasgow.
1881. Forbes, Arthur Drummond, Millearne, Auchterarder, Perthshire.
1890. Forbes, William, Forester, Swinton, Masham, Yorkshire.
1869. Forgan, James, Forester, Bonskeid, Pitlochry, Perthshire.
1884. Foulis, Thomas, Publisher, 9 S. Castle Street, Edinburgh.
1866. *France, Charles S., 11 Bridge Street, Aberdeen.*
1881. Gilchrist, Wm., Forester, Leuchars, Elgin.
1856. Gough, William, Wood Manager, Wykeham, York.
1884. Graham, Wm., of Erins, Tarbert, Lochfyne, Argyle.
1874. Grant, John, Overseer, Daldowie, Tollcross, Glasgow.
1880. Grant, Sir George Macpherson, Bart., M.P., Ballindalloch Castle, Banffshire.
1867. Grimond, Alexander D., of Glenericht, Blairgowrie, Perthshire.
1882. Hamilton, Donald C., Forester, Knowsley, Prescot.
1880. Hare, Colonel, 32 Palmerston Place, Edinburgh.
1874. Herbert, H. A., of Muckross, Killarney, Co. Kerry, Ireland.
1884. Heywood, Arthur, Sudbourne Hall, Wickham Market, Suffolk.
1871. Hope, H. W., of Luffness, Drem, Haddingtonshire.
1876. Horne, John, Director, Forests and Gardens, Mauritius.
1876. Horsburgh, John, 131 Princes Street, Edinburgh.
1869. Huth, Louis, of Possingworth, Hawkhurst, Sussex.
1884. Inglis, Alex., Greenlaw Dean, Greenlaw, Berwickshire.
1882. Jonas, Henry, Land Agent and Surveyor, 4 Whitehall, London, S.W.
1890. Kennedy, James, The Chesters, New Kilpatrick, Glasgow.
1892. Kerr, John, Farmer, Yorkston, Gorebridge, Midlothian.
1894. Lamington, The Hon. Lord, Lamington, Lanarkshire.
1896. Lansdowne, The Most Hon. the Marquess of, K.G., 54 Berkeley Square, London, S.W.
1876. Leicester, The Right Hon. the Earl of, Holkham Hall, Wells, Norfolk.
1868. Leslie, Charles P., of Castle-Leslie, Glasslough, Ireland.
1874. Leslie, The Hon. George Waldegrave, Leslie House, Leslie, Fife.
1881. Leyland, Christopher, Haggerston Castle, Beal, Northumberland.
1883. Loney, Peter, Estate Agent, 22 George Square, Edinburgh.
1881. Lonsdale, Claud, Rose Hill, Carlisle.

Date of Election.

1880. *Love, J. W., c/o Mrs Boyce, Byron Street, St Kilda, Victoria, South Australia.*
1875. Lovelace, The Right Hon. the Earl of, East Horsley Towers, Woking, Surrey.
1881. Lumsden, David, of Pitcairnfield, Perth.
1891. Lumsden, Hugh Gordon, of Clova, Lumsden, Aberdeenshire.
1875. Luttrell, George F., of Dunster Castle, Taunton, Somersetshire.
1874. Macdonald, Ranald, Factor, Cluny Castle, Aberdeenshire.
1895. MacDougall, Robert Stewart, M.A., B.Sc., 9 Brougham Street, Edinburgh.
1884. Macduff, Alex., of Bonhard, Perth.
1879. M'Intosh, Dr W. C., Professor of Natural History, University of St Andrews, 2 Abbotsford Crescent, St Andrews.
1872. Mackenzie, Donald F., Estate Office, Mortonhall, Edinburgh.
1893. Mackenzie, James, Forester, Faskally, Pitlochry, Perthshire.
1880. Mackenzie, Sir Kenneth, Bart., Conon House, Dingwall, Ross-shire.
1895. Maclachlan, John, of Maclachlan, 12 Abercromby Place, Edinburgh.
1879. M'Laren, John, Marionville, Sciennes Gardens, Edinburgh.
1879. MacRitchie, David, C.A., 4 Archibald Place, Edinburgh.
1880. Malcolm, Lieut.-Col. E. D., R.E., 18 Queen's Gate Place, London, S.W.
1895. Mann, Charles, Merchant, Lumsden, Aberdeenshire.
1895. Margerison, Samuel, English Timber Merchant, Calverley, near Leeds.
1876. Martin, James, Forester, Knipton, Grantham, Lincolnshire.
1894. Maughan, John, Estate Agent, Jervaulx Abbey, Middleham R.S.O., Yorks.
1893. Maxwell, Sir John Stirling, Bart. of Pollok, Pollokshaws.
1871. Maxwell, W. H., of Munches, Dalbeattie, Kirkcudbrightshire.
1880. Mesham, Captain, Pontryffydd, Bodvari, Rhyl, Denbighshire.
1881. Michie, John, Forester, Balmoral, Ballater, Aberdeenshire.
1896. Miller, Sir James Percy, Bart. of Manderston, Duns, Berwickshire.
1892. Milne, J. K., Kevock Tower, Lasswade, Midlothian.
1882. Mitchell, Francis, Forester, Harleston, Northamptonshire.
1889. Moffat, James, 48 Castle Street, Edinburgh.
1896. Murray, William Hugh, W.S., 48 Castle Street, Edinburgh.
1893. Nisbet, J., D.Œc., 145 Norwich Road, Ipswich, Suffolk.
1894. Orkney, William C., Overseer, Moncreiffe, Bridge of Earn, Perth.
1878. Pitcaithley, Alexander, Forester, Jeannie Bank, Scone.
1896. Pitman, Archibald Robert Craufurd, W.S., 48 Castle Street, Edinburgh.
1856. Portsmouth, The Right Hon. the Earl of, Eggesford, North Devon.
1887. Profeit, Dr Alexander, Her Majesty's Commissioner, Balmoral.
1878. Punchard, Frederick, Underley Estate Office, Kirkby Lonsdale, Westmoreland.
1876. Rae, William A., Factor, Murthly Castle, Perthshire.
1855. Ramsden, Sir John, Bart., 6 Upper Brook Street, London, W.
1873. Richardson, Adam D., Head Gardener, Royal Botanic Garden, Edinburgh.
1876. Ritchie, William, of Middleton, Gorebridge, Midlothian.
1879. Robertson, Donald, Forester, Dunrobin, Golspie, Ross-shire.

Date of Election.

1866. Robertson, Jas., Wood Manager, Panmure, Carnoustie, Forfarshire.
1890. Robinson, William, 37 Southampton Street, Strand, London.
1883. Rollo, The Hon. Wm. Chas. Wordsworth, Master of Rollo, Duncrub Park, Dunning, Perthshire.
1872. Rosebery, The Right Hon. the Earl of, Dalmeny Park, Edinburgh.
1854. Rutherford, James, Agent, Kirkleatham, Redcar, Yorkshire.
1894. Sanderson, Wm., Talbot House, Ferry Road, Leith.
1867. Scott, Daniel, Wood Manager, Darnaway, Forres.
1896. Shaw-Stewart, Michael Hugh, M.P., of Carnock, 7 Charles Street, Berkeley Square, London, S.W.
1877. Smith, Thomas Valentine, of Ardtornish, Morvern, Argyleshire.
1882. Smythe, David M., of Methven Castle, Perth.
1893. Smythe, Francis Henry, Strathearn, Nottingham Road, Natal.
1889. Somerville, Dr William, B.Sc., F.R.S.E., Professor of Agriculture and Forestry, Durham College of Science, Newcastle.
1883. Sprot, Major Alexander, of Garnkirk, Chryston, Glasgow.
1873. Stair, The Right Hon. the Earl of, Lochinch, Castle Kennedy, Wigtownshire.
1892. Stewart, Sir Mark J. M'Taggart, Bart., M.P., of Southwick, Kirkcudbrightshire.
1880. Sutherland, Evan C., of Skibo Castle, Dornoch, Sutherland.
1883. Sutherland, His Grace the Duke of, Dunrobin Castle, Golspie.
1865. Talbert, Peter, Forester, Glenericht, Blairgowrie, Perthshire.
1887. Taylor, Andrew, 11 Lutton Place, Edinburgh.
1877. Terris, James, Factor, Dullomuir, Blairadam, Kinross-shire.
1880. Thomson, Alexander, Trinity Grove, Trinity Road, Edinburgh.
1855. Thomson, John Grant, Wood Manager, Grantown, Strathspey.
1872. Trotter, Colonel, R.A., The Bush, Roslin, Midlothian.
1883. Trotter, Colonel H., of Mortonhall, Edinburgh.
1872. Urquhart, B. C., of Meldrum, Aberdeenshire.
1878. Walker, Colonel I. Campbell, Late Conservator of Forests, Forest Office, Madras.
1871. Wemyss, Randolph Gordon Erskine, of Wemyss and Torrie, Fife.
1869. Wild, Albert Edward, Conservator of Forests, Darjeeling, India.
1889. Wilson, David, jun., of Carbeth, Killearn, Glasgow.

ORDINARY MEMBERS.

The Names printed in italics are those of Members whose present Addresses are unknown. Any information regarding those Members will be gladly received by the Secretary.

LAW V. Members in arrear shall not receive the *Transactions* while their Subscriptions remain unpaid. Any Member whose Annual Subscription to the Society remains unpaid for three years shall cease to be a Member of the Society, and no such Member shall be eligible for re-election till he shall have paid up his arrears.

Date of Election.

1895. ABBOT, Thomas, Forester, Firknowe, Peebles.
1892. ADAMSON, C., Merchant, Leven, Fife.
1881. AIRLIE, The Right Hon. the Earl of, Cortachy Castle, Forfarshire.
1878. AITKEN, Andrew Peebles, M.A., Sc.D., Professor of Chemistry, Veterinary College, Clyde Street, Edinburgh.
1891. ALEXANDER, Jas., The Gardens, Revesby Abbey, Boston, Lincolnshire.
1865. ALLAN, John, Forester, Dalmeny Park, Edinburgh.
1895. ANDERSON, Duncan, Forester, Headfort House, Kells, Meath, Ireland.
1895. ANDERSON, John G., Forester, Sutherland Estate, Dornoch.
1887. ANNAND, John F., Overseer, Kildrummy Castle, Mossat, Aberdeenshire.
1883. ARGYLL, His Grace the Duke of, K.T., LL.D., D.C.L., F.R.S., F.G.S., Inveraray Castle, Argyleshire.
1860. AUSTIN & M'ASLAN, Nurserymen, 89 Mitchell Street, Glasgow.

1880. BALDEN, John, Dilston, Corbridge-on-Tyne, Northumberland.
1892. BALLINGALL, Neil, Sweet Bank, Markinch, Fife.
1867. BARRIE, David, Forester, Comlongan Castle, Annan, Dumfries.
1895. BARRIE, James Alexander, Assistant Forester, Lilleshall, Newport, Salop.
1889. BARRON, John, Elvaston Nurseries, Borrowash, Derby.
1874. BARTON, James, Forester, Hatfield House, Herts.
1892. BARTY, Rev. D., The Manse, Kirkcolm, Stranraer.
1871. BAXTER, Robert, Forester, Dalkeith Park, Dalkeith.
1894. BAXTER, Wm., Estate Office, Mertoun, St Boswells.
1894. BEECH, George, The Grange Gardens, Bishops Stortford, Herts.
1883. BELL, Andrew, Forester, Culford, Bury St Edmunds.
1895. BENNET, J. B., C.E., A.M.I., 24 George Street, Edinburgh.
1890. BERRIDGE, W., Forester, Stoneleigh Abbey Farm, Kenilworth.
1889. BERRY, Francis, Forester, Williamston, Torphins, Aberdeenshire.
1893. BERRY, James, The Strand, Berwick-on-Tweed.
1896. BETHUNE, William, Grocer, Lundin Mill, Fife.
1869. BISSETT, William S., The Gardens, Moncreiffe House, Perth.

Date of Election.

1896. Blair, David, Factor, Ballikinrain, Balfron, Stirlingshire.
1889. Blair, Peter, The Gardens, Trentham, Stoke-on-Trent, Staffordshire.
1883. Blake, Jas., Forester, Mortonhall, Liberton, Midlothian.
1854. Boa, Andrew, Land Steward, Dalton House, Newcastle-on-Tyne.
1872. Boa, Andrew, jun., Sub-Agent, Great Thurlow, Newmarket, Suffolk.
1892. Bond, Thomas, Forester, Cummertrees, Dumfriesshire.
1895. Boord, W. Bertram, Land Agent, Bewerley, Pateley Bridge, Yorkshire.
1876. Booth, John, 39 Mozartstrasse Gross-Lichterfelde, Berlin.
1887. Boulger, Professor, 18 Ladbroke Grove, London, W.
1883. Boyd, John, Forester, Pollok Estate, Pollokshaws, Glasgow.
1889. Britton, Horatio A., Timber Merchant, Shrewsbury.
1860. Brodie, James, Land Steward, Glasslough, Armagh, Ireland.
1896. Brown, David, Manager, Chevet Park Estate, Wakefield, Yorks.
1878. Brown, J. A. Harvie-, of Quarter, Dunipace House, Larbert.
1893. Brown, Robert, Forester, Castle Craig, Dolphinton, Peeblesshire.
1895. Brown, Walter R., Assistant Forester, East Terrace, South Queensferry.
1883. Browning, John M., The Gardens, Dupplin Castle, Perth.
1893. Brownlie, Alexander, Wood Merchant, Earlston, Berwickshire.
1895. Bruce, Peter, Assistant Forester, Home Farm, Blair Athole.
1895. Bruce, William, Assistant Forester, Murthly, Perthshire.
1873. Buchan, Alexander, A.M., F.R.S.E., LL.D., Secretary of the Scottish Meteorological Society, 42 Heriot Row, Edinburgh.
1894. Buchan, R., Overseer, Guy's Cliff, Warwick.
1896. *Buist, David, Assistant Forester, Royal Botanic Garden, Edinburgh.*
1895. Buist, Robert, Overseer, Newbyth, Prestonkirk, East Lothian.
1896. Burrells, George Henry, Assistant Forester, Royal Botanic Garden, Edinburgh.

1894. Cabry, Tom, Nisbet Hill, Duns.
1887. Cadell, George, National Club, 1 Whitehall Gardens, London, S.W.
1896. Cairns, Richard, The Gardens, Balruddery, near Dundee.
1896. Callander, Henry, of Prestonhall, Dalkeith.
1895. Cameron, R. M., Architect, 24 George Street, Edinburgh.
1890. Campbell, Alexander, of Auchindarroch, Lochgilphead, Argyle.
1895. Campbell, Alexander, Forester, Ayton, Abernethy, Perthshire.
1865. Campbell, James, of Tillichewan Castle, Dumbartonshire.
1896. Campbell, James Alex., M.P., of Stracathro, Brechin.
1894. Campbell, John, Timber Merchant, Inverness.
1895. Chaplin, William, Assistant Forester, Royal Botanic Garden, Edinburgh.
1892. Chapman, Andrew, Breckonhill, Lockerbie, Dumfriesshire.
1892. Chapman, Mungo, Torbrix Nurseries, St Ninians, Stirling.
1884. Christie, Alex. D., The Gardens, Ragley, Alcester, Warwickshire.
1887. Clark, Alexander, Belleville, Linlithgow.
1890. Clark, Charles, Forester, Cawdor Castle, Nairn.
1896. Clark, George Fraser, C.A. Apprentice, 24 St Andrew Square, Edinburgh.

Date of Election.

1891. Clark, John, Forester, Haddo House, Aberdeen.
1892. Clark, John, jun., Assistant Forester, Haddo House, Aberdeen.
1892. Clark, William, 66 Queen Street, Edinburgh.
1896. Cockburn, Alex. K., Assistant Forester, Royal Botanic Garden, Edinburgh.
1893. Collins, Frederick, Assistant Forester, Trentham, Stoke-on-Trent.
1882. Collins, Robt. T., Forester, Trentham, Stoke-on-Trent, Staffordshire.
1895. Connor, George A., Factor, Craigielaw, Longniddry.
1896. Constable, Geo. William, Estate Agent, Traquair, Innerleithen.
1896. Conway, Thomas, Assistant Forester, Castle Kennedy, Stranraer.
1887. Cook, James, Land Steward, Arniston, Gorebridge, Midlothian.
1894. Cook, James, jun., Estate Office, Craigielaw, Longniddry.
1879. Coupar, Robert, Forester, Ashford, Cong, County Galway, Ireland.
1895. Cowan, Bernard, Superintendent, Harton Cemetery, South Shields.
1858. Cowan, James, Forester, Bridgend, Islay, Argyleshire.
1894. Cowie, John, Forester, Meikleour, Perth.
1874. Cowper, R. W., Gortanore, Sittingbourne, Kent.
1875. Crabbe, David, Forester, Byreburnfoot, Canonbie, Dumfriesshire.
1867. Crabbe, James, Forester, Glamis Castle, Forfarshire.
1893. Craig, John, Banker, Dalkeith, Midlothian.
1876. Cromb, James, Assistant Forester, Kelly Castle, Arbirlot, Arbroath.
1895. Crozier, John D., Forester, Durris, Aberdeen.
1895. Cruickshank, Allan Macdonald, 48 Castle Street, Edinburgh.
1887. Cumming, Allan, Blairnachdar, Blair Athole.
1896. Cunningham, Andrew, Seedsman, 98 Mitchell Street, Glasgow.
1894. Cunningham, W. M., Nurseryman, Elgin.
1893. Curr, W. S., Factor, Ninewar, Prestonkirk.
1895. Cuthbert, James, Assistant Forester, Clova, Lumsden, Aberdeenshire.

1891. Daglish, John, Rothley Lake, Cambo R.S.O., Northumberland.
1884. Dalziel, James, Forester, Culzean Castle, Maybole, Ayrshire.
1869. Daniels, Peter, Forester, Slindon Hall, Arundel, Sussex.
1894. Darling, David C., Nurseryman, Aberdeen.
1865. Davidson, John, Agent, Greenwich Hospital Estates, Haydon Bridge-on-Tyne.
1857. Davidson, John, Forester, Aldbar, Brechin, Forfarshire.
1892. Davidson, John, Forester, Dalzell, Motherwell, Lanarkshire.
1892. Davidson, William, Assistant Forester, Aldbar, Brechin.
1884. Deane-Drake, Joseph Edward, Stokestown House, New Ross, Ireland.
1895. Dick, Joseph, Forester, Wentworth, Rotherham, Yorkshire.
1895. Dingwall, Alexander, Wine Merchant, Glendoig Villa, Perth.
1895. Dingwall, George, The Gardens, Belmont Castle, Meigle.
1891. Donald, A. S., Forester, Philiphaugh, Selkirk.
1893. Donaldson, George, Timber Merchant, Leven, Fife.
1893. Donaldson, James, Timber Merchant, Tayport, Fife.
1882. Douglas, Captain Palmer, of Cavers, Hawick.
1887. Douglas, Robert, 64 Princes Street, Edinburgh.

Date of Election.

1892. Dow, R., Forester, Douglas Castle, Douglas, Lanarkshire.
1867. Dow, Thomas, Forester, Bretby, Burton-on-Trent, Derbyshire.
1895. Drummond, David, Wholesale Stationer, 15 Victoria Street, Edinburgh.
1896. Drummond, George T., Forest Tree Seedsman, Stanley, Perthshire.
1862. Drummond & Sons, William, Nurserymen, Stirling.
1896. Duncan, David, Forester, Guynd, Arbroath, Forfarshire.
1873. Durward, Robert, Manager, Blelack, Dinnet, Aberdeenshire.
1894. Duthie, W. G., Forester, Bargany, Girvan, Ayrshire.

1896. Easdale, Andrew, Assistant Forester, Avoch Mains, Avoch, Inverness.
1885. Eddington, Francis, Overseer, Monk Coniston Park, Lancashire.
1893. Elder, William, Forester, Cholmondeley Park, Malpas, Cheshire.
1894. Emslie, William, Finnery, Kemnay, Aberdeenshire.
1887. Erskine, William, of Oaklands, Trinity, Edinburgh.
1896. Ewart, James Cossar, Professor of Natural History, University of Edinburgh.
1873. Ewing, David, Forester, Strichen House, Aberdeen.

1894. Farquharson, James, Forester, Ardgowan, Inverkip.
1895. Ferguson, John, Assistant Forester, 7 Haddow Street, Hamilton.
1880. Fergusson, Sir James Ranken, Bart., Spitalhaugh, West Linton.
1894. *Fernie, Robert, Assistant Forester, Keith Hall, Banffshire.*
1893. Finlayson, Alexander, c/o James Dickson & Sons, Inverleith Nurseries, Edinburgh.
1893. Finlayson, Malcolm, Solicitor, Crieff, Perthshire.
1891. Firth, W. M., Timber Merchant, 19 Montpelier, Edinburgh.
1869. Fisher, William, Estate Agent, Wentworth Castle, Barnsley, Yorkshire.
1895. Fitzpatrick, James, Assistant Forester, Murthly, Perthshire.
1893. Fleming, Rev. Hugh, The Manse, Mordington, Berwick.
1890. Forbes, Arthur C., Wood Manager, Bowood, Calne, Wiltshire.
1878. Forbes, Robert, Overseer, Kennet, Alloa.
1891. Foreman, Frederick, Nurseryman, Eskbank, Dalkeith.
1892. Forgan, James, Sunnybraes, Largo, Fife.
1892. Forgan, William, Assistant Forester, Eden Hall, Langwarthby R.S.O., Cumberland.
1889. Forster, William A., Forester, Belgrave Lodge, Pulford, Wrexham.
1892. Fraser, George, 24 St Andrew Square, Edinburgh.
1895. Fraser, J. C., Nurseryman, Comely Bank, Edinburgh.
1857. Fraser, P. Neill, of Rockville, Murrayfield, Edinburgh.
1892. Fraser, Simon, Forester, Boiden, Luss, Dumbartonshire.
1896. Frater, John, Assistant Forester, Royal Botanic Garden, Edinburgh.
1895. Fyffe, Robert B., Land Steward, Lindertis, Kirriemuir.

1878. Galletly, James, Overseer, Bonhard, Perth.
1874. Galloway, George, Estate Offices, Woodhouses, Whitchurch, Salop.
1893. Galloway, Robert, *Secretary*, 48 Castle Street, Edinburgh.
1896. Gammell, Sydney James, Yr. of Drumtochty, Fordoun, Kincardineshire.

Date of Election.

1895. George, Alfred W., Land Agent, Tedbury Park, Tidenham, Chepstow.
1870. Gilbert, James, Forester, Gallovie, Kingussie.
1887. Gilbert, W. Matthews, The *Scotsman* Office, Edinburgh.
1894. Gillespie, James, Forester, Lochton Lodge, Inchture, Perthshire.
1894. Gilmour, Captain Robert Gordon, of Craigmillar, The Inch, Midlothian.
1893. Gilroy, John, 26 Ravensdoune, Berwick-on-Tweed.
1880. Glen, David A., Forester, Croxteth Park, Liverpool.
1893. Glen, Thomas, The Gardens, Worth Park, Crawley, Sussex.
1893. Goldie, George, Eskdale Lodge, Dalkeith, Midlothian.
1893. Gordon, John G., 48 Castle Street, Edinburgh.
1891. Gorrie, G. H., Estate Office, Dalkeith, Midlothian.
1868. Gossip, James, of Howden & Co., The Nurseries, Inverness.
1887. Grant, Alexander, Assistant Forester, Penicuik House, Penicuik.
1867. Grant, Donald, Forester, Drumin, Ballindalloch, Banffshire.
1873. Grant, James, Forester, Heath, Chesterfield, Derbyshire.
1893. Grant, John B., Forester, Downan House, Glenlivet.
1893. Grant, Peter, Assistant Forester, Ovenstone, Forfar.
1892. Grant, Peter, Forester, Hornby Castle, Hornby, Lancaster.
1896. Gray, Henry, 22 Young Street, Edinburgh.
1883. Green, Arthur A., 20 Annandale Street, Edinburgh.
1890. Greenwood, C. H., Assistant Forester, Welbeck, Worksop, Notts.
1894. Grimes, Ernest, Assistant Forester, Welbeck, Worksop, Notts.

1879. Haddington, The Right Hon. the Earl of, Tyninghame, Prestonkirk.
1880. Haddon, Walter, Solicitor, Royal Bank, Hawick.
1889. Hankins, Charles, Forester, Wordwell, Culford, Bury St Edmunds.
1892. Hannah, George, Forester, The Glen, Innerleithen, Peeblesshire.
1890. Hardie, James F., Overseer, Haystoun Estate, Peebles.
1896. Harley, Andrew M., Assistant Forester, New Scone, Perth.
1895. Harrower, David K., Timber Merchant, Knowe Park, Bo'ness.
1894. Harvey, James, The Gardens, Mortonhall, Liberton.
1893. Hatcher, Bertram, Assistant Forester, Lilleshall, Newport, Salop.
1880. Havelock, W. B., The Nurseries, Brocklesby, Ulceby, Lincolnshire.
1892. Hay, John, Overseer, Dollar's Estate Office, 6 Henrietta Street, Kilmarnock.
1896. Hay, Wm. P., Merchant, Loanhead, Midlothian.
1889. Hayes, John, Overseer, Dormont, Lockerbie, Dumfriesshire.
1869. Hayman, John, Glentarff, Ringford, Kirkcudbrightshire.
1866. Henderson, Arch., Forester, Clonad Cottage, Tullamore, King's County.
1871. Henderson, John, Overseer, Vogrie, Gorebridge.
1893. Henderson, R., 4 High Street, Penicuik, Midlothian.
1883. Henderson, W., The Gardens, Balbirnie, Markinch, Fife.
1893. Henderson, William, Forester, Gosford Demesne, Markethill, Co. Armagh, Ireland.
1896. Henkel, C. C., F.I.I., J.P., Conservator of Forests, Umtata, Cape Colony.
1894. Henrie, Robert, Assistant Forester, Ardgowan, Inverkip.

Date of Election.

1895. HILL, Claude, of Messrs John Hill & Sons, Spot Acre Nurseries, Stone, Staffordshire.
1895. HOARE, Sir Henry Hugh Arthur, Bart. of Stourhead, Bath.
1866. HOGARTH, James, Forester, Culhorn, Stranraer, Wigtownshire.
1896. HOGG, Thomas, jun., Assistant Forester, Witley Court, Stourport, Worcestershire.
1874. HOME, Edward, Assistant Forester, Whiterig, Ayton, Berwickshire.
1892. HONEYMAN, Thomas, Factor, Clunes, Achnacarry, Spean Bridge.
1880. HOPETOUN, The Right Hon. the Earl of, Hopetoun House, South Queensferry.
1876. HULL, Frank, Forester, Lilleshall, Newport, Salop.

1895. INGLIS, A. M., Nurseryman, Forres.
1893. INGLIS, John, Forester, Kelly, Wemyss Bay, Renfrewshire.
1891. INGLIS, William, Forester, Brodick, Isle of Arran.
1895. INNES, Alexander, Assistant Forester, Loch Park, Drummuir, Keith.
1896. INNES, Alexander, Forester, Stourhead, Bath.
1870. IRELAND, J. S., Nurseryman, 39 Montgomery Street, Edinburgh.
1893. IRONS, John, Estate Bailiff, Thorney, Peterborough.

1893. JACK, George, S.S.C., Dalkeith, Midlothian.
1895. JAMIESON, Andrew, Overseer, Carnbroe, Bellshill.
1896. JARDINE, R. W. B., Yr. of Castlemilk, Lockerbie, Dumfriesshire.
1895. JOHNSTON, Alexander, Forester, Mount Teviot, Jedburgh.
1896. JOHNSTON, Alexander, Forester, Royal Botanic Garden, Edinburgh.
1883. JOHNSTON, Robert, Forester, Somerley, Ringwood, Hants.
1878. JOHNSTONE, Adam, Forester, Coollattin, Shillelagh, County Wicklow.
1888. JONES, James, Wood Merchant, Larbert, Stirlingshire.
1893. JONES, Thomas Bruce, Wood Merchant, Larbert.

1867. KAY, James, Wood Manager, Bute Estate, Rothesay, Bute.
1870. KEIR, David, Forester, Ladywell, Dunkeld, Perthshire.
1896. KEIR, David, jun., Assistant Forester, Ladywell, Dunkeld.
1876. KELMAN, John, Forester, Esslemont, Ellon, Aberdeenshire.
1896. KENNEDY, Peter, Forester, Countlich, Ballinluig, Perthshire.
1882. KENNEDY, Walter, Forester, New Tarbet, Parkhill, Ross-shire.
1887. KER, R. D., W.S., 50 George Street, Edinburgh.
1896. KETTLES, Robert, Assistant Forester, Craigend, Perth.
1870. *Kidd, James B., Forester, Dunrobin Estates, Golspie.*
1894. KIDD, Wm., Forester, Harewood, Leeds.
1879. KINCAIRNEY, The Hon. Lord, 6 Heriot Row, Edinburgh.
1894. KING, William G., King's Mills, Elgin.
1895. KIRKWOOD, William, The Gardens, Byethorn, Corbridge-on-Tyne.
1876. KYRKE, R. V., of Penywern, Mold, Flintshire.

1890. LAIRD, David P., Nurseryman, Pinkhill, Murrayfield, Edinburgh.
1895. LAIRD, John, Assistant Forester, Royal Botanic Garden, Edinburgh.

Date of Election.

1896. Laird, Robert, Nurseryman, 17a South Frederick Street, Edinburgh.
1895. Laird, William, Forester, Fyvie Castle, Aberdeenshire.
1896. Laird, William J., Assistant Forester, Fyvie Castle, Aberdeenshire.
1873. Lauriston, Alexander, Rufford Nursery, Ollerton, Newark, Notts.
1874. Leigh, William, of Woodchester Park, Stonehouse, Gloucestershire.
1880. Leishman, John, Manager, Cavers Estate, Hawick, Roxburghshire.
1895. Leithead, William, Forester, St Clair Cottage, Memsie, Fraserburgh.
1893. Leven, George, Forester, Auchencruive, Ayr.
1879. Lindsay, Robert, Windsor House, Ferry Road, Edinburgh.
1896. Lowe, W., Timber Merchant, Meldrum's Mill, Dunfermline.
1894. Lumsden, Fredk. R., Newburn, Largo, Fife.
1895. Lyall, John, Land Steward, Pinkie, Musselburgh.

1892. Macbean, Simon, Forester, Bunchrew, Inverness.
1896. M'Beath, David, Assistant Forester, Blairnachdair, Blair Athole, Perthshire.
1894. M'Callum, Edward, Forester, Falkland Palace, Fife.
1894. M'Clownie, John, The Residency, Zomba, British Central Africa.
1870. M'Corquodale, D. A., Bank of Scotland, Carnoustie, Forfarshire.
1893. M'Coubrie, M. S., Land Steward, Tullamore, King's County, Ireland.
1894. M'Culloch, Christopher, Assistant Forester, Ardgowan, Inverkip.
1887. M'Culloch, James, Forester, Gala House, Galashiels, Selkirkshire.
1893. Macdonald, George, Assistant Forester, Innes House, Elgin.
1894. M'Donald, James, Forester, Kinnaird Castle, Brechin.
1895. Macdonald, John, Assistant Forester, Dunrobin, Golspie.
1896. M'Dougall, Adam, Forester, Sudborne Hall, Wickham Market, Suffolk.
1894. M'Dougall, Alex., Assistant Forester, c/o Little & Ballantyne, Carlisle.
1882. M'Farlane, John, Forester, Tarbet, Loch Lomond, Dumbartonshire.
1896. M'Farlane, Peter, Assistant Forester, Castle Kennedy, Stranraer.
1890. M'Gregor, Alex., The Schoolhouse, Penicuik, Midlothian.
1896. M'Gregor, Angus, Forester, Craigton, Butterstone, Dunkeld.
1878. M'Gregor, Duncan, Forester, Camperdown, Dundee.
1896. Macgregor, John C., Assistant Forester, Spoutwells, Dunkeld.
1893. M'Hattie, J. W., The Gardens, Strathfieldsaye, Winchfield, Hants.
1895. Machray, Frank, Assistant Forester, c/o Thos. Methven & Sons, Nurserymen, Inverleith, Edinburgh.
1894. M'Ilwraith, Wm., Assistant Forester, Royal Botanic Garden, Edinburgh.
1880. MacIntosh, Angus, Overseer, Brookman's Park, Hatfield, Herts.
1885. MacIntosh, William, Drummuir Estate Office, Keith.
1895. Macintosh, W. L., The Gardens, Ballikinrain, Balfron.
1892. M'Kay, Allan, Manager, Saw Mills, Friockheim, Forfarshire.
1875. Mackay, John, Lauderdale Estate Office, Wyndhead, Lauder.
1887. Mackay, Peter, Forester, Kilvrough Estate, Park Mill, Swansea.
1891. Mackendrick, James, Forester, Ballynahinch, Toombeola, Co. Galway, Ireland.
1867. Mackenzie, Alex., Warriston Nursery, Inverleith Row, Edinburgh.

Date of Election.

1867. Mackenzie, John Ord, of Dolphinton, W.S., 9 Hill Street, Edinburgh.
1894. Mackenzie, John R., Assistant Forester, Altyre, Forres.
1896. Mackenzie, Wm., Forester, Novar, Evanton, Ross-shire.
1892. Mackenzie, W. A., Factor, Faskally, Pitlochry.
1883. M'Kinnon, George, The Gardens, Melville Castle, Lasswade.
1892. M'Kinnon, William, Nurseryman, 144 Princes Street, Edinburgh.
1878. Mackintosh, The, of Mackintosh, Moy Hall, Inverness.
1879. M'Laren, Charles, Land Steward, Cally Lodge, Dunkeld.
1878. M'Laren, John T., Factor, Polmaise, Stirling.
1893. M'Laren, William, Forester, Altyre, Forres, Morayshire.
1865. M'Lellan, Duncan, 7 Kelvingrove Terrace, Glasgow.
1892. M'Lennan, William, Factor, Inverlochy Castle, Kingussie.
1874. M'Leod, Angus A., Superintendent of City Gardens, 14 Royal Exchange, Edinburgh.
1883. M'Leod, John, of Dickson & Turnbull, 26 George Street, Perth.
1895. Macmillan, John D., Forester, Ampton Hall Estate, Bury St Edmunds.
1896. M'Naughton, Wm., Forester, Inver, Dunkeld.
1893. *M'Nicoll, John, Assistant Forester, Skelmorlie, Ayrshire.*
1892. MacOwan, Daniel, Assistant Forester, Hornby Castle, Lancaster.
1894. Macpherson, Alex., Assistant Forester, Knipton, Grantham.
1896. M'Pherson, Arch., Assistant Forester, Royal Botanic Garden, Edinburgh.
1896. M'Queen, John, Proprietor of the *Scottish Border Record*, Galashiels.
1890. M'Rae, Alexander, Forester, Castlecomer, Ireland.
1892. M'Rae, Alexander, c/o J. M. Bennett & Sons, Ardwick Station, Hyde Road, Manchester.
1895. M'Tavish, John, Assistant Forester, Dunrobin, Golspie.
1884. Main, Adam, Forester, Loftus R.S.O., Yorkshire.
1894. Malloch, William, 50 South Street, Perth.
1893. Marshall, J. Z., Timber Merchant, Bo'ness, Linlithgowshire.
1895. Martin, David, Overseer, Fettes College, Edinburgh.
1895. Martin, Robert, Forester, Haystoun Estate, Woodbine Cottage, Peebles.
1884. Massie, William H., of Dicksons & Co., 1 Waterloo Place, Edinburgh.
1893. Mather, R. V., of Laing & Mather, Nurserymen, Kelso.
1896. Maxtone, John, Forester, Abercairney, Crieff, Perthshire.
1886. Maxwell, Sir Herbert E., Bart. of Monreith, M.P., Wigtownshire.
1891. Maxwell, James, Forester and Overseer, Ruglen, Maybole.
1895. Maxwell, James, Factor, Screel, Castle-Douglas.
1879. Meikle, R. A., Ri Cruin, Lochgilphead, Argyleshire.
1889. Melville, The Right Hon. Viscount, Melville Castle, Lasswade.
1873. Menzies, George, Agent, Trentham, Stoke-on-Trent, Staffordshire.
1877. Methven, Henry, of Thomas Methven & Sons, 15 Princes Street, Edinburgh.
1869. Methven, John, of Thomas Methven & Sons, Leith Walk Nurseries, Edinburgh.

Date of Election.

1892. Methven, John, The Gardens, Blythswood, Renfrewshire.
1865. Michie, Christopher Young, Forester, Cullen House, Banffshire.
1895. Michie, James, Assistant Forester, Knowsley Prescott, Lancashire.
1893. Michie, William, Forester, Gulworthy, Tavistock, Devonshire.
1893. Middlemass, Archibald, Forester, Tulliallan, Kincardine-on-Forth.
1894. Mill, George, S.S.C., 44 Frederick Street, Edinburgh.
1893. *Millar, K. W., Assistant Forester, Lynedoch, Perth.*
1882. Milne, Alexander, of James Dickson & Sons, 32 Hanover Street, Edinburgh.
1895. Milne, James, The Gardens, Whitslade, Broughton, Peeblesshire.
1891. Milne, R. W., Forester, 9 Etterby Street, Stanwix, Carlisle.
1890. Milne, William, Farmer, Foulden, Berwick-on-Tweed.
1894. Milsom, Isaac, Gardener and Steward, Claydon Park, Winslow, Bucks.
1895. Mitchell, Alexander, Assistant Forester, Rosebery, Gorebridge.
1893. Mitchell, Archibald, Forester, Dunraven Castle, Bridgend, Glamorganshire.
1869. Mitchell, James, Overseer, Aldie Castle, Fossoway.
1894. Moffat, Edward, Forester, Madeley Estate, Staffordshire.
1895. Moncreiffe, Sir Robert D., Bart. of Moncreiffe, Perth.
1896. Moncur, John, Assistant Forester, New Scone, Perth.
1895. Morgan, Malcolm, Wood Merchant, Comrie Street, Crieff.
1895. Morrison, Hew, Librarian, Edinburgh Public Library.
1894. Morton, David, Assistant Forester, Royal Botanic Garden, Edinburgh.
1894. Morton, David, Overseer, Cally, Gatehouse, Kirkcudbrightshire.
1894. Moss, Edward, Assistant Forester, 41 Surrey Road, Darnall, near Sheffield.
1890. Muirhead, George, F.R.S.E., Factor, Haddo House, Aberdeen.
1894. Munro, Alexander, Overseer, Ballinacourte, Co. Tipperary, Ireland.
1890. Munro, Donald, Forester, Coul, Ross-shire.
1895. Munro, Donald, Assistant Forester, Yester, Gifford, Haddington.
1876. Munro, Hugh, Forester, Holkham Hall, Norfolk.
1895. Murdoch, Graham W., Science and Naturalist Editor, *Yorkshire Weekly Post*, Milnthorpe, Westmorland.
1892. Murdoch, John, Ironmonger, Dalkeith, Midlothian.
1892. Murray, Alexander, Forester, Murthly, Perth.
1896. Murray, Hon. A. W. C. O., Master of Elibank, Hay Lodge, Peebles.
1892. Murray, John, Forester, Airthrey Castle, Bridge of Allan.

1894. Neil, Archibald, Forester, Warkton, Kettering, Northamptonshire.
1893. Nelson, Robert, Assistant Forester, Kinmount Estate, Cummertrees, Dumfriesshire.
1896. Nelson, Thomas, The Gardens, Tulliallan, Kincardine-on-Forth.
1885. Newbigging, John W., Nurseryman, Dumfries.
1895. Newton, George, Factor's Assistant, 28 Charlotte Street, Edinburgh.
1893. Nicol, James, Forester, Aird's Mill, Muirkirk, Ayrshire.

Date of Election.

1895. Nicol, James, Assistant Forester, Aird's Mill, Muirkirk, Ayrshire.
1891. Nicoll, John, Solicitor, 20 George Street, Edinburgh.

1875. Page, Andrew Duncan, Land Steward, Culzean, Maybole, Ayrshire.
1893. Page, Walter, Farmer, Myregornie, Kirkcaldy, Fife.
1894. Paton, George, Assistant Gardener, Mortonhall, Liberton, Midlothian.
1879. Paton, Hugh, Nurseryman, Kilmarnock, Ayrshire.
1894. Patterson, George, Forester's Office, Leinster Street, Athy, Co. Kildare, Ireland.
1895. Paxton, George, Richardland, Kilmarnock.
1887. Paxton, Thomas A., Forester, Newbattle, Dalkeith.
1869. Peebles, Andrew, Estate Office, Albury, Guildford, Surrey.
1895. Philip, William Watt, Assistant Forester, Balmoral Castle, Aberdeenshire.
1896. Philp, Henry, jun., Timber Merchant, Campbell Street, Dunfermline.
1896. Philp, John, Timber Merchant, Campbell Street, Dunfermline.
1892. Pirrie, George, Wood Merchant, Dalkeith, Midlothian.
1874. Platt, Colonel Henry, Gorddinog, Llanfairfechan, Carnarvonshire.
1893. Porter, John, Farmer, Nesbit Hill, Duns, Berwickshire.
1892. Potts, G. H., Fettes Mount, Lasswade, Midlothian.
1896. Prentice, George, Factor, Raith, Kirkcaldy, Fife.
1895. Priest, W., The Gardens, Eglinton Castle, Irvine.
1892. Proudfoot, William, Forester, Raith, Kirkcaldy, Fife.

1870. Rattray, Thos., Forester, Westonbirt House, Tetbury, Gloucestershire.
1894. Reid, James S., Forester, Balbirnie, Markinch, Fife.
1893. Reid, Rev. John, The Manse, Foulden, Berwickshire.
1895. Reid, S., Forester, Bowmont Forest, Kelso.
1896. Reid, William, Assistant Forester, Donibristle, Aberdour, Fife.
1892. Ritchie, Alexander, Forester, Cavens Estate, Kirkbean, Dumfries.
1896. Ritchie, Thomas, Nurseryman, Callander, Perthshire.
1896. Robertson, Duncan, Forester, Strathord, Stanley, Perthshire.
1896. Robertson, George, Assistant Forester, Donibristle, Aberdour, Fife.
1894. Robertson, George D., Assistant Forester, Carolside, Earlston.
1895. Robertson, Sir Henry, Pali Corwen, North Wales.
1896. Robertson, James, Assistant Forester, Old Blair, Blair Athole, Perthshire.
1896. Robertson, John, Assistant Forester, High Street, Dunkeld.
1896. Robertson, Peter, Assistant Forester, Panmure, Carnoustie, Forfarshire.
1895. Robertson, Thomas, Forester, Knockboy, Recess, County Galway.
1883. Robertson, William, Assistant Forester, Ringwood, Birnam, Perth.
1893. Rodger, James, Assistant Forester, Field Farm, Weston Longville, Norwich.
1893. Romanes, James, C.A., Meadowbank, Dalkeith.
1887. Ross, John, Forester, Hopetoun, South Queensferry, Linlithgowshire.
1895. Royle, James, Forester, Florence Court, Inneskillen, Ireland.
1867. Russell, John, Manager, Craigie House, Ayr.

Date of Election.

1893. Rutherford, James A., Land Agent, Highclere Park, Newbury, Berks.
1870. Rutherford, John, Forester, Linthaugh, Jedburgh, Roxburghshire.

1894. Samson, David T., Seafield Estates Office, Grantown, Strathspey.
1875. Sang, Edmund, of E. Sang & Sons, Nurserymen, Kirkcaldy.
1896. Sang, Edward, Solicitor, 29 Queen Street, Edinburgh.
1895. Sclater, Alexander, Seed Manager, 15 Princes Street, Edinburgh.
1870. Scott, Adam, Forester, Southwick Park, Fareham, Hants.
1892. Scott, David, Overseer, Dumfries House, Cumnock, Ayrshire.
1883. Scott, D. P., National Bank of Scotland, Hilltown Branch, Dundee.
1881. Scott, James, Forester, Woollaton Hall, Notts.
1894. Scott, J. H., Cedar Villa, Muirpark, Eskbank.
1890. Scott, John, Assistant Forester, Highclere Estate, Newbury, Berks.
1894. Scott, John, Forester, Gordon Castle, Fochabers, Morayshire.
1890. Scrimgeour, John, Overseer, Shanes Castle, Antrim, Ireland.
1870. Shanks, John, Forester, Kildrummy Castle, Mossat, Aberdeenshire.
1893. Shaw, Andrew, Victoria Saw-Mills, Perth.
1893. Shaw, William, School House, Ballingry, Lochgelly, Fife.
1887. Simpson, Anthony, Forester, Alloa Park, Alloa.
1893. Simpson, Hugh, Assistant Forester, Lynedoch, Perth.
1894. Simpson, James, of D. & W. Croll, Nurserymen, Dundee.
1868. Slater, Andrew, Land Steward, Osborne, Cowes, Isle of Wight.
1873. Smith, G. B., Wire Fence Manufacturer, 100 West Regent St., Glasgow.
1894. Smith, Henry, Forester, Duncombe Park, Helmsley, Yorks.
1871. Smith, James, The Gardens, Mentmore, Leighton-Buzzard, Bucks.
1883. Smith, James, The Gardens, Hopetoun, South Queensferry.
1886. Smith, John, Surveyor, Romsey, Hampshire.
1895. Smith, John, Cabinetmaker, Peebles.
1895. *Smith, Robert, Forester, West Park Estate, Damerham, Salisbury.*
1870. Smith, Thomas, Nurseryman, Stranraer, Wigtownshire.
1895. Smith, Thomas, Overseer, The Lodge, Tring Park, Wiggington, Tring, Herts.
1883. Smith, William, Chemist, Stockbridge, Edinburgh.
1896. Smith, William, Assistant Forester, Kinnaird Castle, Brechin.
1896. Smith, William G., Ph.D., Lecturer on Plant Physiology, Royal Botanic Garden, Edinburgh.
1885. Spiers, David, Overseer, Mugdrum, Newburgh, Fife.
1895. Stevens, Thomas, Solicitor and Land Agent, Lincoln's Inn Fields, London.
1896. Stewart, James, Assistant Forester, Spoutwells, Dunkeld.
1875. Stewart, J. M., Hale Park, Salisbury, Hants.
1893. Stewart, Richard, Loxwell Farm, Derryhill, Calne, Wilts.
1876. Stewart, Robert, Forester, Stonefield, Tarbert, Lochfyne, N.B.
1889. Storie, Robert, 92 High Street, Dalkeith.
1893. Storie, William, Forester, Holme Lacy, Hereford.
1893. Storie, W., Whitway House, Newbury, Berks.
1892. Sutherland, John D., Estate Agent, Oban, Argyle.

Date of Election.

1869. TAIT, David, Overseer, Owston Park, Doncaster, Yorkshire.
1892. TAIT, James, Builder, Penicuik, Midlothian.
1895. TAIT, Wm. A., Factor, 13 Brandon Terrace, Edinburgh.
1892. TAYLOR, Alexander, Assistant Forester, Lynedoch, Perth.
1894. TAYLOR, James, Forester, Gilston, Colinsburgh, Fife.
1894. TEMPLE, M., The Gardens, Carron House, Falkirk, Stirlingshire.
1891. TENNANT, Edward P., The Glen, Innerleithen.
1895. TERRAS, Alexander, Forester, Dalgetty Castle, Turiff.
1893. THOMSON, David, Agricultural Engineer, Woodhead Street, Dunfermline.
1893. THOMSON, David W., Nurseryman, 24 Frederick Street, Edinburgh.
1869. THOMSON, Lockhart, S.S.C., 114 George Street, Edinburgh.
1871. TOMLINSON, Wilson, Forester, Clumber Park, Worksop, Notts.
1895. TULLO, James, 2 Hanover Street, Edinburgh.

1883. UNDERWOOD, Henry E., Sub-Agent, Fornham, St Genevieve, Bury St Edmunds, Suffolk.

1896. VEITCH, Archibald, Assistant Forester, Royal Botanic Garden, Edinburgh.
1895. VERT, Alex. C. D., S.S.C., 2a Hill Street, Edinburgh.

1893. WADDELL, Jas., Merchant, Leven, Fife.
1894. WALKER, Henry H., Factor, Monreith, Port William, Wigtownshire.
1870. WALL, G. Y., Land Agent, Grange House, Darlington, Durham.
1893. WALLACE, David P., Forester, The Saw-Mills, Filleigh, Molton, S. Devon.
1893. WALLACE, Robert, Timber Merchant, 31 Leith Walk, Edinburgh.
1894. WARD, James, Forester, Keith, Banffshire.
1893. WATSON, John, Timber Merchant, Annandale Street, Edinburgh.
1893. WATSON, John T., 6 Bruntsfield Gardens, Edinburgh.
1872. WATT, James, J.P., of Little & Ballantyne, Nurserymen, Carlisle.
1893. WATT, James W., Knowefield Nurseries, Carlisle.
1889. WATTERS, Dennis, Forester, Wester Elchies, Carron, Strathspey.
1894. WATTERS, Frank, Forester, Cameron South Lodge, Alexandria, Dumbartonshire.
1894. WEBSTER, Charles, The Gardens, Gordon Castle, Fochabers.
1891. WELSH, James, of Dicksons & Co., 1 Waterloo Place, Edinburgh.
1866. WELSH, William M., of Dicksons & Co., 1 Waterloo Place, Edinburgh.
1895. WHITE, William, Farmer, Edgefield, Loanhead.
1894. *Whitehead, Amos, Assistant Gardener, Mortonhall, Liberton, Midlothian.*
1884. WHITTON, James, Superintendent of Parks, 249 George Street, Glasgow.
1895. WIGHT, Alexander, Overseer, Thurston, Innerwick.
1895. WIGHTON, John, Forester, Newstead Abbey, Nottingham.
1883. WILKIE, Charles, Assistant Forester, Lennoxlove, Haddington.
1891. WILKIE, G., Architect, Hayfield, Peebles.
1882. WILLIAMSON, A., Wood Manager, The Warren, Eridge Hamsell, Tunbridge Wells, Kent.

Date of Election.

1894. WILLIAMSON, Alex., M.A., LL.B., 2 Osborne Terrace, Edinburgh.
1889. WILLIAMSON, A. T., 7 Kew Terrace, Edinburgh.
1890. WILLIAMSON, George, The Links, Leven, Fife.
1895. WILLIAMSON, John, Bank Agent, Loanhead, Midlothian.
1887. WILSON, George, Forester, Penrice Castle, Reynoldston R.S.O., Wales.
1883. WINNING, John G., Estate Office, Branxholm, Hawick.
1892. WINTON, Thomas, Timber Merchant, Dundee.
1893. WISEMAN, Edward, Nurseryman, Elgin.
1895. WISEMAN, William, Nurseryman, Forres.
1894. WOOD, William, The Gardens, Newton Don, Kelso, Berwickshire.
1868. WYLLIE, George, Ballogie, Aboyne, Aberdeenshire.

1875. YOUNG, William, Forester, Morriston Cottage, Earlston, Berwickshire.

1896. ZIMMERMAN, Henry W., Assistant Forester, Rosehaugh, Inverness.

Royal Scottish Arboricultural Society.

Instituted 16th February 1854.

PATRON.

HER MOST GRACIOUS MAJESTY THE QUEEN.

The Forty-third Annual General Meeting of the Royal Scottish Arboricultural Society was held in the Hall, 14 South St Andrew Street, Edinburgh, on Wednesday, 29th January 1896, at 2.30 p.m. R. C. Munro Ferguson, Esq. of Raith and Novar, President of the Society, occupied the Chair.

Minutes.

The Minutes of the General Meeting of the Society, held on 26th July 1895, which had been printed and circulated amongst the Members, were held as read, and unanimously approved of.

Election of New Members.

The election of the following thirty-seven Candidates for Membership, whose names had previously been submitted to the Council, was duly confirmed, viz.:—

Life Members.

Balvaird, The Honourable Lord, Scone Palace, Perth.
Brown, Rev. W. Wallace, Minister of Alness, Ross-shire.
Carmichael, Sir Thos. D. Gibson, Bart. of Castlecraig, Dolphinton, Peeblesshire.
Miller, Sir James Percy, Bart. of Manderston, Duns, Berwickshire.
Murray, William Hugh, W.S., 48 Castle Street, Edinburgh.

Ordinary Members.

Bethune, William, Grocer, Lundin Mill, Fife.
Buist, David, Assistant Forester, Royal Botanic Garden, Edinburgh.

Buist, Robert, Overseer, Newbyth, Prestonkirk, East Lothian.
Burrells, George Henry, Assistant Forester, Royal Botanic Garden, Edinburgh.
Clark, George Fraser, C.A. Apprentice, 24 St Andrew Square, Edinburgh.
Cockburn, Alex. K., Assistant Forester, Royal Botanic Garden, Edinburgh.
Conway, Thomas, Assistant Forester, Castle Kennedy, Stranraer.
Drummond, George T., Forest Tree Seedsman, Stanley, Perthshire.
Duncan, David, Forester, Guynd, Arbroath, Forfarshire.
Easdale, Andrew, Assistant Forester, Avoch Mains, Avoch, Inverness.
Ewart, James Cossar, Professor of Natural History, University of Edinburgh.
Frater, John, Assistant Forester, Royal Botanic Garden, Edinburgh.
Henkel, C. C., F.I.I., J.P., Conservator of Forests, Umtata, Cape Colony.
Innes, Alexander, Forester, Stourhead, Bath.
Kettles, Robert, Assistant Forester, Craigend, Perth.
Laird, William J., Assistant Forester, Fyvie Castle, Aberdeenshire.
Leithead, William, Forester, St Clair Cottage, Memsie, Fraserburgh.
Lowe, W., Timber Merchant, Meldrum's Mill, Dunfermline.
M'Beath, David, Assistant Forester, Blairnachdair, Blair Athole, Perthshire.
M'Dougall, Adam, Forester, Sudborne Hall, Wickham Market, Suffolk.
M'Farlane, Peter, Assistant Forester, Castle Kennedy, Stranraer.
M'Gregor, Angus, Forester, Craigton, Butterstone, Dunkeld.
M'Queen, John, Proprietor of the *Scottish Border Record*, Galashiels.
Maxtone, John, Forester, Abercairney, Crieff, Perthshire.
Murray, Hon. A. W. C. O., Master of Elibank, Hay Lodge, Peebles.
Philp, Henry, jun., Timber Merchant, Campbell Street, Dunfermline.
Philp, John, Timber Merchant, Campbell Street, Dunfermline.
Robertson, James, Assistant Forester, Old Blair, Blair Athole, Perthshire.
Robertson, Peter, Assistant Forester, Panmure, Carnoustie, Forfarshire.
Smith, William, Assistant Forester, Kinnaird Castle, Brechin.
Veitch, Archibald, Assistant Forester, Royal Botanic Garden, Edinburgh.
Zimmerman, Henry W., Assistant Forester, Rosehaugh, Inverness.

Report by the Council.

The Secretary read the Report of the Council on the work of the Society during the past year, which, amongst other matters, referred to the Reports contained in the *Transactions* of the Excursion to Germany, and of the proceedings of the deputation from the Society to the President of the Board of Agriculture in October last. He also directed the attention of Members to the space set apart in the *Transactions* for "Notes and Queries," and invited contributions from Members for insertion in the next part. The Report was approved of.

Finances of the Society.

1894.

The Treasurer read the Report by the Auditor on the Accounts for the year 1894, which showed that the receipts had been £200, 2s. 7d., and the payments £214, 5s. 2d., being an excess of payments over receipts of £14, 2s. 7d. At the end of 1894 there was a balance in favour of the Society of £71, 9s. 1d., and the arrears outstanding amounted to £69, 3s. 6d. The Report was approved of.

1895.

The Chairman suggested that as a full abstract of the Accounts for 1895, duly attested by the Auditor, had been printed and sent to each Member previous to the Meeting, the Accounts should be held as presented and read. This was agreed to, and, on the motion of Mr Welsh, the Accounts were unanimously approved of. The following is a short abstract of the Accounts :—

INCOME.				EXPENDITURE.			
1. Ordinary Subscriptions, .	£189	18	6	1. Printing and Stationery, . .	£72 0 2		
2. Life Subscriptions, . .	85	1	0	*Less* Receipts for Advertisements, etc., .	23 15 1		
3. Donations, . . .	20	7	0			£48	5 1
4. Bank Interest and Miscellaneous, . .	2	0	9	2. Prizes, ...		24	2 10
				3. Subscription to Forestry Chair Endowment Fund, ...		50	0 0
				4. Expenses of Management, .		94	7 1
						216	15 0
				Balance of Income over Expenditure, ...		80	12 3
	£297	7	3			£297	7 3

The total funds of the Society at 31st December 1895 amounted to £142, 10s. 10d., and the arrears of subscriptions to £28, 16s. 6d.

Election of Office-Bearers.

Mr Munro Ferguson was unanimously re-elected President; Colonel F. Bailey was unanimously elected a Vice-President; and Dr Somerville, who had been elected an Interim Vice-President in room of Dr Cleghorn, deceased, was re-elected. The following

Members were duly proposed and seconded to take the place of the five Councillors who retired by rotation, viz.:—Messrs Malcolm Dunn, Andrew Slater, John Methven, John Maclachlan, John T. M'Laren, Alexander Pitcaithley, and James Forgan. Messrs Dunn and Slater, who were two of the retiring Councillors, were unanimously re-elected, and after the other names had been voted upon, the following were declared elected, viz.:—Messrs M'Laren, Methven, and Pitcaithley Mr Robert Baxter, whose tenure of office did not expire till next year, intimated his resignation, when the following were proposed and seconded, viz.: — Messrs John Maclachlan, Donald Robertson, and James F. Hardie. On a vote being taken, Mr Hardie was elected the Interim Councillor. The Secretary and the Auditor were re-elected. Professor Bayley Balfour, Professor Somerville, Mr John Michie, Mr James Kay, and Mr James Moffat were elected Judges; and Professor Bayley Balfour, Mr Dunn, Mr Methven, Professor Somerville, and Colonel Bailey were appointed the Committee on *Transactions*.

The Office-Bearers elected for the year 1896 were therefore as follows:—

PRESIDENT.

R. C. Munro Ferguson, M.P., of Raith and Novar, Raith House, Kirkcaldy, Fife.

VICE-PRESIDENTS.

D. F. Mackenzie, Factor, Mortonhall, Liberton.
Isaac Bayley Balfour, Sc.D., M.D., F.R.S., Professor of Botany, Edinburgh.
James Moffat, 48 Castle Street, Edinburgh.
William Somerville, D.Œc., B.Sc., F.R.S.E., F.L.S., Professor of Agriculture and Forestry, Durham College of Science, Newcastle-on-Tyne.
Colonel F. Bailey, R.E., Lecturer on Forestry, Edinburgh University.

COUNCIL.

James F. Hardie, Overseer, Haystoun, Peebles.
Alexander Milne, Nurseryman, 32 Hanover Street, Edinburgh.
James Robertson, Wood Manager, Panmure, Carnoustie.
James Kay, Forester, Bute Estate, Rothesay.
Charles Buchanan, Overseer, Penicuik House, Penicuik.
John Clark, Forester, Haddo House, Aberdeen.
James Cook, Land Steward, Arniston, Gorebridge.
David Keir, Forester, Ladywell, Dunkeld.

George Mackinnon, The Gardens, Melville Castle, Lasswade.
W. M. Welsh, Nurseryman, 1 Waterloo Place, Edinburgh.
Malcolm Dunn, The Palace Gardens, Dalkeith.
John T. M'Laren, Factor, Polmaise, Stirling.
John Methven, Nurseryman, 15 Princes Street, Edinburgh.
Alexander Pitcaithley, Forester, Scone.
Andrew Slater, Land Steward, Osborne, Cowes, Isle of Wight.

SECRETARY AND TREASURER.

Robert Galloway, 5 St Andrew Square, Edinburgh.

AUDITOR.

John T. Watson, 16 St Andrew Square, Edinburgh.

JUDGES.

James Moffat, 48 Castle Street, Edinburgh (*Convener*).
Professor I. Bayley Balfour, University of Edinburgh.
Professor Somerville, Durham College of Science, Newcastle-on-Tyne.
John Michie, Forester, Balmoral.
James Kay, Forester, Bute.

COMMITTEE ON TRANSACTIONS.

Professor I. Bayley Balfour, University of Edinburgh (*Convener*).
Malcolm Dunn, The Palace Gardens, Dalkeith.
John Methven, Nurseryman, Edinburgh.
Professor Somerville, Durham College of Science, Newcastle-on-Tyne.
Colonel Bailey, R.E., Lecturer on Forestry, University of Edinburgh.

LOCAL SECRETARIES.

Scotland.

Daniel Dewar, Forester, Beaufort Castle, Beauly.
James Kay, Forester, Bute Estate, Rothesay.
William M'Lean, Forester, Eglinton Castle, Irvine.
C. Y. Michie, Forester, Cullen House, Banffshire.
John Michie, Forester, Balmoral, Ballater.
James Robertson, Forester, Panmure House, Carnoustie.
D. Scott, Forester, Darnaway Castle, Forres.

England.

James Barton, Forester, Hatfield, Herts.
James Barrie, Forester, Stevenstone Estate, Torrington, Devon.
Andrew Boa, junior, Sub-Agent, Great Thurlow, Suffolk.
Robert T. Collins, Forester, Trentham, Stoke-on-Trent, Staffordshire.
John Davidson, *Secretary*, English Arboricultural Society, Haydon-Bridge-on-Tyne.

FRANK HULL, Forester, Lillieshall, Newport, Salop.
JAMES RUTHERFORD, Agent, Kirkleatham, Redcar, Yorkshire.
D. TAIT, Estate Bailiff, Owston Park, Doncaster, Yorks.

Ireland.

ROBERT COUPAR, Forester, Ashford, Cong, County Galway.

PRESENTATIONS TO THE SOCIETY'S LIBRARY.

The Secretary reported that the following presentations had been made since the General Meeting in July last:—

1. Schlich's *Manual of Forestry*, vols. iii. and iv. From the Secretary of State for India.
2. Six Copies of the Official Report of the Deputation to the President of the Board of Agriculture.
3. Leaflet on the Magpie Moth, from the Board of Agriculture.
4. Provincial Government Crop Report, Nova Scotia, July 1895.
5. *Transactions of Massachusetts Horticultural Society*, part ii., 1894.
6. Report of State Forest Administration in South Australia for 1894-95.
7. Back numbers of the Society's *Transactions*, and *Journal of Forestry*, etc., from Mr M'LAREN.

Note.—Members may borrow from the Secretary any of the Books or Pamphlets belonging to the Society, provided they pay the cost of transmission, and guarantee their safe return within a reasonable time.

THE CHAIR OF FORESTRY.

The Treasurer read the Auditor's Report on the Accounts for the year 1894 in connection with the fund for the Endowment of a Chair of Forestry in the University of Edinburgh, which showed that the sum handed over to the University Court, as stated at last meeting, was £433, 10s., and that the outstanding subscriptions then amounted to £87, 6s., of which £5, 5s. was considered irrecoverable. He also presented the Accounts for 1895, which showed that £63, 3s. 8d., including the Society's own susbscription of £50, had been received, and that £150, 13s. 10d. had been paid to the University Court, making a total sum of £584, 3s. 10d. handed by the Society to the University towards the Endowment of a Chair of Forestry. The balance outstanding was considered irrecoverable, and should be written off. The Reports were unanimously agreed to.

Proposed School of Forestry.

The President gave a Report from the Deputation of the Society which had waited upon the President of the Board of Agriculture, Mr Long, on the occasion of his visit to Edinburgh in October 1895. He also stated that after the meeting in Edinburgh, Professor Somerville had prepared a Draft Scheme for the establishment by the Government of a Forest area in Scotland, which, with the suggestions made upon it by several members of the Society, had been forwarded by him to Mr Long, and was being considered by the Board of Agriculture. Professor Bayley Balfour, in supporting the statement made by the President, said he hoped that the President of the Board of Agriculture would see his way to give them the necessary aid they so much wanted.

The Excursion of 1895.

In connection with this Excursion, it was reported that after the return of the party from Germany, the President, Mr Munro Ferguson, offered a prize of £10 for the best Essay on the Excursion, and Mr Barron, Borrowash, and Professor Somerville each offered £1, 1s. towards a second prize. Seven Essays were received and submitted to the Judges, Professor Somerville and Colonel Bailey, who awarded the first prize to Mr Andrew Slater, Haystoun, Peebles, and the second prize to Mr Donald Robertson, Novar.

On the motion of Colonel Bailey, the following resolution was submitted and carried with acclamation, viz. :—That the best thanks of the Society be conveyed to the Prussian Ministry of Agriculture, Crown Lands and Forestry, for the valuable assistance which it rendered to the Society during its recent excursion to North Germany, to which assistance much of the success of the visit was due.

The Excursion of 1896.

Colonel Bailey reported that it had been resolved that this year's Excursion should be made to the district lying between Stirling and Loch Lomond. It was expected that Professor Schwappach, one of the principal organisers of the German Excursion, would join the party, and it was proposed that a small number of Members should join him in a somewhat more

extended tour. The Report was approved of, and the matter remitted to the Council.

The Name of the Society.

The following motion, which was notified by Mr Andrew Slater, Haystoun, at the last Annual General Meeting, fell to be discussed and disposed of:—That the name of the Society be altered from "The Royal Scottish Arboricultural Society," to "The Royal Scottish Society of Forestry." Mr Slater explained to the meeting his object in desiring to change the name, and moved the adoption of the motion, which was seconded by Mr W. M. Welsh. Mr D. F. Mackenzie moved the previous question, which was seconded by Mr Alexander Pitcaithley. On a vote being taken, the previous question was carried by a very large majority.

Limelight Exhibition.

At the close of the business, a selection from the Cabinet of Micro-Photographic Slides presented to the Society by Mr D. F. Mackenzie, Factor, Mortonhall, was exhibited and explained by Professor Bayley Balfour.

Votes of Thanks.

The thanks of the Society were awarded to Mr Mackenzie for providing the lantern, etc., for the exhibition free of charge, to Professor Bayley Balfour for explaining the slides, and to the President for presiding.

The Annual Dinner.

In the evening the Members dined together in the Royal British Hotel. Mr D. F. Mackenzie, Senior Vice-President, occupied the Chair, and Mr James Moffat acted as Croupier. The guests of the Society on the occasion were Mr W. W. Robertson, Master of the Merchant Company; the Rev. Andrew Benvie, St Aidan's; Judge Colston; Mr James Macdonald, Secretary of the Highland and Agricultural Society; Mr Isaac Connell, Secretary of the Scottish Chamber of Agriculture; and Mr D. Young, Editor of the *N. B. Agriculturist*. The company numbered about forty-five. Mr W. W. Robertson proposed "The Royal Scottish Arboricultural Society," and the Chairman

replied. A number of other toasts followed; and during the evening several pianoforte solos, songs, and recitations were rendered by members of the company, which were much appreciated.

A General Meeting of the Royal Scottish Arboricultural Society was held in the Lecture Hall at the Royal Botanic Garden, Edinburgh, on Monday, 3rd August 1896, at 2 o'clock P.M. D. F. MACKENZIE, Esq., Senior Vice-President of the Society, presiding.

MINUTES.

The Minutes of the Forty-third Annual General Meeting of the Society, held on 29th January 1896, were read and approved of.

APOLOGIES FOR ABSENCE.

The Chairman intimated that letters of apology for absence had been received from the President, Lord Balvaird, and Dr Somerville. He then read the President's Letter, a copy of which will be found in the *Transactions* for the current year.

ELECTION OF NEW MEMBERS.

The Election of the following thirty-five Candidates, whose names had previously been submitted to the Council, was confirmed, viz.:—

Life Members.

BAIRD, J. G. A., M.P., of Adamton, 89 Eaton Square, London, S.W.
DOUGLAS, Alex., Gardener, Baldersby Park, Thirsk, Yorkshire.
LANSDOWNE, The Most Hon. the Marquess of, K.G., 54 Berkeley Square, London, S.W.
PITMAN, Archibald Robert Craufurd, W.S., 48 Castle Street, Edinburgh.
SHAW-STEWART, Michael Hugh, M.P., of Carnock, 7 Charles Street, Berkeley Square, London, S.W.

Ordinary Members.

BLAIR, David, Factor, Ballikinrain, Balfron, Stirlingshire.
BROWN, David, Manager, Chevet Park Estate, Wakefield, Yorks.
CAIRNS, Richard, Gardener, Balruddery, near Dundee.
CAMPBELL, James Alex., M.P., of Stracathro, Brechin.
CONSTABLE, Geo. William, Estate Agent, Traquair, Innerleithen.
CUNNINGHAM, Andrew, Seedsman, 98 Mitchell Street, Glasgow.

GAMMELL, Sydney James, Yr. of Drumtochty, Fordoun, Kincardineshire.
GRAY, Henry, 22 Young Street, Edinburgh.
HARLEY, Andrew M., Assistant Forester, New Scone, Perth.
HAY, Wm. P., Merchant, Loanhead, Midlothian.
HOGG, Thomas, jun., Assistant Forester, Witley Court, Stourport, Worcestershire.
JARDINE, R. W. B., Yr. of Castlemilk, Lockerbie, Dumfriesshire.
JOHNSTON, Alexander, Forester, Royal Botanic Garden, Edinburgh.
KEIR, David, jun., Assistant Forester, Ladywell, Dunkeld.
KENNEDY, Peter, Forester, Countlich, Ballinluig, Perthshire.
MACGREGOR, John C., Assistant Forester, Spoutwells, Dunkeld.
MACKENZIE, Wm., Forester, Novar, Evanton, Ross-shire.
M'NAUGHTON, Wm., Forester, Inver, Dunkeld.
M'PHERSON, Arch., Assistant Forester, Royal Botanic Garden, Edinburgh.
MONCUR, John, Assistant Forester, New Scone, Perth.
NELSON, Thomas, Gardener, Tulliallan, Kincardine-on-Forth.
PRENTICE, George, Factor, Raith, Kirkcaldy, Fife.
REID, William, Assistant Forester, Donibristle, Aberdour, Fife.
RITCHIE, Thomas, Nurseryman, Callander, Perthshire.
ROBERTSON, Duncan, Forester, Strathord, Stanley, Perthshire.
ROBERTSON, George, Assistant Forester, Donibristle, Aberdour, Fife.
ROBERTSON, John, Assistant Forester, High Street, Dunkeld.
SANG, Edward, Solicitor, 29 Queen Street, Edinburgh.
STEWART, James, Assistant Forester, Spoutwells, Dunkeld.
SMITH, William G., Ph.D., Lecturer on Plant Physiology, Royal Botanic Garden, Edinburgh.

ESSAYS AND AWARDS.

Mr JAMES MOFFAT, Convener of the Judges, then read the Report on the Essays, and the following Awards were made in accordance therewith,—the sealed envelopes accompanying the Essays being opened by the Secretary, and the names of the successful competitors announced to the Meeting.

JUDGES' REPORT.

The Judges are glad to be able to report that thirteen Papers were sent in this year, as against six last year, and that they consider this year's contributions to be possessed of a fair degree of merit.

CLASS I.

In Class I., for open competition, eleven Papers were lodged, six being Essays on subjects given in the Syllabus, four on other Arboricultural subjects selected by the writers themselves, in terms of Section XVI. of the Syllabus, and one being a Paper on

the standing subject, No. V. of the Syllabus, namely, a Report on the Plantations of which the competitor is the forester.

The following are the awards on the different Papers :—

I. On the Best Methods of Pruning Avenue and Park and Forest Trees, keeping in view the Production of Timber and the Landscape Effect; also on the Best Methods of Renovating old Park Trees. (Motto, "Economic Arboriculture.") By JAMES HARVEY, Mortonhall Gardens, Liberton.

Although it cannot be said that this paper adds much to our stock of knowledge, still it treats the subject in an interesting way. The Judges recommend the award of the No. 1 SILVER MEDAL, offered for this subject by Mr W. M. Welsh, of Messrs Dicksons & Co., Edinburgh.

II. On the Valuation of Woods or Plantations for the purpose of Transfer. (Motto, "Equality.")

No award.

III. Report on the Plantations of which the competitor is Forester. (Motto, "Pioneer.")

No award.

IV. On the Thinning of Woods. (Motto, "Pyrus.")

No award.

V. On the Thinning of Woods. (Motto, "Perseverando.") By JOHN F. INGLIS, Forester, Kelly Estate, Wemyss Bay.

This paper lays no stress upon the different degrees of thinning required for different species of trees, but still it contains some useful guiding principles. The Judges recommend a BRONZE MEDAL.

VI. On the Thinning of Woods. (Motto, "A Forerunner.") By ALEXANDER MURRAY, Forester, Murthly, Perthshire.

A sensible essay. Award, No. 2 SILVER MEDAL.

VII. On the Pine Saw-Fly. (Motto, "Pinus.")

No award.

VIII. On the Genus *Pissodes* and its Importance in Forestry. (Motto, "Attack in the beginning.") By R. Stewart MacDougall, M.A., B.Sc., Royal Botanic Garden, Edinburgh.

This is a very useful contribution to the life-history of a genus of insects that has been altogether neglected in this country in the past. Award, No. 1 Silver Medal.

IX. On Forest Valuations. (Motto, "Profit.") By Andrew Slater, Haystoun, Peebles.

A useful though by no means exhaustive contribution to our stock of knowledge of Forest valuations. It is specially welcome because it deals with a subject that is but little understood in this country. Award, No. 2 Silver Medal.

X. On the Nature and Management of Live Fences. (Motto, "Cratægi.") By Francis Berry, Forester, Colquoich, Inverkindie, Aberdeenshire.

This paper is discursive without being exhaustive. Award, Bronze Medal.

XI. On a French Arboricultural Society. (Motto, "Scotland for Ever.") By George Cadell (late H.M. Indian Forest Department).

An interesting paper, though involving no great amount of labour. Award, No. 2 Silver Medal.

Class II.

In Class II., for Assistant Foresters only, the Judges regret that only two papers were sent in, both being on subjects prescribed in the Syllabus.

I. On the Rearing of Natural and Artificial Undercover for Game. (Motto, "Straight Powder.") By Alexander M'Rae, Assistant Forester, Peplow Hall, Market Drayton, Salop.

This paper deals with the subject of game cover in a very thorough and practical manner, and is worthy of a No. 2 Silver Medal.

II. On the Best Method of Protecting Trees from Injury by Ground Game. (Motto, "Protection.") By JAMES GILLESPIE, Lochton Lodge, Inchture, Perthshire.

Though containing nothing new, evidently written by a man who understands his business. Award, BRONZE MEDAL.

For and in name of the Judges,

JAMES MOFFAT, *Convener.*

EDINBURGH, 3*rd August* 1896.

HONORARY OFFICES.

On the motion of Mr DUNN, the recommendation of the Council that the following Honorary Offices be created, was agreed to, and the following appointments were made for the current year, viz.:—

Consulting Botanist, ISAAC BAYLEY BALFOUR, M.D., Sc.D., Regius Keeper, Royal Botanic Garden, Edinburgh.

Consulting Chemist, ANDREW PEEBLES AITKEN, M.A., Sc.D., Professor of Chemistry, Veterinary College, Clyde Street, Edinburgh.

Consulting Cryptogamist, WILLIAM SOMERVILLE, D.Œc., B.Sc., F.R.S.E., F.L.S., Professor of Agriculture and Forestry, Durham College of Science, Newcastle-on-Tyne.

Consulting Entomologist, ROBERT STEWART MACDOUGALL, M.A., B.Sc., Lecturer on Entomology, Royal Botanic Garden, Edinburgh.

Consulting Geologist, JOHN SMITH FLETT, M.A., B.Sc., M.B., C.M., Lecturer on Petrology, University of Edinburgh.

Consulting Meteorologist, ROBERT COCKBURN MOSSMAN, F.R.S.E., F.R. Met. Soc., 10 Blacket Place, Edinburgh.

EXCURSION IN 1897.

Mr DUNN reported that the Council recommended that in 1897 an Excursion should be made to Ireland, and it was remitted to the Council to make the necessary arrangements. He also mentioned that it was proposed to make another

Excursion abroad in 1898, probably to Norway and Sweden, or France, and that the Council was making preliminary inquiries on the subject. On the motion of Mr DUNN, a hearty vote of thanks was accorded to Professor SCHWAPPACH, of Eberswalde (who was present at the Meeting), for the valuable services rendered by him to the Excursionists when in Germany last year.

LIBRARY AND MUSEUM.

The Secretary reported that the following presentations had been made since the Annual General Meeting in January last:—

LIST OF PRESENTATIONS TO THE SOCIETY'S LIBRARY.

1. *Studies in Corsica*, from the Author, J. W. Barry, Fylingdales, Robin Hood's Bay.
2. Vol. i., 2nd edition, and vols. ii. and v. of Dr Schlich's *Manual of Forestry*, from the India Office.
3. Seven volumes of the late Dr Brown's Works on Forestry, from Miss Brown, viz.:—*Modern Forest Economy; The Forests of England; Schools of Forestry in Germany; French Forest Ordinance of* 1669; *Finland, its Forests and Forest Management; Forests and Forestry of Northern Russia;* and *Water Supply of South Africa.*
4. Kew Gardens Bulletins for 1891 to 1895 inclusive.
5. *Guide to the Royal Botanic Garden, Glasnevin*, and several Pamphlets, chiefly relating to Mosses in Ireland, from the Royal Botanic Garden, Dublin.
6. Reports of the Conservators of Forests for 1895, from the Department of Agriculture, Cape of Good Hope.
7. Report of Forest Department, Madras Presidency, 1894-95.
8. *Transactions of the English Arboricultural Society*, vol. iii., part 1.
9. *Proceedings and Transactions of the Nova Scotian Institute of Science*, vol. viii., part 4.
10. Report of the Secretary for Agriculture, Nova Scotia, for 1895.
11. *Journal of the Royal Horticultural Society*, vol. xviii., 2nd edition, and vol. xix., part 3.

12. *Journal of the Royal Agricultural Society of England*, parts 1 and 2, vol. vii., 3rd Series.

13. *Transactions of the Massachusetts Horticultural Society for* 1895, part 1.

14. Agricultural Returns for 1895, and Leaflets on the Cockchafer, the Codlin Moth, the Onion Fly, and Foul Brood or Bee Pest, from the Board of Agriculture.

15. Three Copies of a Pamphlet, by Sir D. Brandis, on "Forest Management and Forest Protection," from the Author.

16. The following Books and Pamphlets from the New South Wales Government Board of Exchanges:—

    The Seven Colonies of Australasia, 1894.
    Australian Timbers, by G. H. Warren, 1892.
    The Forage Plants of Australia, by F. Turner, 1891.
    Statistical Survey of New South Wales, 1893-94.

17. The following Reports, etc., from the Department of Agriculture, Victoria:—

    Report of Public Works, 1893-94.
    Report of Mines and Agriculture, 1894.
    Report of Lands, 1894.
    Report of Railway Commissioners, 1894-95.
    Systematic Arrangement of Australian Fungi, by D. M'Alpine.

18. The following publications of the Smithsonian Institution, Washington:—

    The Internal Work of the Wind, by S. P. Langley.
    On the Relative Intensity of the Heat and Light of the Sun upon different Latitudes of the Earth, by L. W. Meech, A.M.
    On Certain Storms in Europe and America, December 1836, by Elias Loomis, LL.D.
    Account of a Tornado near New Harmony, Indiana, 1852, with Map, by John Chappelsmith.
    And several Pamphlets.

On the motion of Mr DUNN, a vote of thanks was cordially accorded to the Donors of the various Books, Pamphlets, etc.

Note.—Members may borrow from the Secretary any of the Books or Pamphlets belonging to the Society, provided they pay the cost of transmission, and guarantee their safe return within a reasonable time.

Papers Read.[1]

Dr Adam Schwappach, Professor of Forestry, Eberswalde, Prussia, who was introduced to the Meeting by Professor Bayley Balfour, then read a paper on "The Importance of Density in Sylviculture," and the Secretary afterwards read a paper sent by Mr A. C. Forbes, Wood Manager, Bowood, Wiltshire, on the subject, "Is British Forestry Progressive?"

Votes of Thanks.

Very hearty votes of thanks were then accorded to the Judges for their Report, to Dr Schwappach and Mr A. C. Forbes for their papers, to Professor Bayley Balfour for the use of the Lecture Hall for the Meeting, and to the Chairman for presiding, which concluded the Meeting.

IN COUNCIL.

Illustrations Fund.

The Council beg to direct special attention to this Fund, the object of which is to obtain contributions to defray the expense of illustrating the Society's *Transactions.*

The Society's Album.

The Council wish it to be known that the Society has an Album for the Photographs of Members, and the Secretary will be glad to receive contributions.

Members are invited to read short practical papers on any subject connected with Forestry at the Annual General Meeting in January, or at the General Meeting to be held at the time of the Excursion. Those who intend to do so are requested to intimate, in writing, the Title of their subject to the Secretary, not later than 14th December 1896 or 1st June 1897; stating the time they may require for reading the paper.

[1] These papers appear in the *Transactions.*

SYLLABUS.

The following subjects are offered for competition in 1897:—

[*The Judges are empowered to fix the value of the Prizes to be awarded according to the respective merits of the Essays.*

All Essays and Reports intended for Competition must be lodged with the Secretary not later than 1st June 1897. All Collections of Cones, Seeds, and Rustic Work must be in the hands of the Secretary not less than three days before the Annual General Meeting, to be held on 27th January 1897. Each Essay, Report, Collection, or Article must bear a MOTTO, *and be accompanied by a sealed envelope bearing outside the* SAME MOTTO, *and the Class to which the Competitor belongs, and containing inside, a* CARD *with the* NAME *and* ADDRESS *of the Competitor.*

Judges cannot compete during their term of office.

Successful Competitors may either have the medals or their converted values, which are as follows:—Gold, £5; No. 1 *Silver,* £3; No. 2 *Silver,* £2; *Bronze,* 10s.]

CLASS I.—FOR OPEN COMPETITION.

I. For approved Essays upon the best form of, and the best method of establishing, an Experimental Forest area in Scotland, for the exhibition of and for instruction—theoretical and practical—in scientific Forestry. (1st Prize, *Twenty Guineas;* 2nd Prize, *Five Guineas;* offered by the President, R. C. Munro Ferguson, Esq., M.P., and the Society in equal proportions.)

Note.—Mr Munro Ferguson and Professor Somerville are the Judges in this competition, and if in their opinion the Essays are not of sufficient merit, the value of the prizes may be reduced, or they may be withheld.

II. For an approved Report showing the Financial Results of the Cultivation of Woods and Plantations. (*Ten Guineas* offered by Isaac Bayley Balfour, M.D., D.Sc., Professor of Botany in the University of Edinburgh, formerly President of the Society.)

It is not necessary that the names of the estates on which the woods grow should be published, but the reporter must give the annual value of the land previous to planting; statistics of the cost of forming the plantations, including draining and fencing; the expenses of management, the income derived, and the present value of the Woods.

III. For an approved Report detailing the methods employed to bring about the Natural Regeneration of a Wood, and the subsequent Treatment as regards Artificial Assistance, should such have been rendered necessary owing to the Natural Sowing having been irregular, insufficient, or too dense. (*A Medal.*)

The author must cite some particular case, and give the results of a systematic attempt at natural regeneration, bearing in mind the fact that a patchy imperfect restocking cannot be regarded as satisfactory or successful.

IV. For an approved Essay on the best methods of converting Timber. (*Silver Medal* offered by Wm. M. Welsh, Esq., of Messrs Dicksons & Co., 1 Waterloo Place, Edinburgh.)

V. For an approved Essay on the Valuation of Woods or Plantations for the purpose of Transfer. (*A Medal.*)

The writer to describe the method (*a*) of valuing matured woods, (*b*) middle-aged woods, (*c*) park trees and others that may be, in addition to their value as timber, considered as ornamental, (*d*) young woods, and (*e*) coppice.

VI. For an approved Report on the Plantations of which the competitor is Forester. Reporter to state the extent of plantations, the kinds of timber grown, soil, situation, age, management, etc. This is a standing subject. (*A Medal.*)

VII. For an approved Report on the Present State and Future Prospects of Arboriculture in Ireland. (*A Medal.*)

VIII. On the best Method of Procedure in growing a continuous Crop of Timber in Woods or Plantations. (*A Medal.*)

The Essay should deal with the different kinds of Woods, the ages, and proportion per acre of the trees at different stages, and whether these have been raised by natural or artificial means. Reference may be made to any system practised abroad which might prove applicable in this country.

IX. For an approved Report, based on results, on the advantage of Under Planting. (*A Medal.*)

X. For an approved Essay on the best method of Preventing the Inroads of the Pine Saw-fly—*Lophyrus pini* of Curtis. (*A Medal.*)

XI. For an approved Essay on any Disease incidental to Forest Trees. A standing subject. (*A Medal.*)

XII. For an approved Report on the most advantageous methods, not generally practised in this country, of Transporting Timber. (*A Medal.*)

The reporter specially to describe any means, other than by horse-power, of moving felled timber from the interior of woods to their margins, or to roads.

XIII. For an approved Essay on the best methods of utilising Small-wood in the manufacture of Fancy-wood articles, Turnery, Wood Wool, etc. (*A Medal.*)

XIV. For an approved Essay or Report on any other subject connected with Arboriculture. (*A Medal.*)

XV. For an instrument or method for expeditiously obtaining the diameter of trees at a given height, or for any other useful invention or marked improvement on any of the implements used in Forestry. Models or implements to be accompanied by a report. (*A Medal.*)

CLASS II.—FOR ASSISTANT FORESTERS ONLY.

I. For an approved Report, based on personal observation, on the Propagation of Forest Trees and Shrubs. (*A Medal.*)

II. For an approved Report, based on personal observation, on any disease affecting Trees, or injuries caused to Trees, by insects or animals. (*A Medal.*)

III. For an approved Essay on the Peeling and Harvesting of different kinds of British Bark used in Tanning. (*A Medal.*)

IV. For an approved Essay on the best method of protecting Trees from injury by Ground Game. (*A Medal.*)

V. For an approved Essay or Report on any other subject connected with Arboriculture. (*A Medal.*)

VI. For the best and approved Model in Rustic, or Ornamental Woodwork, of any subject designed and executed by the competitor. Model not to exceed six feet in length. (*A Medal.*)

The Council invite the attention of young Foresters to the foregoing subjects, as they wish to encourage their literary efforts.

ROBERT GALLOWAY,
Secretary.

5 ST ANDREW SQUARE,
EDINBURGH.

Scottish Provident Institution

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1895

FIFTY-EIGHTH

ANNUAL REPORT

NEW ASSURANCES

£1,613,200.

PREMIUMS

£676,850.

TOTAL INCOME

£1,052,900.

CLAIMS

£478,050.

THE FUNDS

AT 31ST DEC. 1895 WERE

£9,357,500.

INCREASE IN YEAR £407,750

THE PREMIUMS ARE SO MODERATE THAT, AT USUAL AGES FOR ASSURANCE, **£1200** OR **£1250** MAY BE SECURED FROM THE FIRST FOR THE YEARLY PAYMENT WHICH IN MOST OFFICES WOULD BE CHARGED (WITH PROFITS) FOR **£1000** ONLY,—EQUIVALENT TO AN IMMEDIATE AND CERTAIN BONUS OF **20** TO **25** PER CENT.

THE WHOLE SURPLUS GOES TO THE POLICY-HOLDERS ON A SYSTEM AT ONCE SAFE AND EQUITABLE —NO SHARE GOING TO THOSE BY WHOSE EARLY DEATH THERE IS A LOSS TO THE COMMON FUND.

THE SURPLUS AT LAST SEPTENNIAL INVESTIGATION (1894) AMOUNTED TO **£1,423,000,** AND, AFTER RESERVING **£391,800** FOR FUTURE ACCUMULATION AND DIVISION, WAS DIVIDED AMONG **13,220** POLICIES ENTITLED TO PARTICIPATE. MORE THAN ONE HALF OF THE MEMBERS WHO DIED WERE ENTITLED TO BONUSES WHICH, NOTWITHSTANDING THE LOW PREMIUMS, WERE ON AN AVERAGE EQUAL TO AN ADDITION OF ABOUT **50** PER CENT TO POLICIES WHICH PARTICIPATED.

THE ARRANGEMENTS AS TO SURRENDER, NON-FORFEITURE, FREE RESIDENCE, LOANS ON POLICIES, IMMEDIATE PAYMENT OF CLAIMS, AND ALL OTHER POINTS OF PRACTICE, ARE CONCEIVED ENTIRELY FOR THE BENEFIT OF THE MEMBERS, THERE BEING NO OPPOSING INTERESTS IN A MUTUAL SOCIETY.

HEAD OFFICE: 6 ST. ANDREW SQUARE, EDINBURGH

Scottish Provident Institution.

TABLE OF PREMIUMS, BY DIFFERENT MODES OF PAYMENT,

For Assurance of £100 at Death—With Profits.

Age next Birthday.	Annual Premium payable during Life.	ANNUAL PREMIUM LIMITED TO			Single Payment.	Age next Birthday.
		Twenty-one Payments.	Fourteen Payments.	Seven Payments.		
21	£1 16 3	£2 10 6	£3 4 11	£5 10 0	£33 0 1	21
22	1 16 9	2 11 0	3 5 9	5 11 0	33 5 10	22
23	1 17 2	2 11 6	3 6 5	5 12 1	33 11 2	23
24	1 17 7	2 12 1	3 6 11	5 13 1	33 16 5	24
25	1 18 0	2 12 6	3 7 3	5 14 0	34 2 0	25
26	1 18 6	2 13 0	3 7 10	5 14 11	34 8 2	26
27	1 19 2	2 13 6	3 8 7	5 15 11	34 16 1	27
28	1 19 11	2 14 1	3 9 5	5 17 1	35 4 9	28
29	2 0 8	2 14 8	3 10 3	5 18 6	35 14 1	29
*30	2 1 6	2 15 4	3 11 2	6 0 1	36 4 0	*30
31	2 2 6	2 16 2	3 12 1	6 1 10	36 14 6	31
32	2 3 5	2 17 1	3 13 2	6 3 8	37 5 5	32
33	2 4 6	2 18 0	3 14 4	6 5 8	37 17 2	33
34	2 5 7	2 19 0	3 15 7	6 7 9	38 9 7	34
35	2 6 10	3 0 2	3 16 11	6 10 0	39 2 9	35
36	2 8 2	3 1 5	3 18 4	6 12 5	39 16 11	36
37	2 9 8	3 2 9	3 19 11	6 15 0	40 12 4	37
38	2 11 3	3 4 3	4 1 7	6 17 9	41 8 7	38
39	2 12 11	3 5 9	4 3 4	7 0 7	42 5 4	39
†40	2 14 9	3 7 5	4 5 2	7 3 7	43 2 10	†40
41	2 16 8	3 9 2	4 7 2	7 6 8	44 0 11	41
42	2 18 8	3 11 1	4 9 3	7 9 11	44 19 9	42
43	3 0 11	3 13 1	4 11 5	7 13 3	45 19 3	43
44	3 3 3	3 15 3	4 13 10	7 16 9	46 19 7	44
45	3 5 9	3 17 6	4 16 4	8 0 7	48 0 8	45
46	3 8 5	4 0 0	4 19 1	8 4 6	49 2 8	46
47	3 11 5	4 2 8	5 2 1	8 8 8	50 5 8	47
48	3 14 8	4 5 8	5 5 4	8 13 2	51 9 7	48
49	3 18 1	4 8 9	5 8 9	8 17 11	52 14 1	49
50	4 1 7	4 12 1	5 12 4	9 2 10	53 19 3	50
51	4 5 6	4 15 5	5 16 1	9 7 11	55 4 5	51
52	4 9 5	4 18 10	5 19 11	9 13 1	56 9 0	52
53	4 13 5	5 2 5	6 3 11	9 18 3	57 12 11	53
54	4 17 8	5 6 3	6 8 0	10 3 5	58 17 2	54
55	5 1 11	5 10 2	6 12 1	10 8 6	60 0 8	55

[The usual *non-participating* Rates of other Offices differ little from these Premiums.]

* A person of 30 may secure £1000 at death, by a yearly payment, *during life*, of £20 : 15s.
This Premium would generally elsewhere secure £800 only, instead of £1000.
OR, he may secure £1000 by 21 yearly payments of £27 : 13 : 4—*being thus free of payment after age* 50.

† At age 40, the Premium *ceasing at age* 60 is, for £1000, £33 : 14 : 2,—about the same as most Offices require during the whole term of life. Before the Premiums have ceased, the Policy will have shared in at least one division of surplus. To **Professional Men** and others, whose income is dependent on continuance of health, the limited payment system is specially recommended.

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Royal Scottish Arboricultural Society.

Instituted 16th February 1854.

PATRON.

HER MOST GRACIOUS MAJESTY THE QUEEN.

THE ANNUAL MEETING.

The Forty-fourth Annual General Meeting of the Royal Scottish Arboricultural Society was held in the Hall, 14 South St Andrew Street, Edinburgh, on Wednesday, 27th January 1897, at 2.30 P.M. R. C. Munro Ferguson, M.P., of Raith and Novar, President of the Society, occupied the Chair.

Minutes.

The Minutes of the General Meeting of the Society, held on Monday, 3rd August 1896, which had been printed and circulated amongst the Members, were held as read, and approved of.

Election of New Members.

The election of the following thirty-six Candidates for Membership, whose names had previously been submitted to the Council, was duly confirmed, viz.:—

Anderson, John, Merchant, Forthbank, East Wemyss, Fife.
Barclay, Robert Leatham, Banker, 54 Lombard Street, London, E.C.
Begg, James, The Gardens, Lanrick Castle, Doune, Perthshire.
Bowles, William, The Gardens, Adare Manor, Adare, Co. Limerick.
Brydon, John, Seed Merchant and Nurseryman, Darlington, Co. Durham.
Campbell, James Arthur, Tea Planter, Seacliff, Ardrishaig, Argyleshire.
Flett, John Smith, M.A., M.B., B.Sc., Lecturer on Petrology, University of Edinburgh.
Forbes, James, The Gardens, Overtown, Dumbarton.
Hanton, Thomas, Solicitor, Dalkeith, Midlothian.
Harrower, William, Forester, Garth, Aberfeldy, Perthshire.
Heggie, James George, Overseer, Clova Lumsden, Aberdeenshire.
Lauriston, John, Assistant Forester, Clumber Park, Notts.

M'Donald, James, Assistant Forester, Brodick Castle, Arran.
M'Donald, William, Assistant Forester, Royal Botanic Garden, Edinburgh.
M'Kerrow, Robert, Manager, Carton, Maynooth, Co. Kildare.
M'Lennan, John, The Gardens, Castle Boro', Enniscorthy, Co. Wexford.
M'Michael, William, Solicitor, Callander, Perthshire.
Mar and Kellie, The Right Hon. the Earl of, Alloa House, Alloa.
Meiklejohn, John J. R., Factor, Novar, Evanton, Ross-shire.
Mitchell, William, Assistant Forester, Altyre, Forres.
Moir, Henry, 3 Grange Road, Edinburgh.
Moon, Frederick, Assistant Forester, Millhaugh Cottages, Logie Almond, Perth.
Mossman, Robert Cockburn, F.R.S.E., F.R.Met.Soc., 10 Blacket Place, Edinburgh.
Murdoch, Robert, Merchant, Dalkeith, Midlothian.
Myles, Alexander, Assistant Forester, Royal Botanic Garden, Edinburgh.
Pearson, James Montgomerie, of Over Letham, Estate Agent and C.E., Kilmarnock.
Peebles, James, Assistant Forester, Albury Park, Guildford, Surrey.
Reid, William, Assistant Forester, Dochfour, Inverness.
Robertson, A. Barnett, Forester, The Dean, Kilmarnock, Ayrshire.
Robertson, Andrew Newton, Assistant Forester, Moss-side Cottages, Lynedoch, Perth.
Robertson, William, Assistant Forester, Murthly, Perthshire.
Robson, Charles Durie, 48 Castle Street, Edinburgh.
Steele, W. Craig, Nursery Manager, Westmoor, Kilmarnock, Ayrshire.
Stewart, Charles, Assistant Forester, Scone, Perth.
Wilson, James, M.A., B.Sc., Fordyce Lecturer in Agriculture, University of Aberdeen.
Yeates, Alexander, Assistant Forester, Durris Estate, Aberdeen.

Report by the Council.

The Secretary read the Report by the Council for the past year, from which it appeared that the Membership was at that date 699, being a nett gain of 39 during the year. Attention was directed to Part I. Vol. XV. of the *Transactions* recently issued, which contains, amongst other valuable papers, the first instalment of Reports and Articles by the Honorary Consulting Scientists, who were appointed at the meeting held in August last, and Reports of Excursions to the Forth and Loch Lomond Districts and Arniston. The Report was approved of.

Finances of the Society.

As suggested by the Chairman, who said that a full abstract of the Accounts for the past year had already been printed and circulated amongst the Members, it was agreed that the Accounts

should be held as presented and read. In answer to Mr GEORGE FRASER, Edinburgh, Mr WELSH, the Convener of the Finance Committee, mentioned that the advisability of apportioning the accounts between Capital and Revenue, and the question of the appointment of new trustees, and investment of the Funds of the Society, were being considered by the Council. The Accounts, of which the following is a short abstract, were approved of:—

INCOME.		EXPENDITURE.		
1. Ordinary Subscriptions,	£170 13 0	1. Printing and Stationery,	£64 11 1	
2. Life Subscriptions,	92 8 0	*Less* Receipts for Advertisements,	19 14 3	
3. Donation,	1 6 8			£44 16 10
4. *Transactions* sold,	6 12 6	2. Prizes,		8 0 8
5. Bank Interest,	0 13 9	3. Expenses of Management,		76 1 7
		Balance of Income over Expenditure,		142 14 10
	£271 13 11			£271 13 11

The total funds of the Society at 31st December 1896 amounted to £285, 5s. 8d., and the arrears of subscriptions to £37, 19s. 6d.

EXCURSION FUND.

The Secretary next read the Accounts in connection with the Excursions to Germany in 1895, and to the Forth and Loch Lomond Districts last year, which showed that although there had been a small deficit on the 1895 account, there was now a balance in hand of £3, 8s. 9d. He explained that out of this sum there would have to be paid the cost of the usual presentation copies of last year's Excursion Report, and that the balance would be carried forward to next year. The Accounts were approved of.

ELECTION OF OFFICE-BEARERS.

On the motion of Colonel Bailey, Mr MUNRO FERGUSON was re-elected President. Mr ALEXANDER MILNE, Edinburgh, and Mr CHARLES BUCHANAN, Penicuik, having been nominated as Vice-Presidents, Mr W. H. Massie, Edinburgh, nominated Mr JAMES KAY, Bute, in opposition to Mr MILNE. On a vote being taken, Mr MILNE received the support of a majority of

the Members present, and he and Mr BUCHANAN were accordingly declared elected. The following Members were proposed as Members of Council, and unanimously elected, viz.:—JAMES F. HARDIE, D. F. MACKENZIE, W. A. MACKENZIE, JAMES ROBERTSON, and D. P. LAIRD. The Secretary and Treasurer and the Auditor were re-elected. The following were elected Judges and a Committee on *Transactions*:—Colonel BAILEY (*Convener*), Professor BAYLEY BALFOUR, Professor SOMERVILLE, MALCOLM DUNN, JOHN METHVEN, JOHN MICHIE, and JAMES KAY. The Honorary Consulting Scientists were re-elected. The Local Secretaries were also re-elected, and it was intimated that the Council was considering as to the advisability of increasing the number of Local Secretaries, especially in districts remote from Edinburgh. Mr GEORGE PAXTON, Kilmarnock, a Member of the Society, who photographed the groups of last year's Excursion, was unanimously appointed Photographic Artist.

The Office-Bearers and Officials elected for the year 1897 were therefore as follows:—

PRESIDENT.

R. C. MUNRO FERGUSON, M.P., of Raith and Novar, Raith House, Kirkcaldy, Fife.

VICE-PRESIDENTS.

JAMES MOFFAT, 48 Castle Street, Edinburgh.

WILLIAM SOMERVILLE, D.Œc., D.Sc., F.R.S.E., F.L.S., Professor of Agriculture and Forestry, Durham College of Science, Newcastle-on-Tyne.

Colonel F. BAILEY, R.E., Lecturer on Forestry, Edinburgh University.

ALEXANDER MILNE, Nurseryman and Seedsman, 32 Hanover Street, Edinburgh.

CHARLES BUCHANAN, Overseer, Penicuik Estate, Penicuik.

COUNCIL.

JOHN CLARK, Forester, Haddo House, Aberdeen.

JAMES COOK, Land Steward, Arniston, Gorebridge.

DAVID KEIR, Forester, Ladywell, Dunkeld.

GEORGE MACKINNON, The Gardens, Melville Castle, Lasswade.

W. M. WELSH, Nurseryman and Seedsman, 1 Waterloo Place, Edinburgh.

MALCOLM DUNN, The Palace Gardens, Dalkeith.

JOHN T. M'LAREN, Factor, Polmaise, Stirling.

ANDREW SLATER, Land Steward, Osborne, Cowes, Isle of Wight.

JOHN METHVEN, Nurseryman, 15 Princes Street, Edinburgh.

ALEXANDER PITCAITHLEY, Forester, Scone Estate, Perth.

James F. Hardie, Overseer, Haystoun Estate, Peebles.
D. P. Laird, Nurseryman, Pinkhill, Murrayfield, Edinburgh.
D. F. Mackenzie, Factor, Mortonhall, Liberton.
W. A. Mackenzie, Factor, Faskally, Pitlochry.
James Robertson, Wood Manager, Panmure, Carnoustie.

SECRETARY AND TREASURER.

Robert Galloway, 5 St Andrew Square, Edinburgh.

AUDITOR.

John T. Watson, 16 St Andrew Square, Edinburgh.

JUDGES AND COMMITTEE ON TRANSACTIONS.

Colonel Bailey, R.E., Lecturer on Forestry, University of Edinburgh (*Convener*).
Professor I. Bayley Balfour, University of Edinburgh.
Professor Somerville, Durham College of Science, Newcastle-on-Tyne.
Malcolm Dunn, The Palace Gardens, Dalkeith.
John Methven, Nurseryman, Edinburgh.
John Michie, Forester, Balmoral.
James Kay, Forester, Bute.

HONORARY CONSULTING SCIENTISTS.

Consulting Botanist, Isaac Bayley Balfour, M.D., Sc.D., Professor of Botany, University of Edinburgh, and Regius Keeper, Royal Botanic Garden, Edinburgh.

Consulting Chemist, Andrew Peebles Aitken, M.A., Sc.D., Professor of Chemistry, Veterinary College, Clyde Street, Edinburgh.

Consulting Cryptogamist, William Somerville, D.Œc., D.Sc., F.R.S.E., F.L.S., Professor of Agriculture and Forestry, Durham College of Science, Newcastle-on-Tyne.

Consulting Entomologist, Robert Stewart MacDougall, M.A., B.Sc., Lecturer on Entomology, Royal Botanic Garden, Edinburgh.

Consulting Geologist, John Smith Flett, M.A., B.Sc., M.B., C.M., Lecturer on Petrology, University of Edinburgh.

Consulting Meteorologist, Robert Cockburn Mossman, F.R.S.E., F.R.Met.Soc., 10 Blacket Place, Edinburgh.

LOCAL SECRETARIES.

Scotland.

Daniel Dewar, Forester, Beaufort Castle, Beauly.
James Kay, Forester, Bute Estate, Rothesay.
C. Y. Michie, Forester, Cullen House, Banffshire.

JOHN MICHIE, Forester, Balmoral, Ballater.
JAMES ROBERTSON, Forester, Panmure House, Carnoustie.
D. SCOTT, Forester, Darnaway Castle, Forres.

England.

JAMES BARTON, Forester, Hatfield, Herts.
JAMES BARRIE, Forester, Stevenstone Estate, Torrington, Devon.
ANDREW BOA, junior, Sub-Agent, Great Thurlow, Suffolk.
ROBERT T. COLLINS, Forester, Trentham, Stoke-on-Trent, Staffordshire.
JOHN DAVIDSON, *Secretary* English Arboricultural Society, Haydon-Bridge-on-Tyne.
FRANK HULL, Forester, Lillieshall, Newport, Salop.
JAMES RUTHERFORD, Agent, Kirkleatham, Redcar, Yorkshire.
D. TAIT, Estate Bailiff, Owston Park, Doncaster, Yorks.

Ireland.

ROBERT COUPAR, Forester, Ashford, Cong, County Galway.

PHOTOGRAPHIC ARTIST.

GEORGE PAXTON, Richardland, Kilmarnock.

LIBRARY AND MUSEUM.

The Secretary reported that the following presentations had been made since the General Meeting in August last:—

PRESENTATIONS TO THE SOCIETY'S LIBRARY.

1. Report of the Conifer Conference, 1891. From the Royal Horticultural Society, London.
2. *Journal of the Royal Horticultural Society*, London, vol. xx., part 2.
3. *Journal of the Royal Agricultural Society*, London, vol. vii., parts 3 and 4.
4. *Transactions of the English Arboricultural Society*, vol. iii., part 2.
5. *Transactions of the Massachusetts Horticultural Society*, 1895, part 2; 1896, part 1.
6. *Transactions of the Nova Scotian Institute of Science*, vol. ix., part 1, 1894-95.
7. Provincial Government of Nova Scotia Crop Reports, July and November 1896.

8. Agricultural Returns—Statistical Tables, 1896. Board of Agriculture.
9. Leaflets on Surface Caterpillars and Woolly Aphis or American Blight. Board of Agriculture.
10. *The Forester:* Brown and Nisbet. Blackwood & Sons, Edinburgh.

Note.—Members may borrow from the Secretary any of the Books or Pamphlets belonging to the Society, provided they pay the cost of transmission, and guarantee their safe return within a reasonable time.

Excursion in 1897.

Mr Dunn, Dalkeith, reported the recommendation of the Council, that the Excursion this year should be held in Ireland. He explained that it was proposed to visit the places of interest in and around Dublin, and afterwards Powerscourt, Coollattin, and other places in County Wicklow, and probably Killarney. The recommendation was approved of, and the matter was remitted to the Council with powers.

Forestry Education.

At the close of the business, Dr William Schlich, Professor of Forestry in the Engineering College for India, Coopers Hill, Surrey, delivered an Address on "Forestry Education" a full Report of which will be found in the *Transactions.*

Votes of Thanks.

Votes of thanks were heartily accorded to Dr Schlich for his Address, and to the President for presiding.

THE ANNUAL DINNER.

The Annual Dinner was held in the Royal British Hotel the same evening. Mr Munro Ferguson, M.P., the President of the Society, was Chairman, and Colonel Bailey, Vice-President, was Croupier. The guests of the Society were Dr Schlich; Rev. Dr Paul; Bailie Kinloch Anderson; Mr William Anderson, Treasurer of the Edinburgh Water Trust; County Councillor John Dobbie; Mr James Macdonald, Secretary, Highland and Agricultural Society; Mr Isaac Connell, Secretary of the Scottish Chamber of Agriculture; and Mr D. Young, Editor of the *North British Agriculturist.* The company numbered about

forty. Dr SCHLICH proposed the toast, "The Royal Scottish Arboricultural Society," and the President replied. Colonel BAILEY proposed "The Corporation of Edinburgh," and Bailie KINLOCH ANDERSON replied. The President proposed "Our Guests," and Dr SCHLICH replied. A number of other toasts, songs, and recitations followed, and a pleasant and profitable evening was spent.

THE GENERAL MEETING.

A General Meeting of the Royal Scottish Arboricultural Society was held in No. 5 St Andrew Square, Edinburgh, on Monday, 16th August 1897, at 2 o'clock P.M. R. C. MUNRO FERGUSON, M.P., President, in the Chair.

MINUTES.

The Minutes of the Forty-fourth Annual General Meeting of the Society, held on 27th January 1897, were read and approved of.

APOLOGIES FOR ABSENCE.

The Secretary intimated that apologies for absence had been received from Lord Balvaird, Mr W. M. Welsh, Mr John Methven, Edinburgh, and Mr James Robertson, Panmure.

ELECTION OF NEW MEMBERS.

The Election of the following seventy-three Candidates, whose names had previously been submitted to and approved of by the Council, was confirmed, viz.:—

Life Members.

BLACK, Alexander, The Gardens, Carton, Maynooth, Co. Kildare.
FOTHERINGHAM, W. Stewart, of Murthly, Perthshire.
GOUGH, Reginald, Forester, Woburn, Beds.
WALLACE, John A. A., of Lochryan, Cairnryan, Stranraer.

Ordinary Members.

ARMIT, James, The Gardens, Antrim Castle, Antrim.
BIDDULPH, Lieut.-Colonel (retired), Armaghmore, Tullamore, King's County.
BRAID, John Barnes, Assistant Forester, Avoch, Ross-shire.
BROUGH, D., The Gardens, Duntreath Castle, Strathblane.
BROWNE, Ernest de S. H., Land Agent, Brookfield, Tullamore.

CHALMERS, James, Overseer, Gask, Auchterarder, Perthshire.
CHISHOLM, Colin, Assistant Forester, Glamis Castle, Forfarshire.
COUPAR, Wm., Overseer, Balgowan, Perthshire.
CRAIG, Rev. Graham, Rector of Tullamore, King's County.
CURR, Wm. Henry, Factor, Pitkellony, Muthill.
DAILLY, James, Assistant Forester, Kirklee, Riccarr-Johnstone, Holytown, Lanarkshire.
DON, Alex., jun., Bank House, Fettercairn, Kincardineshire.
DONALDSON, James Sidney, 33 Derby Street, Moss-side, Manchester.
DORMAN, Arthur John, of Grey Towers, Newby, Yorks.
DUNNE, Robert H. P., J.P., Brittas, Clonaslee, Queen's County.
FRASER, Jas., Wood Merchant, Marcassie Sawmills, Forres.
GELLATLY, Thos., Assistant Forester, Gala House, Galashiels, Selkirkshire.
GEMMILL, Wm., Farmer, Greendykes, Macmerry, East Lothian.
GILLANDERS, A. F., Forester, High Legh, Knutsford, Cheshire.
GOW, Peter Douglas, Farmer, Bonaly, Colinton, Midlothian.
GRANT, Lauchlan, Solicitor, Perth.
HALLIDAY, Geo., Timber Merchant, Rothesay, Bute.
HAMILTON-OGILVY, H. T. M., of Beil, Prestonkirk, East Lothian.
HART, John, Factor, Mains of Cowie, Stonehaven, Kincardineshire.
HAY, Alex., of Ben. Reid & Co., Nurserymen, Aberdeen.
HOGG, Thos., The Gardens, Woodside, Paisley.
HOLM, Alexander, Coney Park Nurseries, Stirling.
INCH, Chas. F., Assistant Forester, Altyre, Forres.
INGLIS, Geo. Erskine, Estate Agent, Campbeltown, Argyleshire.
KEMP, David, 22 Young Street, Edinburgh.
LEWIS, Thos. J., Artbog, Dolgelly, Merionethshire.
LITTLE, John, Land Agent, Hackness Hall, Scarborough, Yorks.
LOCK, Hampton, Assistant Forester, Lynedoch, Perthshire.
LOW, John, Timber Merchant, Kirkcaldy, Fife.
MACKENZIE, John, Forester, Stenton, Prestonkirk, East Lothian.
MACMILLAN, Duncan, Forester, Keir, Dunblane, Perthshire.
M'INTYRE, Malcolm, The Gardens, The Glen, Innerleithen, Peeblesshire.
M'KENNA, Robert, The Gardens, Charleville Forest, Tullamore, King's County.
M'LAREN, Patrick M., Assistant Forester, Altyre, Forres.
M'LEISH, John, Assistant Forester, Murthly, Perthshire.
M'LEOD, Geo., Overseer, Harviestoun, Dollar, Clackmannanshire.
MARSHALL, Alex., 150 Leadenhall Street, London, E.C.
MILNE-HOME, J. Hepburn, Caldra, Duns, Berwickshire.
MORGAN, Alex., Timber Merchant, Crieff, Perthshire.
MUNRO, Hugh, Teacher, Penicuik, Midlothian.
MURRAY, John, Factor, Glenearn, Bridge of Earn, Perthshire.
PATTERSON, James Purves, Nursery Manager, Dollardstown Nursery, Athy, Ireland.
PEARSON, James, Forester, Sessay, Thirsk, Yorks.
PEEBLES, Philip, Estate Office, Albury, Guildford, Surrey.
PETER, James, Land Steward, Berkeley, Gloucestershire.

PHILIP, Alexander, Solicitor, Brechin, Forfarshire.
POOLE, William, Corn Exchange Buildings, Edinburgh.
RICHMOND, T. S., 25 Marchmont Road, Edinburgh.
ROBERTSON, David, Merchant, Kirkcaldy, Fife.
RODGER, James, Factor, Keir, Dunblane, Perthshire.
RUSSELL, Rev. W. G., Rector of Gravhill, King's County.
SHARP, Thomas, Forester, Monreith, Port-William, Wigtownshire.
SHERLOCK, David, D.L., J.P., B.L., Rahan Lodge, Tullamore, King's County.
SMITH, George, Assistant Forester, Hope Cottage, Ruthwell, Dumfriesshire.
STODDART, James, Builder, Bonnyrigg, Midlothian.
STUART, Robert, Forester, Elm Grove, Grantown, Inverness-shire.
TAYLOR, William, Forester, Sandside, Kirkcudbright.
TURNBULL, George, Estate Office, Tullamore, King's County.
TURNBULL, Walter Scott, Estate Office, Geashill, King's County.
WILSON, William, Wood Merchant, Crieff, Perthshire.
WILSON, William, Forester, Dingley, Market Harborough, Leicestershire.
WILSON, William, Assistant Forester, Philiphaugh, Selkirk.
WYLIE, James, Bank Agent, Leven Street, Edinburgh.
YOUNG, Donald, care of Bennetts Limited, Hyde Road, Manchester.

ELECTION OF TRUSTEES.

The Hon. Lord BALVAIRD, Scone Palace, and R. C. MUNRO FERGUSON, M.P., were elected Trustees in room of Dr Hugh Cleghorn of Stravithie, and Robert Hutchison, Esq. of Carlowrie, both deceased.

ELECTION OF LOCAL SECRETARIES.

The Secretary reported that the Council, as empowered by the rules, had elected the following additional Local Secretaries, and their election was duly confirmed :—

Scotland.

Counties.	
Aberdeen,	JOHN CLARK, Forester, Haddo House, Aberdeen.
	JAMES WILSON, M.A., B.Sc., Fordyce Lecturer on Agriculture, Aberdeen University.
Argyle,	WALTER ELLIOT, Manager, Ardtornish.
	JOHN D. SUTHERLAND, Estate Agent, Oban.
Ayr,	JOHN HAY, Overseer, Dollars Estate Office, Kilmarnock.
	ANDREW D. PAGE, Overseer, Culzean, Maybole.
Banff,	JOHN BRYDON, Forester, Rothes, Elgin.
Berwick,	WM. MILNE, Foulden Newton, Berwick-on-Tweed.
Bute,	WM. INGLIS, Forester, Cladoch, Brodick.
Clackmannan,	ROBERT FORBES, Estate Office, Kennet, Alloa.

Counties.	
Dumfries, .	D. Crabbe, Forester, Byreburnfoot, Canonbie.
	John Hayes, Dormont Grange, Lockerbie.
	John Newbigging, Nurseryman, Dumfries.
East Lothian, .	W. S. Curr, Factor, Ninewar, Prestonkirk.
Fife, . .	Edmund Sang, Nurseryman, Kirkcaldy.
Forfar, . .	R. Cairns, The Gardens, Balruddery, near Dundee.
	James Crabbe, Forester, Glamis.
Inverness, .	James A. Gossip, Nurseryman, Inverness.
Kinross, .	James Terris, Factor, Dullomuir, Blairadam.
Lanark, . .	John Davidson, Forester, Dalzell, Motherwell.
	James Whitton, Superintendent of Parks, City Chambers, Glasgow.
Moray, . .	Wm. Gilchrist, Forester, Leuchars, Elgin.
Peebles, . .	James F. Hardie, Woodbine Cottage, Peebles.
Perth, . .	W. Harrower, Forester, Tomnacroich, Garth, Aberfeldy.
	W. A. Mackenzie, Factor, Faskally, Pitlochry.
	Alex. Pitcaithley, Jeanie Bank, Old Scone, Perth.
Ross, . .	Sir Kenneth Mackenzie, Bart., Conan House, Conon Bridge.
Roxburgh, .	John Leishman, Manager, Cavers Estate, Hawick.
	R. V. Mather, Nurseryman, Kelso.
Sutherland, .	Donald Robertson, Forester, Dunrobin, Golspie.
West Lothian,	James Smith, Hopetoun Gardens, South Queensferry.
Wigtown, .	James Hogarth, Forester, Culhorn, Stranraer.
	H. H. Walker, Monreith Estate Office, Whauphill.

England.

Berks, . .	W. Storie, Whitway House, Newbury.
Bucks, . .	James Smith, The Gardens, Mentmore, Leighton-Buzzard.
Cheshire, .	Wm. Elder, Cholmondeley Park, near Malpas.
Derby, . .	Thomas Dow, Forester, Bretby, Burton-on-Trent.
Devon, . .	W. Michie, Bedford Office, Tavistock, South Devon.
Durham, .	Professor Somerville, Durham College of Science, Newcastle-on-Tyne.
Hants, . .	Andrew Slater, Land Steward, Osborne, Cowes, Isle of Wight.
Hereford, .	Wm. Storie, Forester, Holme Lacy, Hereford.
Herts, . .	Thomas Smith, Overseer, Tring Park, Wiggington, Tring.
Kent, . .	R. W. Cowper, Gortanore, Sittingbourne.
Lancashire, .	Peter Grant, Forester, Hornby Castle, Hornby, Lancaster.
	D. C. Hamilton, Forester, Knowsley, Prescot.
Leicester, .	James Martin, The Reservoir, Knipton, Grantham.
Lincoln, .	J. Alexander, The Gardens, Revesby Abbey, Boston.
	W. B. Havelock, The Nurseries, Brocklesby Park.
Middlesex, .	Professor Boulger, 66 Abingdon Road, Kensington, London, W.
	George Cadell, c/o The Secretary, Surveyor's Institution, Savoy Street, Victoria Embankment, London.

Counties.	
Norfolk,	H. Munro, Garden Cottage, Holkham.
	James Rodger, Forester, Morton Hall, Norwich.
Northampton,	F. Mitchell, Forester, Harlestone, Northampton.
Notts,	Wilson Tomlinson, Forester, Clumber Park, Worksop.
Surrey,	Philip Peebles, Estate Office, Albury, Guildford.
Warwick,	W. Berridge, Forester, Stoneleigh Abbey Farm, Kenilworth.
	A. D. Christie, The Gardens, Ragley Hall, Alcester.
Wilts,	A. C. Forbes, Wood Manager, Bowood, Calne.
Yorks,	Wm. Forbes, Forester, Swinton, Masham.
	Adam Main, Forester, Rose Cottage, Loftus.
	Wales.
Flint,	R. V. Kyrke of Penywern, Mold.
Glamorgan,	Arch. Mitchell, Forester, Dunraven, Bridgend.
	Geo. Wilson, Forester, Penrice Castle, Reynoldston R.S.O.
	Ireland.
Antrim,	John Scrimgeour, Land Steward, Shane's Castle.
Galway,	Thomas Robertson, Forester, Knockboy, Recess.
Kildare,	Robert M'Kerrow, Manager, Carton, Maynooth.
Kilkenny,	Alex. M'Rae, Forester, Castlecomer.
King's County,	Arch. Henderson, Forester, Clonad Cottage, Tullamore.
Monaghan,	James Brodie, Land Steward, Glaslough.
Tipperary,	David G. Cross, Forester, Kylisk, Nenagh.
Wicklow,	Adam Johnstone, Forester, Coollattin, Shillelagh.

Address by the President.

Mr Munro Ferguson delivered the Annual Presidential Address, which is printed in full in the *Transactions*.

Essays on an Experimental Forest Area.

Professor Somerville read the Report[1] of the President and himself on the four Essays received on the following subject: "The best form of, and the best method of establishing, an Experimental Forest area in Scotland, for the exhibition of and for instruction—theoretical and practical—in Scientific Forestry," and their recommendations were approved of, as follows:—

Motto, "Novice." No award.

,, "South Esk." No award.

,, "Nil Desperandum." Mr D. F. Mackenzie, Factor, Mortonhall, Midlothian. Prize, £5, 5s.

,, "Moon Raker." Mr A. C. Forbes, Wood Manager, Bowood, Calne, Wilts. Prize, £10, 10s.

[1] The Report is printed in the *Transactions*.

The President intimated that although the whole of the twenty-five guineas offered had not been awarded, he would pay the half of that sum, and thus leave the balance of the Society's half of the sum awarded available for some other competition. The President was cordially thanked for his generosity.

On the motion of Mr Dunn, the Judges were thanked for the trouble they had taken in the matter, and their Report was remitted to the Council with power to frame an official scheme, and to report at a future meeting.

Other Essays.

In the absence of Colonel Bailey, Convener of the Judges, the Secretary read their Report on the other Essays received, and the following Awards were made in accordance therewith,—the sealed envelopes accompanying the Essays being opened, and the names of the successful competitors announced to the Meeting.

Class I.

I. On the best methods of Converting Timber. (Motto, "Economist.")

No award.

II. On the best methods of Converting Timber. (Motto, "Sawdust.") By D. F. Mackenzie, Factor, Mortonhall.

Award, the Silver Medal offered by Mr W. M. Welsh, of Messrs Dicksons & Co., Edinburgh.

III. On the Afforestation of Waste Land. (Motto, "Arboreous.")

No award.

IV. On Forestry and Game Preserving. (Motto, "Enthusiasm.") By Archibald Mitchell, Forester, Dunraven Castle, Bridgend, Glamorganshire.

Award, a Bronze Medal.

V. On the Forest Institute of Vallombrosa. (Motto, "Thick as Autumnal Leaves," etc.) By George Cadell (late Indian Forest Department).

Award, a Bronze Medal.

Class II.

I. On the Planting and Management of Hedges. (Motto, "White Thorn.") By James Gillespie, Lochton Lodge, Inchture.

Award, a Bronze Medal.

Excursion in 1898.

Mr Dunn, Convener of the Excursion Committee, reported that the general feeling of the Council appeared to be in favour of the postponement for another year of the proposed Excursion to Scandinavia or France, and the matter was again remitted to the Council for further consideration.

Library and Museum.

The Secretary reported that the following presentations had been made since the Annual General Meeting in January last:—

List of Presentations to the Society's Library.

1. *Journal of the Royal Agricultural Society*, London, vol. viii., parts 1 and 2.
2. *Journal of the Royal Horticultural Society*, London, vol. xx., part 3.
3. Report of the Smithsonian Institution, 1894.
4. *Transactions of the Edinburgh Botanical Society*, vol. xx., parts 2 and 3.
5. *Transactions of the Nova Scotian Institute of Science*, vol. ix., part 2.
6. *Transactions of the Massachusetts Horticultural Society*, 1895, part 3; 1896, part 2.
7. Report of the Secretary for Agriculture, Nova Scotia, 1896.
8. Agricultural Returns from the Board of Agriculture, 1896.
9. Leaflets on Rabies and Celery Fly. Board of Agriculture, 1896.
10. Reports of Conservators of Forests, Cape of Good Hope, 1896.
11. Two Papers on Forestry, by Hon. John D. Lyman, New Hampshire, 1895 and 1897.
12. Paper on Indian Forestry, by Sir Dietrich Brandis.

13. Abstract of Meteorological Observations made at Rothesay, by James Kay, Bute.
14. Two Pamphlets, on Wheat Experiments and Tuberculin Test, by Department of Agriculture, Victoria.

Note.—Members may borrow from the Secretary any of the Books or Pamphlets belonging to the Society, provided they pay the cost of transmission, and guarantee their safe return within a reasonable time.

Notices of Motion.

Mr Dunn, on behalf of the Council, gave notice of the following motions, which will fall to be discussed at next Meeting :—

1. That the Council be empowered to decide the class under which any Candidate for Membership shall be placed.
2. That the Council be empowered to appoint Correspondents in any part of the world.

Forestry in Scotland during the Sixty Years of the Queen's Reign.

Mr Dunn read a Paper on this subject, which is printed in full in the *Transactions*.

The Queen's Diamond Jubilee.

The President read the Congratulatory Address which had been presented to Her Majesty the Queen, on the occasion of her Diamond Jubilee, and the Royal acknowledgment which had been received, as follows :—

To the Queen's Most Excellent Majesty.

May it please your Majesty, we, your Majesty's most faithful and loyal subjects, the Members of the Royal Scottish Arboricultural Society, venture, with profound respect, on this, the completion of the sixtieth year of your Majesty's reign, humbly to offer our dutiful and heartfelt congratulations, and to express our continued and unswerving loyalty to your Majesty.

As an Association formed in the early part of your Majesty's reign, we participate with peculiar enthusiasm in the rejoicings that mark this great occasion, and we would wish to avail ourselves of this opportunity to lay at your Majesty's feet an expression of our humble and sincere thankfulness for the many tokens of Royal favour which your Majesty has been graciously pleased to confer on our Society, and of the gratitude we have long felt for

the preservation, through your Majesty's gracious care, of that beautiful portion of the old Caledonian Forest which surrounds your Majesty's Highland home.

We pray that your Majesty may continue to experience those blessings which have hitherto signalized your Majesty's reign, and that your Majesty may long be spared to enjoy, in peace and happiness, the beauties of our Scottish forests.

R. C. Munro Ferguson, *President.*
Robert Galloway, *Secretary.*

Scottish Office,
Whitehall, S.W., *6th July* 1897.

Sir,—I have had the honour to lay before the Queen the loyal and dutiful Address by the Members of the Royal Scottish Arboricultural Society on the occasion of the completion of the sixtieth year of Her Majesty's reign.

Her Majesty was pleased to receive the same in the most gracious manner, and I have it in command to acquaint you that the evidence received from all parts of Scotland of the attachment of her Scottish subjects to her throne and person affords Her Majesty great satisfaction.—I am, Sir, your obedient Servant, Balfour of Burleigh.

R. C. Munro Ferguson, Esq., M.P.,
Novar, Evanton, Ross-shire.

Jubilee Memorial Tree Planting.

On the motion of the Chairman, the following resolution was put to the Meeting and unanimously carried, viz.:—

"That this Meeting of the Society approves of the recommendation of the Council that Members of the Society should use their influence with Town and County Councils and other Local Authorities, as well as Landed Proprietors generally, to induce them to plant specimens of ornamental trees, avenues, groups, and woods of all sizes, during the ensuing season, to commemorate in an appropriate manner the Queen's Diamond Jubilee Year."

Votes of Thanks.

Votes of thanks were accorded to the President for his Address, the Judges for their Reports on the Essays, Mr Dunn for his Paper, and the Chairman for presiding, which concluded the business.

ILLUSTRATIONS FUND.

The Council beg to direct special attention to this Fund, the object of which is to obtain contributions to defray the expense of illustrating the Society's *Transactions*.

Subscriptions received in 1897:—

Professor Somerville,	£2	5	0
J. K. Milne, Kevock Tower, Lasswade,	1	1	0

THE SOCIETY'S ALBUM.

The Council wish it to be known that the Society has an Album for the Photographs of Members, and the Secretary will be glad to receive contributions.

Members are invited to read short practical papers on any subject connected with Forestry at the Annual General Meeting in January, or at the General Meeting to be held at the time of the Excursion. Those who intend to do so are requested to intimate, in writing, the Title of their subject to the Secretary, not later than 15th December 1897 or 1st June 1898; stating the time they may require for reading the paper.

SYLLABUS OF SUBJECTS FOR ESSAYS.

The following subjects are offered for competition in 1898:—

[*The Judges are empowered to fix the value of the Prizes to be awarded according to the respective merits of the Essays.*

All Essays and Reports intended for Competition must be lodged with the Secretary not later than 1st June 1898. All Collections of Cones, Seeds, and Rustic Work must be in the hands of the Secretary not less than three days before the Annual General Meeting, to be held on 26th January 1898. Each Essay, Report, Collection, or Article must bear a MOTTO, *and be accompanied by a sealed envelope bearing outside the* SAME MOTTO, *and the Class to which the Competitor belongs, and containing inside, a* CARD *with the* NAME *and* ADDRESS *of the Competitor.*

Judges cannot compete during their term of office.

Successful Competitors may either have the medals or their converted values, which are as follows:—Gold, £5; No. 1 *Silver*, £3; No. 2 *Silver*, £2; *Bronze*, 10s.]

Class I.—For Open Competition.

I. For an approved Report showing the Financial Results of the Cultivation of Woods and Plantations. (*Ten Guineas* offered by Isaac Bayley Balfour, M.D., D.Sc., Professor of Botany in the University of Edinburgh, formerly President of the Society.)

It is not necessary that the names of the estates on which the woods grow should be published, but the reporter must give the annual value of the land previous to planting; statistics of the cost of forming the plantations, including draining and fencing; the expenses of management, the income derived, and the present value of the Woods.

II. For an approved Report on the Gales of November 1893 and December 1894, their results and consequences. (*A Medal.*)

III. For an approved Report detailing the methods employed to bring about the Natural Regeneration of a Wood, and the subsequent Treatment as regards Artificial Assistance, should such have been rendered necessary owing to the Natural Sowing having been irregular, insufficient, or too dense. (*A Medal.*)

The author must cite some particular case, and give the results of a systematic attempt at natural regeneration, bearing in mind the fact that a patchy imperfect restocking cannot be regarded as satisfactory or successful.

IV. For an approved Essay on the best methods of realising Forest Products. (*Silver Medal* offered by Wm. M. Welsh, Esq., of Messrs Dicksons & Co., 1 Waterloo Place, Edinburgh.)

V. For an approved Essay on the Valuation of Woods or Plantations for the purpose of Transfer. (*A Medal.*)

The writer to describe the method (*a*) of valuing matured woods, (*b*) middle-aged woods, (*c*) park trees and others that may be, in addition to their value as timber, considered as ornamental, (*d*) young woods, and (*e*) coppice.

VI. For an approved Report on the Plantations of which the competitor is Forester. Reporter to state the extent of plantations, the kinds of timber grown, soil, situation, age, management, etc. This is a standing subject. (*A Medal.*)

VII. For an approved Report on the Present State and Future Prospects of Arboriculture in Ireland. (*A Medal.*)

VIII. For an approved Report on the Present State and Future Prospects of Arboriculture in the West of England and Wales. (*A Medal.*)

IX. On the best Method of Procedure in growing a continuous Crop of Timber in Woods or Plantations. (*A Medal.*)

The Essay should deal with the different kinds of Woods, the ages, and proportion per acre of the trees at different stages, and whether these have been raised by natural or artificial means. Reference may be made to any system practised abroad which might prove applicable in this country.

X. For an approved Report, based on results, on the advantage of Under Planting. (*A Medal.*)

XI. For an approved Essay on the best method of Preventing the Inroads of the Pine Saw-fly—*Lophyrus pini* of Curtis. (*A Medal.*)

XII. For an approved Essay on any Disease incidental to Forest Trees. A standing subject. (*A Medal.*)

XIII. For an approved Report on the most advantageous methods, not generally practised in this country, of Transporting Timber. (*A Medal.*)

The reporter specially to describe any means, other than by horse-power, of moving felled timber from the interior of woods to their margins, or to roads.

XIV. For an approved Essay on the best methods of utilising Small-wood in the manufacture of Fancy-wood articles, Turnery, Wood Wool, etc. (*A Medal.*)

XV. For an approved Essay on the erection and maintenance of a Saw-mill and other wood-working Machinery suitable for Estate purposes. (*A Medal.*)

The writer should describe the various kinds of motive power; the size of the buildings and stores; the fittings required—benches, saws, tools, timber carriages, etc., their maintenance and repair; and the methods of dressing the various woods for the saws, and the manner of sawing them to the best advantage.

XVI. For an approved Essay or Report on any other subject connected with Arboriculture. (*A Medal.*)

XVII. For an instrument or method for expeditiously obtaining the diameter of trees at a given height, or for any other useful invention or marked improvement on any of the implements used in Forestry. Models or implements to be accompanied by a report. (*A Medal.*)

CLASS II.—FOR ASSISTANT FORESTERS ONLY.

I. For an approved Report, based on personal observation, on the Propagation of Forest Trees and Shrubs. (*A Medal.*)

II. For an approved Report, based on personal observation, on any disease affecting Trees, or injuries caused to Trees, by insects or animals. (*A Medal.*)

III. For an approved Essay on the Peeling and Harvesting of different kinds of British Bark used in Tanning. (*A Medal.*)

IV. For an approved Essay on the best method of protecting Trees from injury by Ground Game. (*A Medal.*)

V. For an approved Essay or Report on any other subject connected with Arboriculture. (*A Medal.*)

VI. For the best and approved Model in Rustic, or Ornamental Woodwork, of any subject designed and executed by the competitor. Model not to exceed six feet in length. (*A Medal.*)

The Council invite the attention of young Foresters to the foregoing subjects, as they wish to encourage their literary efforts.

ROBERT GALLOWAY,
Secretary.

5 ST ANDREW SQUARE,
EDINBURGH.

Scottish Provident Institution

ESTABL^{D}. 1837 — INCORP^{D}. 1848

Family Provision

IN the selection of an Assurance Office for the purpose of providing Capital Sums at Death to meet Family Settlements, Partnership or other Business Arrangements, Estate Duties, etc., the main question, after that of Absolute Security, is which Office will provide this Fund on *the most moderate terms*, without sacrifice of the valuable right to participate in the Surplus.

The system of the **Scottish Provident Institution** is specially suited for such requirements. The PREMIUMS are so moderate that, at usual ages for assuring, £1200 or £1250 may be secured from the first for the yearly payment which is generally charged (with profits) for £1000 only—the £200 or £250 being equivalent to an immediate and certain Bonus. The WHOLE SURPLUS goes to the Policyholders, on a system at once safe and equitable—no share being given to those by whose early death there is a *loss* to the Common Fund.

The SURPLUS at last Septennial Valuation (1894) was **£1,423,018.** The additions to policies sharing the first time, speaking generally, varied according to class and duration, from 15 to upwards of 30 per cent. **More than one-half** of the Members who died during the period (1888-1894) were entitled to **Bonuses** which, **notwithstanding that the Premiums do not as a rule exceed the non-profit rates of other Offices,** were on the average equal to **an addition of about 50 per cent** to the Policies which participated.

The Accumulated Funds now exceed
Ten Millions Sterling.

LONDON: 17 KING WILLIAM STREET, E.C.
HEAD OFFICE: 6 ST. ANDREW SQUARE, EDINBURGH.

Scottish Provident Institution.

TABLE OF PREMIUMS, BY DIFFERENT MODES OF PAYMENT,

For Assurance of £100 at Death—With Profits.

Age next Birthday.	Annual Premium payable during Life.			ANNUAL PREMIUM LIMITED TO															Single Payment.			Age next Birthday.
				25 Payments.			20 Payments.			15 Payments.			10 Payments.			5 Payments.						
	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	
21	1	16	3	2	8	10	2	15	4	3	6	7	4	9	4	7	19	1	36	1	3	21
22	1	16	9	2	9	3	2	15	9	3	7	2	4	10	2	8	0	8	36	8	0	22
23	1	17	2	2	9	7	2	16	2	3	7	7	4	10	11	8	1	11	36	13	8	23
24	1	17	7	2	9	11	2	16	6	3	8	0	4	11	6	8	3	1	36	19	4	24
25	1	18	0	2	10	2	2	16	10	3	8	5	4	12	1	8	4	3	37	5	0	25
26	1	18	6	2	10	6	2	17	3	3	8	11	4	12	9	8	5	8	37	11	6	26
27	1	19	2	2	11	0	2	17	10	3	9	7	4	13	8	8	7	3	37	19	9	27
28	1	19	11	2	11	7	2	18	5	3	10	4	4	14	8	8	9	2	38	8	10	28
29	2	0	8	2	12	3	2	19	2	3	11	2	4	15	10	8	11	3	38	18	6	29
*30	*2	1	6	*2	13	0	2	19	11	3	12	1	4	17	1	8	13	6	39	8	10	*30
31	2	2	6	2	13	9	3	0	9	3	13	1	4	18	5	8	15	11	40	0	6	31
32	2	3	5	2	14	8	3	1	9	3	14	2	4	19	11	8	18	6	40	12	8	32
33	2	4	6	2	15	7	3	2	9	3	15	5	5	1	6	9	1	4	41	5	8	33
34	2	5	7	2	16	8	3	3	10	3	16	8	5	3	2	9	4	4	41	19	4	34
35	2	6	10	2	17	9	3	5	0	3	18	0	5	5	0	9	7	6	42	13	9	35
36	2	8	2	2	19	0	3	6	3	3	19	6	5	6	11	9	10	11	43	8	11	36
37	2	9	8	3	0	3	3	7	7	4	1	0	5	8	11	9	14	5	44	4	7	37
38	2	11	3	3	1	7	3	8	11	4	2	5	5	10	11	9	18	0	45	0	7	38
39	2	12	11	3	3	0	3	10	5	4	4	0	5	13	0	10	1	8	45	17	0	39
†40	2	14	9	†3	4	6	3	11	11	4	5	8	5	15	0	10	5	4	46	14	0	†40
41	2	16	8	3	6	1	3	13	7	4	7	6	5	17	3	10	9	3	47	11	7	41
42	2	18	8	3	7	10	3	15	4	4	9	5	5	19	6	10	13	4	48	10	4	42
43	3	0	11	3	9	8	3	17	3	4	11	6	6	2	1	10	17	8	49	9	2	43
44	3	3	3	3	11	9	3	19	4	4	13	8	6	4	8	11	2	1	50	10	3	44
45	3	5	9	3	14	0	4	1	7	4	16	2	6	7	7	11	6	9	51	11	5	45
46	3	8	5	3	16	6	4	4	1	4	18	9	6	10	8	11	11	9	52	13	5	46
47	3	11	5	3	19	2	4	6	9	5	1	8	6	14	2	11	17	1	53	17	0	47
48	3	14	8	4	2	1	4	9	9	5	4	10	6	17	10	12	2	10	55	1	5	48
49	3	18	1	4	5	3	4	12	11	5	8	2	7	1	10	12	8	11	56	6	5	49
50	4	1	7	4	8	7	4	16	3	5	11	8	7	6	1	12	15	3	57	11	9	50
51	4	5	6	4	12	1	4	19	8	5	15	4	7	10	4	13	1	9	58	17	3	51
52	4	9	5	4	15	8	5	3	2	5	19	0	7	14	7	13	8	3	60	1	10	52
53	4	13	5	4	19	4	5	6	9	6	2	7	7	18	10	13	14	7	61	5	9	53
54	4	17	8	5	3	1	5	10	5	6	6	3	8	3	0	14	0	10	62	9	4	54
55	5	1	11	5	6	11	5	14	2	6	9	11	8	7	1	14	7	0	63	12	4	55

[The usual *non-participating* Rates of other Offices differ little from these Premiums.]

* A person of 30 may secure £1000 at death, by a yearly payment, *during life*, of £20 : 15s.

This Premium would generally elsewhere secure (with Profits) **£800** *only, instead of* **£1000.**

OR, he may secure £1000 by 25 yearly payments of £26 : 10s.—*being thus free of payment before age* 55.

† At age 40, the Premium *ceasing before age* 65 is, for £1000, £32 : 5s.—about the same as most Offices require during the whole term of life. Before the Premiums have ceased, the Policy will have shared in at least one division of surplus. To **Professional Men** and others, whose income is dependent on continuance of health, the limited payment system is specially recommended.

BRANCH OFFICES:

GLASGOW, 29 St. Vincent Pl.
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DUNDEE, 12 Victoria Chambers.
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BRISTOL, 31 Clare Street.
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LEEDS, 35 Park Row.
LIVERPOOL, 25 Castle Street.
MANCHESTER, 10 Albert Sq.
NEWCASTLE, 1 Queen Street.
NOTTINGHAM, 27 Victoria St.
BELFAST, 10 Donegall Sq., N.

DUBLIN . . . 36 COLLEGE GREEN

LONDON OFFICE: 17 KING WILLIAM STREET, E.C.

HEAD OFFICE: 6 ST. ANDREW SQUARE, EDINBURGH.

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Royal Scottish Arboricultural Society.

PATRON—HER MOST GRACIOUS MAJESTY THE QUEEN.

1.—FORMER PRESIDENTS.

YEAR.

1854. JAMES BROWN, Deputy-Surveyor of the Royal Forest of Dean.
1855. Ditto, Wood Commissioner to the Earl of Seafield.
1856. Ditto, ditto.
1857. The Right Hon. THE EARL OF DUCIE.
1858. The Right Hon. THE EARL OF STAIR.
1859. Sir JOHN HALL, Bart. of Dunglass.
1860. His Grace THE DUKE of ATHOLE.
1861. JOHN J. CHALMERS of Aldbar.
1862. The Right Hon. THE EARL OF AIRLIE.
1863. The Right Hon. T. F. KENNEDY.
1864. ROBERT HUTCHISON of Carlowrie, F.R.S.E.
1865. Ditto, ditto.
1866. Ditto, ditto.
1867. Ditto, ditto.
1868. Ditto, ditto.
1869. Ditto, ditto.
1870. Ditto, ditto.
1871. Ditto, ditto.
1872. HUGH CLEGHORN, M.D., LL.D., F.R.S.E., of Stravithie.
1873. Ditto, ditto.
1874. JOHN HUTTON BALFOUR, M.D., M.A., F.R.SS. L. & E., Professor of Botany in the University of Edinburgh.
1875. Ditto, ditto.
1876. The Right Hon. W. P. ADAM of Blairadam, M.P.
1877. Ditto, ditto.
1878. Ditto, ditto.
1879. The Most Hon. THE MARQUIS OF LOTHIAN, K.T.
1880. Ditto, ditto.
1881. Ditto, ditto.
1882. ALEXANDER DICKSON, M.D., F.R.S.E., of Hartree, Regius Professor of Botany in the University of Edinburgh.
1883. HUGH CLEGHORN, M.D., LL.D., F.R.S.E., of Stravithie.
1884. Ditto, ditto.
1885. Ditto, ditto.
1886. Sir HERBERT EUSTACE MAXWELL, Bart. of Monreith, M.P.
1887. Ditto, ditto.

YEAR.

1888. The Right Hon. THE EARL OF HOPETOUN Hopetoun House, South Queensferry.

1889. His Excellency The Right Hon. THE EARL OF HOPETOUN, Governor of Victoria, Australia.

1890. ISAAC BAYLEY BALFOUR, M.D., Sc.D., F.R.S., Professor of Botany in the University of Edinburgh.

1891. Ditto, ditto.

1892. Ditto, ditto.

1893. Ditto, ditto.

1894. R. C. MUNRO FERGUSON, M.P., of Raith and Novar, Raith House, Kirkcaldy, Fife.

1895. Ditto, ditto.

1896. Ditto, ditto.

1897. Ditto, ditto.

1898. Colonel F. BAILEY, R.E. (retired), Lecturer on Forestry, University of Edinburgh.

2.—LIST OF MEMBERS.

Corrected to December 1898.

HONORARY MEMBERS.

Date of Election.

1873. BRANDIS, Sir Dietrich, K.C.S.I., Ph.D., *Ex*-Inspector General of Forests in India, Bonn, Germany.

1886. CAMPBELL, Sir James, Bart. of Aberuchill, Redhill, Lydney, Gloucestershire.

1898. DUNN, Malcolm, The Palace Gardens, Dalkeith (also a *Life* Member by composition 1867).

1886. HOOKER, Sir Joseph D., M.D., K.C.S.I., The Camp, Sunningdale Berks.

1886. JOHORE, The Maharajah of, Johore, Malay Peninsula.

1894. LOGAN, Charles B., W.S., Commissioner to the Countess Dowager of Seafield, Coulnakyle, Grantown, Strathspey.

1869. LOTHIAN, The Most Hon. the Marquis of, K.T., Newbattle Abbey, Dalkeith (also a *Life* Member by composition).

1886. LUBBOCK, Sir John, Bart., M.P., D.C.L., High Elms, Down, Kent.

1886. MICHAEL, General, C.S.I., Bangor Lodge, Ascot, Berkshire.

1889. SARGENT, Professor C. S., Director of the Arnold Arboretum, Harvard College, Brookline, Massachusetts, U.S.A.

1889. SCHLICH, Dr William, Professor of Forestry in the Engineering College for India, Coopers Hill, Surrey.

1895. SCHWAPPACH, Dr Adam, Professor of Forestry, Eberswalde, Prussia.

1886. SOUTHEY, Hon. Robert, Cape Town, Cape Colony.

1881. TEMPLE, Sir Richard, Bart., G.C.S.I., The Nash, Kempsey, Worcestershire.

1886. TOKAI, Tokio, Japan.

LIFE MEMBERS.

Date of Election.

1875. Acland, Sir Thomas Dyke, Bart., M.P., of Killerton, Exeter, Devon.
1883. Adam, Sir Charles Elphinstone, Bart. of Blairadam, 5 New Square Lincoln's Inn, London, W.C.
1874. Addington, The Right Hon. Lord, Addington Manor, Winslow, Bucks.
1883. Alexander, John, 38 St Augustine's Road, Bedford.
1883. Athole, His Grace the Duke of, K.T., Blair Castle, Blair Athole.
1887. Bailey, Colonel F., R.E., Lecturer on Forestry, Edinburgh University, 7 Drummond Place, Edinburgh.
1896. Baird, J. G. A., M.P., of Adamton, 89 Eaton Square, London, S.W.
1884. Balfour of Burleigh, The Right Hon. Lord, Secretary for Scotland, Kennet House, Alloa.
1886. Balfour, Edward, of Balbirnie, Markinch, Fife.
1877. Balfour, Isaac Bayley, Sc.D., M.D., F.L.S., Professor of Botany, Edinburgh.
1866. Barrie, James, Forester, Stevenstone, Torrington, North Devon.
1877. Barry, John W., of Fyling Hall, Fylingdales, Scarborough, Yorks.
1884. Bates, Cadwallader John, Langley Castle, Northumberland.
1871. Bell, William, of Gribdae, Kirkcudbright.
1897. Black, Alexander, The Gardens, Carton, Maynooth, Co. Kildare.
1877. Bolckow, C. F. H., of Brackenhoe, Marton Hall, Marton R.S.O., Yorks.
1895. Boord, W. Bertram, Land Agent, Bewerley, Pateley Bridge, Yorks.
1857. Borthwick, Wm., Forester, Dunnichen, Forfar.
1896. Brown, Rev. W. Wallace, Minister of Alness, Ross-shire.
1867. Bruce, Thomas Rae, Old Garroch, New Galloway.
1873. Brydon, John, Forester, Rothes, Elgin.
1879. Buccleuch, His Grace the Duke of, K.T., Dalkeith Palace, Dalkeith.
1879. Buchanan, Charles, Overseer, Penicuik Estate, Penicuik.
1897. Campbell, James Arthur, Seacliff, Ardrishaig, Argyleshire.
1896. Carmichael, Sir Thos. D. Gibson, Bart., M.P., of Castlecraig, Dolphinton, Peeblesshire.
1882. Chowler, Christopher, Gamekeeper, Dalkeith Park, Dalkeith.
1890. Christie, John, of Cowden, Dollar, Clackmannanshire.
1883. Christie, William, Nurseryman, Fochabers.
1877. Clay, J. Spender, Ford Manor, Lingfield, Surrey.
1872. Clerk, Sir George D., Bart. of Penicuik, Midlothian.
1898. Coats, Sir Thomas Glen, Bart, Ferguslie Park, Paisley.
1879. *Colquhoun, Andrew, 75 Buchanan Street, Glasgow.*
1897. Coupar, Wm., Overseer, Balgowan, Perthshire.
1876. Cowan, Charles W., of Logan House, Valleyfield, Penicuik.
1892. Cowan, George, 1 Gillsland Road, Edinburgh.
1874. Cowper, R. W., Gortanore, Sittingbourne, Kent.
1875. Craig, Wm., M.D., C.M., F.R.S.E., 71 Bruntsfield Place, Edinburgh.
1865. Cross, David G., Forester, Kylisk, Nenagh, Ireland.
1880. Curr, Henry, Factor, Pitkellony House, Muthill, Perthshire.
1884. Currie, Sir Donald, K.C.M.G., M.P., of Garth Castle, Aberfeldy.
1867. Dalgleish, John G., of Ardnamurchan, Brankston Grange, Stirling.

Date of Election.

1876. DALGLEISH, Laurence, of Dalbeath, Rutland Square, Edinburgh.
1877. DEWAR, Daniel, Forester, Beaufort Castle, Beauly, Inverness.
1898. DIGBY, The Right Hon. Baron, Minterne, Cerne, Dorsetshire.
1896. DOUGLAS, Alex., The Gardens, Baldersby Park, Thirsk, Yorkshire.
1883. DUNDAS, Charles H., of Dunira, Dalchonzie, Crieff, Perthshire.
1872. DUNDAS, Sir Robert, Bart. of Arniston, Gorebridge, Midlothian.
1895. DUNDAS, Captain Robert, Yr. of Arniston, Kirkhill, Gorebridge.
1875. EASTWOOD, James, The Gardens, Bryn-y-Neuadd, Bangor, Wales.
1876. EDWARDS, William Peacock, S.S.C., 21 Hill Street, Edinburgh.
1881. ELLIOT, Walter, Manager, Ardtornish, Morvern, Oban, Argyle.
1879. FALCONER, Dr John, St Ann's, Lasswade, Midlothian.
1888. FERGUSON, R. C. Munro, M.P., of Raith and Novar, Raith, Fife.
1869. FISH, David T., 12 Fettes Row, Edinburgh.
1874. FITZWILLIAM, The Right Hon. the Earl, K.G., Wentworth, Rotherham, Yorkshire.
1885. FLEMING, J. B., "Beaconsfield," Kelvinside, Glasgow.
1881. FORBES, Arthur Drummond, Millearne, Auchterarder, Perthshire.
1890. FORBES, William, Forester, Swinton, Masham, Yorkshire.
1869. FORGAN, James, Forester, Bonskeid, Pitlochry, Perthshire.
1897. FOTHERINGHAM, W. Stewart, of Murthly, Perthshire.
1884. FOULIS, Thomas, Publisher, 9 S. Castle Street, Edinburgh.
1866. FRANCE, Charles S., 7 Belmont Place, Aberdeen.
1892. FRASER, George, Factor, Dalzell, Motherwell, Lanarkshire.
1892. FRASER, Simon, Land Agent, Hutton in the Forest, Penrith.
1881. GILCHRIST, Wm., Forester, Leuchars, Elgin.
1897. GOUGH, Reginald, Forester, Wykeham, York.
1884. GRAHAM, Wm., of Erins, Tarbert, Lochfyne, Argyle.
1874. GRANT, John, Overseer, Daldowie, Tollcross, Glasgow.
1880. GRANT, Sir George Macpherson, Bart., Ballindalloch Castle, Banffshire.
1867. GRIMOND, Alexander D., of Glenericht, Blairgowrie, Perthshire.
1882. HAMILTON, Donald C., Forester, Knowsley, Prescot.
1880. HARE, Colonel, 32 Palmerston Place, Edinburgh.
1874. HERBERT, H. A., of Muckross, Killarney, Co. Kerry, Ireland.
1884. HEYWOOD, Arthur, Sudbourne Hall, Wickham Market, Suffolk.
1871. HOPE, H. W., of Luffness, Drem, Haddingtonshire.
1876. HORNE, John, Director, Forests and Gardens, Mauritius.
1876. HORSBURGH, John, 131 Princes Street, Edinburgh.
1869. HUTH, Louis, of Possingworth, Hawkhurst, Sussex.
1884. INGLIS, Alex., Greenlaw Dean, Greenlaw, Berwickshire.
1882. JONAS, Henry, Land Agent and Surveyor, 4 Whitehall, London, S.W.
1890. KENNEDY, James, Doonholm, Ayr.
1892. KERR, John, Farmer, Yorkston, Gorebridge, Midlothian.
1898. KINROSS, John, Architect, Drummond Place, Edinburgh.
1894. LAMINGTON, The Hon. Lord, Lamington, Lanarkshire.
1896. LANSDOWNE, The Most Hon. the Marquess of, K.G., 54 Berkeley Square, London, S.W.
1876. LEICESTER, The Right Hon. the Earl of, Holkham Hall, Wells, Norfolk.
1868. LESLIE, Charles P., of Castle-Leslie, Glaslough, Ireland.
1874. LESLIE, The Hon. George Waldegrave, Leslie House, Leslie, Fife.

Date of Election.

1881. LEYLAND, Christopher, Haggerston Castle, Beal, Northumberland.
1883. LONEY, Peter, Estate Agent, 6 Carlton Street, Edinburgh.
1881. LONSDALE, Claud, Rose Hill, Carlisle.
1898. LOVAT, The Right Hon. Baron, Beaufort Castle, Beauly, Inverness.
1880. *Love, J. W., c/o Mrs Boyce, Byron Street, St Kilda, Victoria, South Australia.*
1875. LOVELACE, The Right Hon. the Earl of, East Horsley Towers, Woking, Surrey.
1881. LUMSDEN, David, of Pitcairnfield, Perth.
1891. LUMSDEN, Hugh Gordon, of Clova, Lumsden, Aberdeenshire.
1875. LUTTRELL, George F., of Dunster Castle, Taunton, Somersetshire.
1874. MACDONALD, Ranald, Factor, Cluny Castle, Aberdeenshire.
1895. MACDOUGALL, Robert Stewart, M.A., D.Sc., 3 Mertoun Place, Edinburgh.
1884. MACDUFF, Alex., of Bonhard, Perth.
1879. M'INTOSH, Dr W. C., Professor of Natural History, University of St Andrews, 2 Abbotsford Crescent, St Andrews.
1872. MACKENZIE, Donald F., Estate Office, Mortonhall, Edinburgh.
1893. MACKENZIE, James, Forester, Rosehaugh, Avoch, Inverness.
1880. MACKENZIE, Sir Kenneth, Bart., Conan House, Dingwall, Ross-shire.
1897. M'KERROW, Robert, Manager, Carton, Maynooth, Co. Kildare.
1898. MACKINNON, A., The Gardens, Scone Palace, Perth.
1895. MACLACHLAN, John, of Maclachlan, 12 Abercromby Place, Edinburgh.
1879. M'LAREN, John, Marionville, Sciennes Gardens, Edinburgh.
1898. M'LAREN, John, Gardener, Ballencrieff, Drem, East Lothian.
1879. MACRITCHIE, David, C.A., 4 Archibald Place, Edinburgh.
1880. MALCOLM, Lieut.-Col. E. D., R.E., Achnamara, Lochgilphead.
1895. MANN, Charles, Merchant, Lumsden, Aberdeenshire.
1896. MANSFIELD, The Right Hon. the Earl of, Scone Palace, Perth.
1895. MARGERISON, Samuel, English Timber Merchant, Calverley, near Leeds.
1876. MARTIN, James, Forester, Knipton, Grantham, Lincolnshire.
1884. MASSIE, W. H., of Dicksons & Co., 1 Waterloo Place, Edinburgh.
1894. MAUGHAN, John, Estate Agent, Jervaulx Abbey, Middleham R.S.O., Yorks.
1893. MAXWELL, Sir John Stirling, Bart. of Pollok, Pollokshaws.
1871. MAXWELL, W. H., of Munches, Dalbeattie, Kirkcudbrightshire.
1879. MEIKLE, R. A., Ri Cruin, Lochgilphead, Argyleshire.
1880. MESHAM, Captain, Pontryffydd, Bodvari, Rhyl, Denbighshire.
1881. MICHIE, John, Forester, Balmoral, Ballater, Aberdeenshire.
1896. MILLER, Sir James Percy, Bart. of Manderston, Duns, Berwickshire.
1892. MILNE, J. K., Kevock Tower, Lasswade, Midlothian.
1882. MITCHELL, Francis, Forester, Harleston, Northamptonshire
1889. MOFFAT, James, 48 Castle Street, Edinburgh.
1898. MURRAY, Hon. Alan David, Scone Palace, Perth.
1896. MURRAY, William Hugh, W.S., 48 Castle Street, Edinburgh.
1893. NISBET, J., D.Œc., 94 Lexham Gardens, Kensington, W.
1894. ORKNEY, William C., Clerk of Works, Thoresby, Ollerton, Notts.
1898. PATON, Robert Johnston, Nurseryman, Kilmarnock.
1878. PITCAITHLEY, Alexander, Forester, Jeanie Bank, Scone.

Date of Election.

1896. PITMAN, Archibald Robert Craufurd, W.S., 48 Castle Street, Edinburgh.
1856. PORTSMOUTH, The Right Hon. the Earl of, Eggesford, North Devon.
1878. PUNCHARD, Frederick, Underley Estate Office, Kirkby Lonsdale, Westmoreland.
1876. RAE, William A., Factor, Murthly Castle, Perthshire.
1855. RAMSDEN, Sir John, Bart., Byrom Hall, Ferrybridge, Normanton.
1873. RICHARDSON, Adam D., Head Gardener, Royal Botanic Garden, Edinburgh.
1876. RITCHIE, William, of Middleton, Gorebridge, Midlothian.
1879. ROBERTSON, Donald, Forester, Dunrobin, Golspie.
1866. ROBERTSON, Jas., Wood Manager, Panmure, Carnoustie, Forfarshire.
1890. ROBINSON, William, 37 Southampton Street, Strand, London.
1883. ROLLO, The Hon. Wm. Chas. Wordsworth, Master of Rollo, Duncrub Park, Dunning, Perthshire.
1872. ROSEBERY, The Right Hon. the Earl of, Dalmeny Park, Edinburgh.
1894. SANDERSON, Wm., Talbot House, Ferry Road, Leith.
1867. SCOTT, Daniel, Wood Manager, Darnaway, Forres.
1896. SHAW-STEWART, Michael Hugh, M.P., of Carnock, 7 Charles Street, Berkeley Square, London, S.W.
1877. SMITH, Thomas Valentine, of Ardtornish, Morvern, Argyleshire.
1882. SMYTHE, David M., of Methven Castle, Perth.
1893. SMYTHE, Francis Henry, Strathearn, Nottingham Road, Natal.
1889. SOMERVILLE, Dr William, M.A., D.Sc., D.Œc., F.R.S.E., Professor of Agriculture and Forestry, Durham College of Science, Newcastle.
1883. SPROT, Major Alexander, of Garnkirk, Chryston, Glasgow.
1873. STAIR, The Right Hon. the Earl of, Lochinch, Castle Kennedy, Wigtownshire.
1892. STEWART, Sir Mark J. M'Taggart, Bart., M.P., of Southwick, Kirkcudbrightshire.
1880. SUTHERLAND, Evan C., of Skibo, Dornoch, Sutherland.
1883. SUTHERLAND, His Grace the Duke of, Dunrobin Castle, Golspie.
1865. TALBERT, Peter, Forester, David Street, Blairgowrie, Perthshire.
1887. TAYLOR, Andrew, 11 Lutton Place, Edinburgh.
1877. TERRIS, James, Factor, Dullomuir, Blairadam, Kinross-shire.
1880. THOMSON, Alexander, Trinity Grove, Trinity Road, Edinburgh.
1855. THOMSON, John Grant, Wood Manager, Grantown, Strathspey.
1872. TROTTER, Colonel, R.A., The Bush, Roslin, Midlothian.
1883. TROTTER, Colonel H., of Mortonhall, Edinburgh.
1872. URQUHART, B. C., of Meldrum, Aberdeenshire.
1878. WALKER, Colonel I. Campbell, Late Conservator of Forests, Forest Office, Madras.
1897. WALLACE, John A. A., of Lochryan, Cairnryan, Stranraer.
1891. WELSH, James, of Dicksons & Co., 1 Waterloo Place, Edinburgh.
1866. WELSH, Wm. M., of Dicksons & Co., 1 Waterloo Place, Edinburgh.
1871. WEMYSS, Randolph Gordon Erskine, of Wemyss and Torrie, Fife.
1898. WHITE, J. Martin, Balruddery, near Dundee.
1869. WILD, Albert Edward, Conservator of Forests, Darjeeling, India, c/o Henry S. King & Co., 65 Cornhill, London, E.C.
1889. WILSON, David, jun., of Carbeth, Killearn, Glasgow.

ORDINARY MEMBERS.

The Names printed in italics (in this and preceding list) are those of Members whose present Addresses are unknown. Any information regarding those Members will be gladly received by the Secretary.

Law V. Members in arrear shall not receive the *Transactions* while their Subscriptions remain unpaid. Any Member whose Annual Subscription to the Society remains unpaid for three years shall cease to be a Member of the Society, and no such Member shall be eligible for re-election till he shall have paid up his arrears.

Date of Election.

1895. Abbot, Thomas, Forester, Firknowe, Peebles.
1892. Adamson, C., Merchant, Leven, Fife.
1881. Airlie, The Right Hon. the Earl of, Cortachy Castle, Forfarshire.
1878. Aitken, Andrew Peebles, M.A., Sc.D., Professor of Chemistry, Veterinary College, Clyde Street, Edinburgh.
1891. Alexander, Jas., The Gardens, Revesby Abbey, Boston, Lincolnshire.
1865. Allan, John, Forester, Dalmeny Park, Edinburgh.
1898. Allaway, William, 13 St Andrew Square, Edinburgh.
1895. Anderson, Duncan, Forester, Headfort House, Kells, Co. Meath, Ireland.
1897. Anderson, John, Merchant, Forthbank, East Wemyss, Fife.
1887. Annand, John F., Overseer, Kildrummy Castle, Mossat, Aberdeenshire.
1898. Archibald, John, Assistant Forester, Moss-side, Lynedoch, Perth.
1883. Argyll, His Grace the Duke of, K.T., LL.D., D.C.L., F.R.S., F.G.S., Inveraray Castle, Argyleshire.
1897. Armit, James, The Gardens, Antrim Castle, Antrim.
1898. Armstrong, Thos. J., Factor, Glenborrodale, Salen, Ardgour.
1860. Austin & M'Aslan, Nurserymen, 89 Mitchell Street, Glasgow.

1898. Bain, Charles, Assistant Forester, Moss-side, Lynedoch, Perth.
1880. Balden, John, Dilston, Corbridge-on-Tyne, Northumberland.
1892. Ballingall, Neil, Sweet Bank, Markinch, Fife.
1898. Bannan, Andrew, Forester, Glenfarg Estate, Abernethy.
1897. Barclay, Robert Leatham, Banker, 54 Lombard Street, London, E.C.
1867. Barrie, David, Forester, Comlongan Castle, Annan, Dumfries.
1895. Barrie, James Alexander, Assistant Forester, Lilleshall, Newport, Salop.
1889. Barron, John, Elvaston Nurseries, Borrowash, Derby.
1874. Barton, James, Forester, Hatfield House, Herts.
1892. Barty, Rev. Dr, The Manse, Kirkcolm, Stranraer.
1871. Baxter, Robert, Forester, Dalkeith Park, Dalkeith.
1898. Bedford, Surgeon Major Wm. Jas. Guthrie, Kierfiold House, Stromness.
1894. Beech, George, The Grange Gardens, Bishops Stortford, Herts.
1897. Begg, James, The Gardens, Lanrick Castle, Doune, Perthshire.
1883. Bell, Andrew, Forester, Forglen, Turiff, Aberdeenshire.
1898. Bell, David, Seed Merchant, Leith.

Date of Election.

1895. Bennet, J. B., C.E., A.M.I., 24 George Street, Edinburgh.
1889. Berry, Francis, Forester, Aden, Mintlaw, Aberdeenshire.
1896. Bethune, William, Grocer, Lundin Mill, Fife.
1896. Blair, David, Factor, Ballikinrain, Balfron, Stirlingshire.
1883. Blake, Jas., Forester, Mortonhall, Liberton, Midlothian.
1854. Boa, Andrew, Great Thurlow, Suffolk.
1872. Boa, Andrew, jun., Estate-Agent, Great Thurlow, Suffolk.
1892. Bond, Thomas, Forester, Lambton Park, Fence Houses, Durham.
1876. Booth, John, 39 Mozartstrasse Gross-Lichterfelde, Berlin.
1898. Borthwick, Francis J. G., W.S., 9 Hill Street, Edinburgh.
1887. Boulger, Professor, 34 Argyll Mansions, West Kensington, London, W.
1896. Bowles, William, The Gardens, Adare Manor, Adare, Co. Limerick.
1883. Boyd, John, Forester, Pollok Estate, Pollokshaws, Glasgow.
1897. Braid, John Barnes, Assistant Forester, Beeley Rowsley, Derbyshire.
1889. Britton, Horatio A., Timber Merchant, Shrewsbury.
1897. Brough, D., Manse Road, Corstorphine.
1860. Brodie, James, Land Steward, Glaslough, Armagh, Ireland.
1896. Brown, David, Manager, Chevet Park Estate, Wakefield, Yorks.
1878. Brown, J. A. Harvie-, of Quarter, Dunipace House, Larbert.
1893. Brown, Robert, Forester, Boiden, Luss.
1895. Brown, Walter R., Assistant Forester, Harewood, Leeds.
1883. Browning, John M., The Gardens, Dupplin Castle, Perth.
1893. Brownlie, Alexander, Wood Merchant, Earlston, Berwickshire.
1895. Bruce, Peter, Assistant Forester, Dirnsnean, Pitlochry.
1897. Brydon, John, Seed Merchant and Nurseryman, Darlington, Co. Durham.
1873. Buchan, Alexander, A.M., F.R.S.E., LL.D., Secretary of the Scottish Meteorological Society, 42 Heriot Row, Edinburgh.
1896. *Buist, David, Assistant Forester, Royal Botanic Garden, Edinburgh.*
1895. Buist, Robert, Overseer, Newbyth, Prestonkirk, East Lothian.
1896. Burrells, George Henry, Assistant Forester, Royal Botanic Garden, Edinburgh.

1887. Cadell, George, National Club, 1 Whitehall Gardens, London, S.W.
1896. Cairns, Richard, The Gardens, Balruddery, near Dundee.
1896. Callander, Henry, of Prestonhall, Dalkeith.
1890. Campbell, Alexander, of Auchindarroch, Lochgilphead, Argyle
1895. Campbell, Alexander, Forester, Ayton, Abernethy, Perthshire.
1865. Campbell, James, of Tillichewan Castle, Dumbartonshire.
1896. Campbell, James Alex., M.P., of Stracathro, Brechin.
1894. Campbell, John, Timber Merchant, Inverness.
1898. Carr, Alexander, Assistant Forester, Moss-side, Lynedoch, Perth.
1898. Carson, David Simpson, C.A., 209 West George Street, Glasgow.
1897. Chalmers, James, Overseer, Gask, Auchterarder, Perthshire.
1898. Chalmers, James, Assistant Forester, Tayinloan, Kintyre.
1898. Chalmers, Thomas, Nursery Manager, Raith, Kirkcaldy.
1895. Chaplin, William, Assistant Forester, Royal Botanic Garden, Edinburgh.

Date of Election.

1892. Chapman, Andrew, Breckonhill, Lockerbie, Dumfriesshire.
1892. Chapman, Mungo, Torbrix Nurseries, St Ninians, Stirling.
1897. Chisholm, Colin, Assistant Forester, Glamis Castle, Forfarshire.
1884. Christie, Alex. D., The Gardens, Ragley, Alcester, Warwickshire.
1887. Clark, Alexander, Belleville, Linlithgow.
1890. Clark, Charles, Forester, Cawdor Castle, Nairn.
1896. Clark, George Fraser, C.A. Apprentice, 24 St Andrew Square, Edinburgh.
1891. Clark, John, Forester, Haddo House, Aberdeen
1892. Clark, John, jun., Forester, Murthly, Perthshire.
1892. Clark, William, 66 Queen Street, Edinburgh.
1896. Cockburn, Alex. K., Assistant Forester, 40 High Street, Peebles.
1893. Collins, Frederick, Assistant Forester, West Mill, Ware, Herts.
1882. Collins, Robt. T., Forester, Trentham, Stoke-on-Trent, Staffordshire.
1895. Connor, George A., Factor, Craigielaw, Longniddry.
1896. Constable, Geo. William, Estate Agent, Traquair, Innerleithen.
1896. Conway, Thomas, Assistant Forester, Castle Kennedy, Stranraer.
1887. Cook, James, Land Steward, Arniston, Gorebridge, Midlothian.
1894. Cook, James, jun., Estate Office, Craigielaw, Longniddry.
1895. Cowan, Bernard, Superintendent, Harton Cemetery, South Shields.
1858. Cowan, James, Forester, Bridgend, Islay, Argyleshire.
1875. Crabbe, David, Forester, Byreburnfoot, Canonbie, Dumfriesshire.
1867. Crabbe, James, Forester, Glamis Castle, Forfarshire.
1893. Craig, John, Banker, Dalkeith, Midlothian.
1898. Crichton, William, Manager, Castle Ward, Downpatrick.
1898. Crombie, Alexander T., Assistant Forester, Lintmill, Cullen, Banffshire.
1898. Crombie, James, Assistant Forester, Raith, Kirkcaldy.
1895. Crozier, John D., Forester, Durris, Aberdeen.
1887. Cumming, Allan, Blairnachdar, Blair Athole.
1896. Cunningham, Andrew, Seedsman, 98 Mitchell Street, Glasgow.
1898. Cunningham, George, Advocate, 19 Northumberland Street, Edinburgh.
1894. Cunningham, W. M., Nurseryman, Elgin.
1897. Curr, William Henry, Factor, Pitkellony, Muthill, Perthshire.
1893. Curr, W. S., Factor, Ninewar, Prestonkirk.
1895. *Cuthbert, James, Assistant Forester, Clova, Lumsden, Aberdeenshire.*

1891. Daglish, John, Rothley Lake, Cambo R.S.O., Northumberland.
1897. Dailly, James, Assistant Forester, Kirklea by Mossend, Lanarkshire.
1884. Dalziel, James, Forester, Culzean Castle, Maybole, Ayrshire.
1869. Daniels, Peter, Forester, Slindon Hall, Arundel, Sussex.
1894. Darling, David C., Nurseryman, Aberdeen.
1865. Davidson, John, Agent, Greenwich Hospital Estates, Haydon Bridge-on-Tyne.
1892. Davidson, John, Forester, Dalzell, Motherwell, Lanarkshire.
1892. Davidson, William, Margam Park, Port Talbot, Wales.
1884. Deane-Drake, Joseph Edward, Stokestown House, New Ross, Ireland.
1895. Dick, Joseph, Forester, Wentworth, Rotherham, Yorkshire.
1897. Digby, Reginald, Land Agent, Geashill Castle, King's County.

Date of Election.

1895. DINGWALL, Alexander, Glendoig Villa, Perth.
1897. DON, Alex., jun., Bank House, Fettercairn, Kincardineshire.
1891. DONALD, Alex. S., Forester, 15 Haldane Street, Whiteinch, Glasgow.
1893. DONALDSON, James, Timber Merchant, Tayport, Fife.
1897. DORMAN, Arthur John, of Grey Towers, Newby, Yorks.
1897. DOUGLAS, James, The Gardens, Charleville, Enniskerry, Co. Wicklow.
1882. DOUGLAS, Captain Palmer, of Cavers, Hawick.
1887. DOUGLAS, Robert, 64 Princes Street, Edinburgh.
1892. DOW, R., Forester, Douglas Castle, Douglas, Lanarkshire.
1867. DOW, Thomas, Forester, Bretby, Burton-on-Trent, Derbyshire.
1898. DOW, Thomas, Assistant Forester, Lintmill, Cullen, Banffshire.
1898. DOWNIE, John, Beech-hill Nurseries, Murrayfield, Midlothian.
1896. DRUMMOND, George T., Forest Tree Seedsman, Stanley, Perthshire.
1862. DRUMMOND & SONS, William, Nurserymen, Stirling.
1896. DUNCAN, David, Forester, Guynd, Arbroath, Forfarshire.
1873. DURWARD, Robert, Manager, Blelack, Dinnet, Aberdeenshire.
1894. *Duthie W. G., Forester, Bargany, Girvan, Ayrshire.*

1885. EDDINGTON, Francis, Overseer, Monk Coniston Park, Lancashire.
1898. EDMINSON, Wm. D., Tweed View, Berwick-on-Tweed.
1893. ELDER, William, Forester, Cholmondeley Park, Malpas, Cheshire.
1898. ELDER, Wm., Engineer, Berwick-on-Tweed.
1898. ERSKINE, Henry, Seedsman, 80a George Street, Edinburgh.
1887. ERSKINE, William, of Oaklands, Trinity, Edinburgh.
1898. EWAN, Peter, Assistant Forester, Moss-side, Lynedoch, Perth.
1896. EWART, James Cossar, Professor of Natural History, University of Edinburgh.
1873. EWING, David, Forester, Strichen House, Aberdeen.

1894. FARQUHARSON, James, Forester, Ardgowan, Inverkip.
1898. FARQUHARSON, Dr Robert, of Finzean, M.P., Aboyne, Aberdeenshire.
1895. FERGUSON, John, Assistant Forester, 7 Haddow Street, Hamilton.
1880. FERGUSSON, Sir James Ranken, Bart., Spitalhaugh, West Linton.
1893. FINLAYSON, Alexander, 60 Inverleith Row, Edinburgh.
1893. FINLAYSON, Malcolm, Solicitor, Crieff, Perthshire.
1891. FIRTH, W. M., Timber Merchant, Rose Villa, Viewforth, Edinburgh.
1869. FISHER, William, Estate Agent, Wentworth Castle, Barnsley, Yorkshire.
1897. FLETT, John Smith, M.A., M.B., B.Sc., Lecturer on Petrology, University of Edinburgh.
1890. FORBES, Arthur C., Wood Manager, Bowood, Calne, Wiltshire.
1896. FORBES, James, The Gardens, Overtown, Dumbartonshire.
1878. FORBES, Robert, Overseer, Kennet, Alloa.
1891. FOREMAN, Frederick, Nurseryman, Eskbank, Dalkeith.
1892. FORGAN, James, Sunnybraes, Largo, Fife.
1892. FORGAN, William, Assistant Forester, Royal Botanic Garden, Edinburgh.
1889. FORSTER, William A., Forester, Belgrave Lodge, Pulford, Wrexham.
1898. FOSTER, James, jun., Kennet Village, Alloa.
1898. FRASER, James, Assistant Forester, Innes House, Elgin.

Date of Election.

1895. Fraser, J. C., Nurseryman, Comely Bank, Edinburgh.
1857. Fraser, P. Neill, of Rockville, Murrayfield, Edinburgh.
1896. Frater, John, Assistant Forester, Ardross Mains, Alness, Ross-shire.
1895. Fyffe, Robert B., Land Steward, The Cottage, Old Deer, Mintlaw Station.

1878. Galletly, James, Overseer, Bonhard, Perth.
1874. Galloway, George, Estate Offices, Woodhouses, Whitchurch, Salop.
1893. Galloway, Robert, *Secretary*, 48 Castle Street, Edinburgh.
1896. Gammell, Sydney James, Yr. of Drumtochty, Westhill House, Skene, by Aberdeen.
1898. Gauld, William, Assistant Forester, Raith, Kirkcaldy.
1897. Gellatly, Thomas, Forester, Meggernie Castle, Gallin, Glenlyon.
1897. Gemmill, Wm., Farmer, Greendykes, Macmerry, East Lothian.
1895. George, Alfred W., Land Agent, Sedbury Park, Tidenham, Chepstow.
1870. Gilbert, James, Forester, Gallovie, Kingussie.
1887. Gilbert, W. Matthews, The *Scotsman* Office, Edinburgh.
1898. Gilchrist, Archibald, Ivanhoe Cottage, Bonnyrigg, Midlothian.
1897. Gillanders, A. T., Forester, Alnwick Castle, Northumberland.
1894. Gillespie, James, Forester, Lochton Lodge, Inchture, Perthshire.
1894. Gilmour, Major Robert Gordon, of Craigmillar, The Inch, Midlothian.
1880. Glen, David A., Forester, Croxteth Park, Liverpool.
1893. Goldie, George, Eskdale Lodge, Dalkeith, Midlothian.
1893. Gordon, John G., 48 Castle Street, Edinburgh.
1891. Gorrie, G. H., Estate Office, Dalkeith, Midlothian.
1868. Gossip, James, of Howden & Co., The Nurseries, Inverness.
1897. Gow, Peter, Land Steward, Johnston Castle, Wexford.
1897. Gow, Peter Douglas, Farmer, Bonaly, Colinton, Midlothian.
1887. Grant, Alexander, Assistant Forester, Parkhead, Hopetoun, South Queensferry.
1867. Grant, Donald, Forester, Drumin, Ballindalloch, Banffshire.
1873. Grant, James, Forester, Heath, Chesterfield, Derbyshire.
1893. Grant, John B., Forester, Downan House, Glenlivet.
1893. Grant, Peter, Assistant Forester, Ovenstone, Forfar.
1892. Grant, Peter, Forester, Hornby Castle, Hornby, Lancaster.
1896. Gray, Henry, 22 Young Street, Edinburgh.
1883. Green, Arthur A., 20 Annandale Street, Edinburgh.
1898. Grey, Sir Edward, Bart., M. P., of Falloden, Chathill, Northumberland.
1898. Grove, Richard, Silverbank Sawmills, Banchory, Aberdeenshire.

1879. Haddington, The Right Hon. the Earl of, Tyninghame, Prestonkirk.
1880. Haddon, Walter, Solicitor, Royal Bank, Hawick.
1897. Halliday, Geo., Timber Merchant, Rothesay, Bute.
1897. Hamilton-Ogilvy, H. T. M., of Beil, Prestonkirk, East Lothian.
1889. Hankins, Charles, Forester, Wordwell, Culford, Bury St Edmunds.
1892. Hannah, George, Forester, The Glen, Innerleithen, Peeblesshire.
1897. Hanton, Thomas, Solicitor, Dalkeith, Midlothian.
1890. Hardie, James F., Overseer, Haystoun Estate, Peebles.
1896. Harley, Andrew M., Assistant Forester, Langford Lodge, Crumlin, Co. Antrim.

Date of Election.

1897. HARRIS, James, Manager, Luffness Mains, Drem, East Lothian.
1895. HARROWER, David K., Timber Merchant, Knowe Park, Bo'ness.
1897. HARROWER, William, Forester, Garth, Aberfeldy, Perthshire.
1897. HART, John, Factor, Mains of Cowie, Stonehaven, Kincardineshire.
1894. HARVEY, James, The Gardens, Mortonhall, Liberton.
1893. HATCHER, Bertram H., Forester, Panshanger Park, Hertford.
1880. HAVELOCK, W. B., The Nurseries, Brocklesby, Ulceby, Lincolnshire.
1897. HAY, Alexander, of Benjamin Reid & Co., Nurserymen, Aberdeen.
1892. HAY, John, Overseer, Dollars Estate Office, 4 Craigie Road, Kilmarnock.
1896. HAY, Wm. P., Merchant, Rosebank, Loanhead, Midlothian.
1889. HAYES, John, Overseer, Dormont, Lockerbie, Dumfriesshire.
1869. HAYMAN, John, Glentarff, Ringford, Kirkcudbrightshire.
1897. HEGGIE, James George, Overseer, Clova, Lumsden, Aberdeenshire.
1866. HENDERSON, Arch., Forester, Clonad Cottage, Tullamore, King's County.
1871. HENDERSON, John, Overseer, Vogrie, Gorebridge.
1893. HENDERSON, R., 4 High Street, Penicuik, Midlothian.
1883. HENDERSON, W., The Gardens, Balbirnie, Markinch, Fife.
1893. HENDERSON, William, Forester, Gosford Demesne, Markethill, Co. Armagh, Ireland.
1898. HENDRY, James, 5 Thistle Street, Edinburgh.
1896. HENKEL, C. C., F.I.I., J.P., Conservator of Forests, Umtata, Cape Colony.
1895. HILL, Claude, of Messrs John Hill & Sons, Spot Acre Nurseries, Stone, Staffordshire.
1895. HOARE, Sir Henry Hugh Arthur, Bart. of Stourhead, Bath.
1866. HOGARTH, James, Forester, Culhorn, Stranraer, Wigtownshire.
1897. HOGG, Thos., The Gardens, Woodside, Paisley.
1896. HOGG, Thomas, jun., Assistant Forester, Witley Court, Stourport, Worcestershire.
1897. HOLM, Alexander, Coney Park Nurseries, Stirling.
1874. HOME, Edward, Assistant Forester, Whiterig, Ayton, Berwickshire.
1892. HONEYMAN, Thomas, Factor, Clunes, Achnacarry, Spean Bridge.
1880. HOPETOUN, The Right Hon. the Earl of, Hopetoun House, South Queensferry.
1898. HUGGAN, John A., Seed Merchant, 35 Market Street, Aberdeen.
1876. HULL, Frank, Forester, Lilleshall, Newport, Salop.

1897. INCH, Charles F., Assistant Forester, Altyre, Forres.
1895. INGLIS, A. M., Nurseryman, Forres.
1897. INGLIS, George Erskine, Estate Agent, Campbeltown, Argyleshire.
1893. INGLIS, John F., Forester, Amisfield Estate, Goatfield Cottage, Haddington.
1891. INGLIS, William, Forester, Brodick, Isle of Arran.
1895. INNES, Alexander, Forester, Innes House, Elgin.
1896. INNES, Alexander, Forester, Stourhead, Bath.

1893. JACK, George, S.S.C., Dalkeith, Midlothian.
1895. JAMIESON, Andrew, Overseer, Carnbroe, Bellshill.
1898. JAMIESON, James, Forester, Crosswood Estate, Aberystwyth.

Date of Election.

1896. Jardine, R. W. B., Yr. of Castlemilk, Lockerbie, Dumfriesshire.
1895. Johnston, Alexander, Forester, Mount Teviot, Jedburgh.
1896. Johnston, Alexander, Forester, Royal Botanic Garden, Edinburgh.
1883. Johnston, Robert, Forester, Somerley, Ringwood, Hants.
1878. Johnstone, Adam, Forester, Coollattin, Shillelagh, County Wicklow.
1888. Jones, James, Wood Merchant, Larbert, Stirlingshire.
1893. Jones, Thomas Bruce, Wood Merchant, Larbert.

1867. Kay, James, Wood Manager, Bute Estate, Rothesay, Bute.
1870. Keir, David, Forester, Ladywell, Dunkeld, Perthshire.
1896. Keir, David, jun., Assistant Forester, Ladywell, Dunkeld.
1876. Kelman, John, Forester, Esslemont, Ellon, Aberdeenshire.
1897. Kemp, David, 22 Young Street, Edinburgh.
1896. Kennedy, Peter, Forester, Countlich, Ballinluig, Perthshire.
1887. Ker, R. D., W.S., 50 George Street, Edinburgh.
1896. Kettles, Robert, Assistant Forester, Craigend, Perth.
1894. Kidd, Wm., Forester, Harewood, Leeds.
1879. Kincairney, The Hon. Lord, 6 Heriot Row, Edinburgh.
1895. Kirkwood, William, The Gardens, Byethorn, Corbridge-on-Tyne.
1898. Kyllachy, The Right Hon. Lord, of Kyllachy, 6 Randolph Crescent, Edinburgh.
1876. Kyrke, R. V., of Penywern, Mold, Flintshire.

1890. Laird, David P., Nurseryman, Pinkhill, Murrayfield, Edinburgh.
1895. Laird, John, Assistant Forester, Royal Botanic Garden, Edinburgh.
1896. Laird, Robert, Nurseryman, 17a South Frederick Street, Edinburgh.
1895. Laird, William, Forester and Ground Officer, Fyvie Castle, Aberdeenshire.
1896. Laird, William J., Assistant Forester, Royal Botanic Garden, Edinburgh.
1873. Lauriston, Alexander, Rufford Nursery, Ollerton, Newark, Notts.
1897. Lauriston, John, Assistant Forester, Clumber Park, Worksop, Notts.
1874. Leigh, William, of Woodchester Park, Stonehouse, Gloucestershire.
1880. Leishman, John, Manager, Cavers Estate, Hawick, Roxburghshire.
1895. Leithead, William, Forester, St Clair Cottage, Memsie, Fraserburgh.
1893. Leven, George, Forester, Auchencruive, Ayr.
1897. Lewis, Thomas, jun., Artbog, Dolgelly, Merionethshire.
1898. Leys, Wm. B., Assistant Forester, Innes House, Elgin.
1898. Lightfoot, Francis P., Land Agent, Dunchurch, Rugby.
1879. Lindsay, Robert, Kaimes Lodge, Murrayfield, Midlothian.
1897. Little, John, Land Agent, Hackness Hall, Scarborough, Yorks.
1897. Lock, Hampton C., Assistant Forester, Lynedoch, Colenden, Stormontfield, Perth.
1898. Low, James, Temple, Gorebridge, Midlothian.
1898. Low, James, Assistant Forester, Durris, Aberdeen.
1897. Low, John, Timber Merchant, Kirkcaldy, Fife.
1898. Low, John, Seedsman, St Giles Street, Edinburgh.
1894. Lumsden, Fredk. R., Newburn, Largo, Fife.
1898. Lynch, Francis, Gascoed Hall, Wrexham.

Date of Election.

1892. Macbean, Simon, Forester, Bunchrew, Inverness.
1896. M'Beath, David, Assistant Forester, Crossroad Cottages, Elveden, Thetford, Norfolk.
1894. M'Callum, Edward, Forester, Falkland Palace, Fife.
1898. M'Callum, James, Forester, Doneraile, Co. Cork.
1870. M'Corquodale, D. A., Bank of Scotland, Carnoustie, Forfarshire.
1893. M'Coubrie, M. S., Land Steward, Tullamore, King's County, Ireland.
1894. M'Culloch, Christopher, Assistant Forester, Ardgowan, Inverkip.
1887. M'Culloch, James, Forester, Gala House, Galashiels, Selkirkshire.
1893. Macdonald, George, Forester, Raith, Kirkcaldy.
1894. M'Donald, James, Forester, Kinnaird Castle, Brechin.
1897. M'Donald, James, Forester, Craigbarnet, Campsie Glen, Stirlingshire.
1895. Macdonald, John, Assistant Forester, Dunrobin, Golspie.
1897. M'Donald, William, Assistant Forester, c/o Mrs Hurford, Mills Green, Frome.
1896. *M'Dougall, Adam, Forester, Sudborne Hall, Wickham Market, Suffolk.*
1894. M'Dougall, Alex., Forester, Tuncombe Park, Helmsley R.S.O., Yorks.
1882. M'Farlane, John, Forester, Tarbet, Loch Lomond, Dumbartonshire.
1896. M'Farlane, Peter, Assistant Forester, Castle Kennedy, Stranraer.
1890. M'Gregor, Alex., The Schoolhouse, Penicuik, Midlothian.
1896. M'Gregor, Angus, Forester, Craigton, Butterstone, Dunkeld.
1878. M'Gregor, Duncan, Forester, Camperdown, Dundee.
1896. Macgregor, John C., Assistant Forester, Spoutwells, Dunkeld.
1893. M'Hattie, J. W., The Gardens, Strathfieldsaye, Winchfield, Hants.
1895. Machray, Frank, Ground Officer, Culloden, Inverness.
1894. M'Ilwraith, Wm., Assistant Forester, Royal Botanic Garden, Edinburgh.
1885. MacIntosh, William, Drummuir Estate Office, Keith.
1895. Macintosh, W. L., The Gardens, Ballikinrain, Balfron.
1898. M'Intyre, Malcolm, The Gardens, The Glen, Innerleithen, Peeblesshire.
1898. Mackay, Æneas J. G., LL.D., Advocate, 2 Albyn Place, Edinburgh.
1892. M'Kay, Allan, 21 John Street, Forfar.
1875. Mackay, John, Lauderdale Estate Office, Wyndhead, Lauder.
1887. Mackay, Peter, Forester, Taymouth Castle, Aberfeldy.
1891. Mackendrick, James, Forester, Pallas, Loughrea, Co. Galway.
1897. M'Kenna, Robert, The Gardens, Charleville Forest, Tullamore, King's County.
1867. Mackenzie, Alex., Warriston Nursery, Inverleith Row, Edinburgh.
1897. Mackenzie, John, Forester, Stenton, Prestonkirk, East Lothian.
1867. Mackenzie, John Ord, of Dolphinton, W.S., 9 Hill Street, Edinburgh.
1892. Mackenzie, W. A., Factor, Faskally, Pitlochry.
1896. Mackenzie, Wm., Forester, Novar, Evanton, Ross-shire.
1883. M'Kinnon, George, The Gardens, Melville Castle, Lasswade.
1892. M'Kinnon, William, Nurseryman, 144 Princes Street, Edinburgh.
1878. Mackintosh, The, of Mackintosh, Moy Hall, Inverness.
1879. M'Laren, Charles, Land Steward, Cally Lodge, Dunkeld.
1878. M'Laren, John T., Factor, Polmaise, Stirling.
1897. M'Laren, Patrick M., Assistant Forester, Altyre, Forres.

Date of Election.

1893. M'Laren, William, Forester, Altyre, Forres, Morayshire.
1897. M'Leish, John, Assistant Forester, Murthly, Perthshire.
1898. M'Lennan, John, The Gardens, Castle Boro, Enniscorthy, Co. Wexford.
1874. M'Leod, Angus A., Superintendent of City Gardens, 14 Royal Exchange, Edinburgh.
1897. M'Leod, Geo., Overseer, Harviestoun, Dollar, Clackmannanshire.
1883. M'Leod, John, of Dickson & Turnbull, 26 George Street, Perth.
1898. M'Manus, Edmund, Timber Merchant, Randalstown, Co. Antrim.
1897. Macmillan, Duncan, Forester, Keir, Dunblane, Perthshire.
1895. Macmillan, John D., Forester, 3 Milton Road, Stowmarket.
1896. M'Naughton, Wm., Forester, Inver, Dunkeld.
1894. Macpherson, Alex., Assistant Forester, Knipton, Grantham.
1896. M'Pherson, Arch., Assistant Forester, Royal Botanic Garden, Edinburgh.
1896. M'Queen, John, Proprietor of the *Scottish Border Record*, Galashiels.
1890. M'Rae, Alexander, Forester, Castlecomer, Ireland.
1892. M'Rae, Alexander, c/o Bennetts, Limited, Ardwick Station, Hyde Road, Manchester.
1895. M'Tavish, John, Assistant Forester, The Poles, Dornoch.
1884. Main, Adam, Forester, Loftus R.S.O., Yorkshire.
1894. Malloch, William, 50 South Street, Perth.
1896. Mar and Kellie, The Right Hon. the Earl of, Alloa House, Alloa.
1897. Marshall, Alexander, 150 Leadenhall Street, London, E.C.
1898. Marshall, John, Wood Merchant, Killiecrankie, Perthshire.
1893. Marshall, J. Z., Timber Merchant, Bo'ness, Linlithgowshire.
1895. Martin, David, Overseer, Fettes College, Edinburgh.
1893. Mather, R. V., of Laing & Mather, Nurserymen, Kelso.
1896. Maxtone, John, Forester, Abercairney, Crieff, Perthshire.
1886. Maxwell, The Right Hon. Sir Herbert E., Bart. of Monreith, M.P., Port William, Wigtownshire.
1891. Maxwell, James, Forester and Overseer, Ruglen, Maybole.
1895. Maxwell, James, Factor, Screel, Castle-Douglas.
1896. Meiklejohn, John J. R., Factor, Novar, Evanton, Ross-shire.
1889. Melville, The Right Hon. Viscount, Melville Castle, Lasswade.
1877. Methven, Henry, of Thomas Methven & Sons, 15 Princes Street, Edinburgh.
1869. Methven, John, of Thomas Methven & Sons, Leith Walk Nurseries, Edinburgh.
1892. Methven, John, The Gardens, Blythswood, Renfrewshire.
1895. Michie, James, Assistant Forester, Knowsley, Prescot, Lancashire.
1893. Michie, William, Forester, Welbeck, Worksop, Notts.
1893. Middlemass, Archibald, Forester, Tulliallan, Kincardine-on-Forth.
1882. Milne, Alexander, of James Dickson & Sons, 32 Hanover Street, Edinburgh.
1895. Milne, James, The Gardens, Whitslade, Broughton, Peeblesshire.
1898. Milne, Robert P., Spittal Mains, Berwick-on-Tweed.
1891. Milne, R. W., Forester, 26 Etterby Street, Stanwix, Carlisle.
1890. Milne, William, Farmer, Foulden, Berwick-on-Tweed.

Date of Election.

1897. MILNE-HOME, J. Hepburn, Caldra, Duns, Berwickshire.
1894. MILSOM, Isaac, Gardener and Steward, Claydon Park, Winslow, Bucks.
1895. MITCHELL, Alexander, Assistant Forester, Rosebery, Gorebridge.
1893. MITCHELL, Archibald, Forester, Dunraven Castle, Bridgend, Glamorganshire.
1898. MITCHELL, David, Forester, Drumtochty, Fordoun.
1869. MITCHELL, James, Factor, Neuk House, Aldie, Fossoway.
1898. MITCHELL, James, Assistant Sawmiller, Philiphaugh, Selkirk.
1897. MITCHELL, Wm., Assistant Forester, Altyre, Forres.
1894. MOFFAT, Edward, Forester, Madeley Estate, Staffordshire.
1895. MONCREIFFE, Sir Robert D., Bart. of Moncreiffe, Perth.
1896. *Moncur, John, Forester, Kilvrough Park Mill R.S.O., Glamorganshire.*
1897. MOON, Frederick, Assistant Forester, 48 Pollok Street, Pollokshaws.
1897. MORGAN, Alex., Timber Merchant, Crieff, Perthshire.
1898. MORGAN, Hugh, Timber Merchant, Crieff, Perthshire.
1895. MORGAN, Malcolm, Timber Merchant, Crieff, Perthshire.
1895. MORRISON, Hew, Librarian, Edinburgh Public Library.
1894. MORTON, David, Assistant Forester, Royal Botanic Garden, Edinburgh.
1894. Moss, Edward, Assistant Forester, 41 Surrey Road, Darnall, near Sheffield.
1896. MOSSMAN, Robert C., F.R.S.E., F.R.Met.Soc., 10 Blacket Place, Edinburgh.
1890. MUIRHEAD, George, F.R.S.E., Factor, Speybank, Fochabers.
1894. MUNRO, Alexander, Overseer, Ballinacourte, Co. Tipperary, Ireland.
1895. MUNRO, Donald, Assistant Forester, Holkham Hall, Norfolk.
1876. MUNRO, Hugh, Forester, Holkham Hall, Norfolk.
1897. MUNRO, Hugh, Teacher, Penicuik, Midlothian.
1892. MURDOCH, John, Ironmonger, Dalkeith, Midlothian.
1897. MURDOCH, Robert, Merchant, Dalkeith, Midlothian.
1892. MURRAY, Alexander, Forester, Powerscourt, Enniskerry, Co. Wicklow.
1896. MURRAY, Hon. A. W. C. O., Master of Elibank, Juniper Bank, Walkerburn.
1892. MURRAY, John, Forester, Airthrey Castle, Bridge of Allan.
1897. MURRAY, John, Factor, Glenearn, Bridge of Earn, Perthshire.
1897. *Myles, Alexander, Assistant Forester, Royal Botanic Garden, Edinburgh.*
1898. MYLES, William, Assistant Forester, Beil, Prestonkirk, East Lothian.

1894. NEIL, Archibald, Forester, Warkton, Kettering, Northamptonshire.
1893. NELSON, Robert, Assistant Forester, Kinmount Estate, Cummertrees, Dumfriesshire.
1896. NELSON, Thomas, The Gardens, Tulliallan, Kincardine-on-Forth.
1885. NEWBIGGING, John, Nurseryman, Dumfries.
1895. NEWTON, George, Factor's Assistant, 28 Charlotte Square, Edinburgh.
1893. NICOL, James, Forester, Aird's Mill, Muirkirk, Ayrshire.
1895. NICOL, James, Assistant Forester, Knowsley, Prescot, Lancashire.
1891. NICOLL, John, Solicitor, 10 Shandwick Place, Edinburgh.
1898. NISBETT, J. L. More, The Drum, Liberton, Midlothian.
1897. NORMAND, Patrick Hill, Whitehill, Aberdour, Fife.

Date of Election.

1875. PAGE, Andrew Duncan, Land Steward, Culzean, Maybole, Ayrshire.
1893. PAGE, Walter, Farmer, Myregornie, Kirkcaldy, Fife.
1879. PATON, Hugh, Nurseryman, Kilmarnock, Ayrshire.
1894. PATTERSON, George, Forester's Office, Leinster Street, Athy, Co. Kildare, Ireland.
1897. PATTERSON, James P., Nursery Manager, Dollardstown Nursery, Athy, Ireland.
1895. PAXTON, George, Richardland, Kilmarnock.
1897. PEARSON, James, Forester, Sessay, Thirsk, Yorks.
1897. PEARSON, James M., of Over Letham, Estate Agent and C.E., Kilmarnock.
1869. PEEBLES, Andrew, Estate Office, Albury, Guildford, Surrey.
1897. PEEBLES, James, Assistant Forester, Albury, Guildford, Surrey.
1897. PEEBLES, Philip, Estate Office, Albury, Guildford, Surrey.
1898. PEIRSON, George B., Land Agent, Baldersby Park, Thirsk, Yorks.
1898. PEIRSON, George H., Assistant Land Agent, Balderbsy Park, Thirsk, Yorks.
1898. PETER, James, Land Steward, Berkeley, Gloucestershire.
1897. PHILIP, Alexander, Solicitor, Brechin, Forfarshire.
1895. PHILIP, William Watt, Forester, Ballynahinch Castle, Toombeold, Co. Galway.
1896. PHILP, Henry, jun., Timber Merchant, Campbell Street, Dunfermline.
1896. PHILP, John, Timber Merchant, Campbell Street, Dunfermline.
1874. PLATT, Colonel Henry, Gorddinog, Llanfairfechan, Carnarvonshire.
1897. POOLE, Wm., Corn Exchange Buildings, Edinburgh.
1892. POTTS, G. H., Fettes Mount, Lasswade, Midlothian.
1896. PRENTICE, George, Factor, Raith, Kirkcaldy, Fife.
1898. PRICE, W. M., Factor, Minto, Hawick.
1895. PRIEST, W., The Gardens, Eglinton Castle, Irvine.
1892. PROUDFOOT, William, Forester, Clunie, Kirkcaldy, Fife.

1897. RALSTON, Andrew Agnew, Factor, Hopetoun, South Queensferry.
1870. RATTRAY, Thos., Forester, Westonbirt House, Tetbury, Gloucestershire.
1894. REID, James S., Forester, Balbirnie, Markinch, Fife.
1896. REID, William, Assistant Forester, Donibristle, Aberdour, Fife.
1897. REID, William, Assistant Forester, Dochfour, Inverness.
1897. RICHMOND, T. S., 25 Marchmont Road, Edinburgh.
1892. RITCHIE, Alexander, Forester, Cavens Estate, Kirkbean, Dumfries.
1896. RITCHIE, Thomas, Nurseryman, Callander, Perthshire.
1898. RITCHIE, Wm., Assistant Forester, Moss-side Cottage, Lynedoch, Perth.
1897. ROBERTSON, A. Barnett, Forester, The Dean, Kilmarnock, Ayrshire.
1897. ROBERTSON, Andrew N., Assistant Forester, Colenden, Old Scone, Perthshire.
1896. ROBERTSON, Duncan, Forester, Strathord, Stanley, Perthshire.
1896. ROBERTSON, George, Assistant Forester, Ardgowan, Inverkip.
1894. ROBERTSON, George D., Assistant Forester, Carolside, Earlston.
1895. ROBERTSON, Sir Henry, Pali Corwen, North Wales.

Date of Election.

1896. Robertson, James, Assistant Forester, Old Blair, Blair Athole, Perthshire.
1896. Robertson, John, Assistant Forester, Glenfarg Lodge, Abernethy.
1896. Robertson, Peter, Assistant Forester, Keir, Dunblane.
1895. Robertson, Thomas, Forester, Knockboy, Recess, County Galway.
1883. Robertson, William, Assistant Forester, Ringwood, Birnam, Perth.
1897. Robertson, William, Assistant Forester, Murthly, Perthshire.
1897. Robson, Charles Durie, 66 Queen Street, Edinburgh.
1893. Rodger, James, Forester, Morton Hall, Norwich.
1897. Rodger, James, Factor, Keir, Dunblane, Perthshire.
1898. Rodimer, Charles S., Factor, Benmore, Kilmun, Argyleshire.
1893. Romanes, James, C.A., Meadowbank, Dalkeith.
1898. Ross, Charles D. M., Factor, Abercairney, Crieff.
1887. Ross, John, Forester, Hopetoun, South Queensferry, Linlithgowshire.
1895. Royle, James, Forester, Florence Court, Inneskillen, Ireland.
1867. Russell, John, Manager, Craigie House, Ayr.
1897. Russell, Rev. W. G., Rector of Gravhill, King's County.
1893. Rutherford, James A., Land Agent, Highclere Park, Newbury, Berks.
1870. Rutherford, John, Forester, Linthaugh, Jedburgh, Roxburghshire.

1894. Samson, David T., Seafield Estates Office, Grantown, Strathspey.
1898. Samson, John, 9 Hill Street. Edinburgh.
1875. Sang, Edmund, of E. Sang & Sons, Nurserymen, Kirkcaldy.
1896. Sang, Edward, Solicitor, 29 Queen Street, Edinburgh.
1897. Schmidt, V. H. J., Forester, Dochfour, Inverness.
1895. Sclater, Alexander, Seed Manager, 15 Princes Street, Edinburgh.
1870. Scott, Adam, Forester, Southwick Park, Fareham, Hants.
1892. Scott, David, Overseer, Dumfries House, Cumnock, Ayrshire.
1883. Scott, D. P., National Bank of Scotland, Hilltown Branch, Dundee.
1881. Scott, James, Forester, Wollaton Hall, Nottingham.
1894. Scott, J. H., Cedar Villa, Muirpark, Eskbank.
1890. Scott, John D., Forester, Bingham, Notts.
1894. Scott, John, Forester, Gordon Castle, Fochabers, Morayshire.
1890. Scrimgeour, John, Overseer, Shanes Castle, Antrim, Ireland.
1897. Sharp, Thomas, Forester, Monreith, Port William, Wigtownshire.
1893. Shaw, Andrew, Victoria Saw-Mills, Perth.
1893. Shaw, William, School House, Ballingry, Lochgelly, Fife.
1887. Simpson, Anthony, Forester, Bargany, Ayrshire.
1893. Simpson, Hugh, Assistant Forester, Hardwick Hall, Sedgefield, Durham.
1894. Simpson, James, of D. & W. Croll, Nurserymen, Dundee.
1898. Sinclair, William, Forester, Donibristle, Aberdour, Fife.
1868. Slater, Andrew, Land Steward, Osborne, Cowes, Isle of Wight.
1898. Smith, Charles G., Factor, Haddo House, Aberdeen.
1897. Smith, George, Assistant Factor, Hope Cottage, Ruthwell, Dumfriesshire.
1873. Smith, G. B., Wire Fence Manufacturer, Craighall Ironworks, Glasgow.

Date of Election.

1871. Smith, James, The Gardens, Mentmore, Leighton-Buzzard, Bucks.
1883. Smith, James, The Gardens, Hopetoun, South Queensferry.
1895. Smith, John, Cabinetmaker, Peebles.
1895. *Smith, Robert, Forester, West Park Estate, Damerham, Salisbury.*
1895. Smith, Thomas, Overseer, The Lodge, Tring Park, Wiggington, Tring, Herts.
1896. Smith, William, Assistant Forester, Kinnaird Castle, Brechin.
1896. Smith, William G., Ph.D., Professor, Yorkshire College, Leeds.
1898. Spence, William, Assistant Forester, Clunie, Kirkcaldy.
1885. Spiers, David, Overseer, Mugdrum, Newburgh, Fife.
1897. Steele, W. Craig, Nursery Manager, Westmoor, Kilmarnock, Ayrshire.
1895. Stevens, Thomas, Solicitor and Land Agent, 1 Ladbroke Terrace, London, W.
1897. Stewart, Charles, Assistant Forester, Scone, Perth.
1896. Stewart, James, Assistant Forester, Baledyarno, Inchture.
1898. Stewart, James, Land Steward, Moncreiffe, Bridge of Earn.
1876. Stewart, Robert, Forester, Stonefield, Tarbert, Lochfyne, N.B.
1897. Stoddart, James, Builder, Bonnyrigg, Midlothian.
1898. Stoddart, William, Land Steward, Dartrey, Co. Monaghan.
1889. Storie, Robert, 92 High Street, Dalkeith.
1893. Storie, William, Forester, Gulworthy, Tavistock, Devon.
1893. Storie, W., Whitway House, Newbury, Berks.
1897. Stuart, Robert, Forester, Elm Grove, Grantown, Inverness-shire.
1892. Sutherland, John D., Estate Agent, Oban, Argyle.

1869. Tait, David, Overseer, Owston Park, Doncaster, Yorkshire.
1892. Tait, James, Builder, Penicuik, Midlothian.
1898. Tait, William, Assistant Seedsman, 144 Princes Street, Edinburgh.
1895. Tait, Wm. A., 13 Brandon Terrace, Edinburgh.
1897. Taylor, William, Forester, Sandside, Kirkcudbright.
1891. Tennant, Edward P., Stockton House, Codford St Mary, Bath.
1895. Terras, Alexander, Forester, Dalgetty Castle, Turiff.
1893. Thomson, David, Agricultural Engineer, Woodhead Street, Dunfermline.
1893. Thomson, David W., Nurseryman, 24 Frederick Street, Edinburgh.
1869. Thomson, Lockhart, S.S.C., 114 George Street, Edinburgh.
1871. Tomlinson, Wilson, Forester, Clumber Park, Worksop, Notts.
1895. Tullo, James, 2 Hanover Street, Edinburgh.
1897. Turnbull, George, Estate Office, Tullamore, King's County.
1897 Turnbull, Walter Scott, Estate Office, Geashill, King's County.
1898. Tweedie, Alexander, Forester, Faskally, Pitlochry.

1883. Underwood, Henry E., Sub-Agent, Fornham, St Genevieve, Bury St Edmunds, Suffolk.

1896. Veitch, Archibald, Chattapore Tea Estate, Shamsherungger, South Sylhet, India.
1895. Vert, Alex. C. D., S.S.C., 2a Hill Street, Edinburgh.

Date of Election.

1893. WADDELL, Jas., 73 Gorgie Road, Edinburgh.
1894. WALKER, Henry H., Factor, Monreith, Port William, Wigtownshire.
1870. WALL, G. Y., Land Agent, Grange House, Darlington, Durham.
1893. WALLACE, David P., Forester, The Saw-Mills, Filleigh, Molton, S. Devon.
1893. WALLACE, Robert, Timber Merchant, 31 Leith Walk, Edinburgh.
1898. WANN, James J., The Gardens, Kennet, Alloa.
1893. WATSON, John, Timber Merchant, Annandale Street, Edinburgh.
1893. WATSON, John T., 6 Bruntsfield Gardens, Edinburgh.
1872. WATT, James, J.P., of Little & Ballantyne, Nurserymen, Carlisle.
1893. WATT, James W., Knowefield Nurseries, Carlisle.
1889. WATTERS, Dennis, Forester, Wester Elchies, Carron, Strathspey.
1894. WATTERS, Frank, Forester, Cameron South Lodge, Alexandria, Dumbartonshire.
1894. WEBSTER, Charles, The Gardens, Gordon Castle, Fochabers.
1895. WHITE, William, Farmer, Edgefield, Loanhead.
1884. WHITTON, James, Superintendent of Parks, 249 George Street, Glasgow.
1895. WIGHT, Alexander, Overseer, Thurston, Innerwick.
1895. WIGHTON, John, Forester, Newstead Abbey, Nottingham.
1883. WILKIE, Charles, Assistant Forester, Lennoxlove, Haddington.
1891. WILKIE, G., Architect, Hayfield, Peebles.
1882. WILLIAMSON, A., Wood Manager, The Warren, Eridge Hamsell, Tunbridge Wells, Kent.
1894. WILLIAMSON, Professor Alex., M.A., LL.B., 11 Great King Street, Edinburgh.
1890. WILLIAMSON, George, The Links, Leven, Fife.
1895. WILLIAMSON, John, Bank Agent, Loanhead, Midlothian.
1887. WILSON, George, Forester, Penrice Castle, Reynoldston R.S.O., Wales.
1896. WILSON, James, M.A., B.Sc., Fordyce Lecturer in Agriculture, University of Aberdeen.
1897. WILSON, William, Forester, Dingley, Market Harborough, Leicestershire.
1897. WILSON, William, Assistant Forester, Philiphaugh, Selkirk.
1892. WINTON, Thomas, Timber Merchant, Dundee.
1893. WISEMAN, Edward, Nurseryman, Elgin.
1895. WISEMAN, William, Nurseryman, Forres.
1898. WISHART, John, Ellangowan, Venlaw, Peebles.
1894. WOOD, William, The Gardens, Newton Don, Kelso, Berwickshire.
1868. WYLLIE, George, Ballogie, Aboyne, Aberdeenshire.

1897. YEATES, Alexander, Assistant Forester, Durris Estate, Aberdeen.
1897. YOUNG, Donald, c/o Bennetts Limited, Hyde Road, Manchester.
1875. YOUNG, William, Forester, Morriston Cottage, Earlston, Berwickshire.

1896. ZIMMERMAN, Henry W., Assistant Forester, Rosehaugh, Inverness.

Royal Scottish Arboricultural Society.

Instituted 16th February 1854.

PATRON.

HER MOST GRACIOUS MAJESTY THE QUEEN.

THE ANNUAL MEETING.

The Forty-fifth Annual Meeting of the Royal Scottish Arboricultural Society was held in No. 5 St Andrew Square, Edinburgh, on Wednesday, 26th January 1898, at 2.30 p.m. R. C. Munro Ferguson, M.P., of Raith and Novar, President of the Society, occupied the Chair.

Minutes.

The Minutes of the General Meeting of the Society, held on Monday, 16th August 1897, which had been printed and circulated amongst the Members, were held as read, and approved of.

Apologies for Absence.

The Secretary reported that he had received letters of apology for absence from The Lord Balvaird, and from Messrs James Robertson and W. A. Mackenzie, Members of Council.

Election of New Members.

The election of the following sixy-two Candidates for Membership, whose names had previously been submitted to the Council, was duly confirmed, viz.:—

Life Members.

Coats, Sir Thomas Glen, Bart., Ferguslie Park, Paisley.
Digby, The Right Hon. Baron, Minterne, Cerne, Dorsetshire.
Kinross, John, Architect, Drummond Place, Edinburgh.
Lovat, The Right Hon. Lord, Beaufort Castle, Beauly, Inverness.

Mackinnon, A., The Gardens, Scone Palace, Perth.
M'Laren, John, Gardener, Ballencrieff, Drem.
Murray, Hon. Alan David, Scone Palace, Perth.
White, J. Martin, Balruddery, near Dundee.

Ordinary Members.

Allaway, William, 13 St Andrew Square, Edinburgh.
Archibald, John, Assistant Forester, Moss-side, Lynedoch, Perth.
Bain, Charles, Assistant Forester, Moss-side, Lynedoch, Perth.
Bannan, Andrew, Forester, Glenfarg Estate, Abernethy.
Borthwick, Francis J. G., W.S., 9 Hill Street, Edinburgh.
Carr, Alexander, Assistant Forester, Moss-side, Lynedoch, Perth.
Chalmers, Thomas, Nursery Manager, Raith, Kirkcaldy.
Crombie, Alexander T., Assistant Forester, Lintmill, Cullen.
Crombie, James, Assistant Forester, Raith, Kirkcaldy.
Cunningham, George, Advocate, 19 Northumberland Street, Edinburgh.
Digby, Reginald, Land Agent, Geashill Castle, King's County.
Douglas, James, The Gardens, Charleville, Enniskerry, Co. Wicklow.
Dow, Thomas, Assistant Forester, Lintmill, Cullen.
Downie, John, Beech-hill Nurseries, Murrayfield, Midlothian.
Edminson, Wm. D., Tweed View, Berwick-on-Tweed.
Elder, William, Engineer, Berwick-on-Tweed.
Ewan, Peter, Assistant Forester, Moss-side, Lynedoch, Perth.
Farquharson, Dr Robert, of Finzean, M.P., Aboyne, Aberdeenshire.
Foster, James, jun., Kennet Village, Alloa.
Fraser, James, Assistant Forester, Innes House, Elgin.
Gauld, William, Assistant Forester, Raith, Kirkcaldy.
Gilchrist, Arch., Ivanhoe Cottage, Bonnyrigg, Midlothian.
Gow, Peter, Land Steward, Johnstone Castle, Wexford.
Grey, Sir Edward, Bart., M.P., of Falloden, Chathill, Northumberland.
Harris, James, Manager, Luffness Mains, Drem.
Hendry, James, 5 Thistle Street, Edinburgh.
Kyllachy, The Right Hon. Lord, of Kyllachy, 6 Randolph Crescent, Edinburgh.
Leys, Wm. B., Assistant Forester, Innes House, Elgin.
Low, James, Temple, Gorebridge, Midlothian.
Low, James, Assistant Forester, Durris, Aberdeen.
Low, John, Seedsman, St Giles Street, Edinburgh.
Lynch, Francis, Gascoed Hall, Wrexham.
M'Callum, James, Forester, Doneraile, Co. Cork.
Michie, William, Cullen, Banffshire.
Milne, Robert P., Spittal Mains, Berwick-on-Tweed.
Morgan, Hugh, Timber Merchant, Crieff.
Myles, William, Assistant Forester, Biel, Prestonkirk, East Lothian.
Normand, Patrick Hill, Whitehill, Aberdour, Fife.
Peirson, George B., Land Agent, Baldersby Park, Thirsk, Yorks.
Peirson, George H., Assistant Land Agent, Baldersby Park, Thirsk, Yorks.

PRICE, W. M., Factor, Minto, Hawick.
RALSTON, Andrew Agnew, Factor, Hopetoun, South Queensferry.
RITCHIE, William, Assistant Forester, Moss-side Cottage, Lynedoch, Perth.
RODIMER, Charles S., Factor, Benmore, Kilmun, Argyleshire.
SAMSON, John, 9 Hill Street, Edinburgh.
SCHMIDT, V. H. J., Forester, Dochfour, Inverness.
SCOTT, George, 7 Brazenose Street, Manchester.
SINCLAIR, William, Forester, Donibristle, Aberdour, Fife.
SMITH, Charles G., Factor, Haddo House, Aberdeen.
STODDART, William, Land Steward, Dartrey, Co. Monaghan.
TAIT, William, Assistant Seedsman, 144 Princes Street, Edinburgh.
TWEEDIE, Alexander, Forester, Faskally, Pitlochry.
WANN, James J., The Gardens, Kennet, Alloa.
WISHART, John, Ellangowan, Venlaw, Peebles.

ELECTION OF AN HONORARY MEMBER.

Professor SOMERVILLE moved that Mr MALCOLM DUNN, The Palace Gardens, Dalkeith, be elected an Honorary Member of the Society. The Professor said that in conferring this honour on Mr DUNN, the Society would mark its sense of the extraordinary value of his services to the cause of Arboriculture, Horticulture, and Forestry, not only in Scotland, but in Great Britain and Ireland, and would at the same time give expression to the feelings of every Member that no one had done more to advance the best interests of the Royal Scottish Arboricultural Society than Mr Dunn. Colonel BAILEY seconded the motion, which was adopted unanimously.

Mr DUNN, who was present, cordially expressed his thanks to the Society for the honour it had conferred on him, and sincerely wished he might be able to do more in the future to merit the high distinction.

REPORT BY THE COUNCIL.

The Secretary read the Report by the Council, which gave a summary of the work of the Society and of the Council during the past year. Special reference was made to the Excursions to Ireland and Dolphinton; the contents of the forthcoming Part of the *Transactions*; the Reports of the Honorary Scientists; the appointment of new Trustees; and the progress made with the preparation of a scheme for the Establishment of State Model Forests for Scotland. The Membership had increased from 699 to 788, being a nett gain of 89 during the year.

Finances of the Society.

The Accounts for the past year, which had previously been printed and circulated amongst the Members, were held as read. The following is a short abstract of the Accounts:—

INCOME.				EXPENDITURE.			
1. Ordinary Subscriptions,	£214	19	0	1. Printing and Stationery, £75 2 10			
2. Life Subscriptions,	75	12	0	*Less* Receipts for Advertisements, 21 12 6			
3. Donations,	17	16	4		£53	10	4
4. Bank Interest and Miscellaneous,	9	2	2	2. Prizes,	18	6	2
				3. Expenses of Management,	76	11	11
					148	8	5
				Balance of Income over Expenditure,	169	1	1
	£317	9	6		£317	9	6

The total funds of the Society at 31st December 1897 amounted to £454, 6s. 1d., of which £399, 3s. 2d. had been invested, in the names of the Trustees, in the purchase of £266 Caledonian Railway Co. 4 % Guaranteed Annuity Stock No. 2. The arrears of subscriptions carried forward amounted to £22, 6s. 6d.

On the motion of Mr W. M. Welsh, Convener of the Finance Committee, the Accounts were approved of.

Excursion Fund.

The Secretary mentioned that as the Accounts in connection with the Excursion to Ireland in August last could not yet be closed, the position of this Fund would be reported at a future meeting.

A Plea for a Forest Area.

Mr Munro Ferguson, M.P., in demitting the office of President which he had held for the last four years, thanked the Council and the Members for all they had done to make the Society a success during his term. They had seen a good deal done during the last three or four years. They had been not uneventful years in the history of Scottish forestry, and he was proud to

think that he should have been associated with the Society when so many new ideas were coming in amongst them as to the management of their forests. He believed that the Excursion to Germany, and the manner in which their transactions had been carried through, had made their mark upon the affairs of the Society.

He thought they would find that the Society was yet only in its infancy, and that it would rise to the great opportunity that still lay before it. All Scotsmen liked to see things done in a right way. If British agriculture was the first in the world, he would be a bold man who would say that Scottish forestry was first also. What first awoke his interest in the whole subject of forestry, was this, that he felt that they were so much farther ahead in the science of agriculture than they were in forestry, and that there was such a great field for usefulness in that direction. They had, for example, the whole great Highland area. Most of it was fit for growing timber, and it was really fit for no other productive occupation. The solution of the land and the labour troubles there, was, he believed, within the scope of the pursuit of their calling; and it was to forestry they had to look if there was to be any satisfactory ending to the economic troubles in the northern part of Scotland. That was the only way in which they could put a population on the land. They would never have any large population on the land by creating small holdings or large holdings, or by any agricultural occupation of the greater part of the Highlands. But there was hardly any limit to the population they could bring up on the Highland area if they had a properly developed system of forestry, and a properly developed system of manufactures along with it.

He had the privilege of nominating his successor, and it was with very great pleasure that he submitted the name of Colonel Bailey. It would not be easy to find any one more worthy to fill this high office. His work would lie very much in the direction of establishing some experimental area, which might by degrees develop into a forest school. He had mentioned the Highlands in order to draw attention to what he thought was the great need for some experimental area and regular forest school in Scotland. They could begin with the area, and go on to the forest school, for without training their men thoroughly they would not be in a position to go to any Government to ask for any great national scheme of forestry. They had men who

could manage forests, no doubt, but there were many points they needed to clear up. Many of these new ideas that had come amongst them, needed to be tested to see how far they would hold good in this country. Their Scottish foresters had shown great readiness to take up new ideas. It was a marked characteristic of the revolution going on of late in Scottish forestry, that their foresters had so readily accepted new ideas, and had endeavoured to turn them to the best account; but still, many of these new ideas had to be put to the test, and they wanted some place where that could be done. It could not be done on a private estate. They must have an area where the experiments would be continuous and successive. It was because he saw so great a field open, and because he believed it could, with adequate preparation, be suitably occupied, that he considered it an auspicious circumstance to move Colonel BAILEY for their President. The Colonel had given attention to this question, and he (Mr Munro Ferguson) trusted Colonel BAILEY would be in a position soon to give effect to his views upon it.

Colonel BAILEY, in taking the chair vacated by Mr MUNRO FERGUSON, thanked the Members for the great honour they had done him. It was a position he was proud to hold. During his term of office, he should endeavour to promote the interests of the Society, and if, in this matter of the forest area, in which they were all so deeply interested, he could render any special service, he should feel proud if that would mark his term of the presidential chair. He might say that on this question, he was authorised to state by the Council that a draft report had been prepared by Professor Somerville and himself, which embodied a scheme. They had hoped it might have been ready for presentation that day; but, in order that no time might be lost, he asked them to give the Council power to deal with it, and to report to next meeting.

The matter was remitted to the Council, with powers.

ELECTION OF OFFICE-BEARERS.

Colonel BAILEY having been elected President, Mr Dunn moved that the office of Honorary Secretary be created, and that Mr MUNRO FERGUSON, M.P., be elected Honorary Secretary. He explained that in this way Mr MUNRO FERGUSON's influence among the proprietors of the country, Government officials and

departments, and in Parliament, would be conserved to the Society. The motion was carried unanimously, and Mr Munro Ferguson cordially accepted office. Professor Somerville, Mr W. M. Welsh, and The Lord Balvaird were elected Vice-Presidents, and Messrs James Cook, Robert Forbes, George Mackinnon, R. V. Mather, and James Moffat, Members of Council. The Secretary and Treasurer, the Auditor, the Honorary Consulting Scientists, the Photographic Artist, and the Local Secretaries were re-elected. Mr J. Clark, Haddo House, was elected a Member of the combined Committee on *Transactions* and Judges, in room of Mr James Kay, resigned. The other Members of the Committee were re-elected.

The Office-Bearers and Officials elected for the year 1898 were therefore as follows:—

PRESIDENT.

Colonel F. Bailey, R.E., Lecturer on Forestry, Edinburgh University.

VICE-PRESIDENTS.

Alexander Milne, Nurseryman and Seedsman, 32 Hanover Street, Edinburgh.
Charles Buchanan, Overseer, Penicuik Estate, Penicuik.
William Somerville, M.A., D.Œc., D.Sc., F.R.S.E., F.L.S., Professor of Agriculture and Forestry, Durham College of Science, Newcastle-on-Tyne.
W. M. Welsh, Nurseryman and Seedsman, 1 Waterloo Place, Edinburgh.
The Lord Balvaird, Scone Palace, Perth.

COUNCIL.

Malcolm Dunn, The Palace Gardens, Dalkeith.
John T. M'Laren, Factor, Polmaise, Stirling.
Andrew Slater, Land Steward, Osborne, Cowes, Isle of Wight.
John Methven, Nurseryman, 15 Princes Street, Edinburgh.
Alexander Pitcaithley, Forester, Scone Estate, Perth.
James F. Hardie, Overseer, Haystoun Estate, Peebles.
D. P. Laird, Nurseryman, Pinkhill, Murrayfield, Edinburgh.
D. F. Mackenzie, Factor, Mortonhall, Liberton.
W. A. Mackenzie, Factor, Faskally, Pitlochry.
James Robertson, Wood Manager, Panmure, Carnoustie.
James Cook, Land Steward, Arniston, Gorebridge.
Robert Forbes, Overseer, Kennet, Alloa.
George Mackinnon, Overseer, Melville Castle, Lasswade.
R. V. Mather, Nurseryman, Kelso.
James Moffat, 48 Castle Street, Edinburgh.

HON. SECRETARY.

R. C. Munro Ferguson, M.P., of Raith and Novar, Raith House, Kirkcaldy, Fife.

SECRETARY AND TREASURER.

Robert Galloway, 5 St Andrew Square, Edinburgh.

AUDITOR.

John T. Watson, 16 St Andrew Square, Edinburgh.

JUDGES AND COMMITTEE ON TRANSACTIONS.

Colonel Bailey, R.E., Lecturer on Forestry, University of Edinburgh (*Convener*).
Professor I. Bayley Balfour, University of Edinburgh.
Professor Somerville, Durham College of Science, Newcastle-on-Tyne.
Malcolm Dunn, The Palace Gardens, Dalkeith.
John Methven, Nurseryman, Edinburgh.
John Michie, Forester, Balmoral.
John Clark, Forester, Haddo House, Aberdeen.

HONORARY CONSULTING SCIENTISTS.

Consulting Botanist, Isaac Bayley Balfour, M.D., Sc.D., Professor of Botany, University of Edinburgh, and Regius Keeper, Royal Botanic Garden, Edinburgh.

Consulting Chemist, Andrew Peebles Aitken, M.A., Sc.D., Professor of Chemistry, Veterinary College, Clyde Street, Edinburgh.

Consulting Cryptogamist, William Somerville, M.A., D.Œc., D.Sc., F.R.S.E., F.L.S., Professor of Agriculture and Forestry, Durham College of Science, Newcastle-on-Tyne.

Consulting Entomologist, Robert Stewart MacDougall, M.A., D.Sc., Lecturer on Entomology, Royal Botanic Garden, Edinburgh.

Consulting Geologist, John Smith Flett, M.A., B.Sc., M.B., C.M., Lecturer on Petrology, University of Edinburgh.

Consulting Meteorologist, Robert Cockburn Mossman, F.R.S.E., F.R.Met.Soc., 10 Blacket Place, Edinburgh.

LOCAL SECRETARIES.

Scotland.

Counties.	
Aberdeen, .	John Clark, Forester, Haddo House, Aberdeen.
	John Michie, Forester, Balmoral, Ballater.
	James Wilson, M.A., B.Sc., Fordyce Lecturer on Agriculture, Aberdeen University.
Argyle, . .	Walter Elliot, Manager, Ardtornish.
	John D. Sutherland, Estate Agent, Oban.

Counties.	
Ayr,	JOHN HAY, Overseer, Dollars Estate Office, Kilmarnock.
	ANDREW D. PAGE, Overseer, Culzean, Maybole.
Banff,	JOHN BRYDON, Forester, Rothes, Elgin.
Berwick,	WM. MILNE, Foulden Newton, Berwick-on-Tweed.
Bute,	WM. INGLIS, Forester, Cladoch, Brodick.
	JAMES KAY, Forester, Bute Estate, Rothesay.
Clackmannan,	ROBERT FORBES, Estate Office, Kennet, Alloa.
Dumfries,	D. CRABBE, Forester, Byreburnfoot, Canonbie.
	JOHN HAYES, Dormont Grange, Lockerbie.
	JOHN NEWBIGGING, Nurseryman, Dumfries.
East Lothian,	W. S. CURR, Factor, Ninewar, Prestonkirk.
Fife,	EDMUND SANG, Nurseryman, Kirkcaldy.
Forfar,	R. CAIRNS, The Gardens, Balruddery, near Dundee.
	JAMES CRABBE, Forester, Glamis.
	JAMES ROBERTSON, Forester, Panmure House, Carnoustie.
Inverness,	DANIEL DEWAR, Forester, Beaufort Castle, Beauly.
	JAMES A. GOSSIP, Nurseryman, Inverness.
Kinross,	JAMES TERRIS, Factor, Dullomuir, Blairadam.
Lanark,	JOHN DAVIDSON, Forester, Dalzell, Motherwell.
	JAMES WHITTON, Superintendent of Parks, City Chambers, Glasgow.
Moray,	WM. GILCHRIST, Forester, Leuchars, Elgin.
	D. SCOTT, Forester, Darnaway Castle, Forres.
Peebles,	JAMES F. HARDIE, Woodbine Cottage, Peebles.
Perth,	W. HARROWER, Forester, Tomnacroich, Garth, Aberfeldy.
	W. A. MACKENZIE, Factor, Faskally, Pitlochry.
	ALEX. PITCAITHLEY, Jeanie Bank, Old Scone, Perth.
Ross,	Sir KENNETH MACKENZIE, Bart., Conan House, Conon Bridge.
Roxburgh,	JOHN LEISHMAN, Manager, Cavers Estate, Hawick.
	R. V. MATHER, Nurseryman, Kelso.
Sutherland,	DONALD ROBERTSON, Forester, Dunrobin, Golspie.
West Lothian,	JAMES SMITH, Hopetoun Gardens, South Queensferry.
Wigtown,	JAMES HOGARTH, Forester, Culhorn, Stranraer.
	H. H. WALKER, Monreith Estate Office, Whauphill.

England.

Berks,	W. STORIE, Whitway House, Newbury.
Bucks,	JAMES SMITH, The Gardens, Mentmore, Leighton-Buzzard.
Cheshire,	WM. ELDER, Cholmondeley Park, near Malpas.
Derby,	THOMAS DOW, Forester, Bretby, Burton-on-Trent.
Devon,	JAMES BARRIE, Forester, Stevenstone Estate, Torrington.
Durham,	Professor SOMERVILLE, Durham College of Science, Newcastle-on-Tyne.
Hants,	ANDREW SLATER, Land Steward, Osborne, Cowes, Isle of Wight.
Hereford,	WM. STORIE, Forester, Holme Lacy, Hereford.

Counties.	
Herts, . .	JAMES BARTON, Forester, Hatfield.
	THOMAS SMITH, Overseer, Tring Park, Wiggington, Tring.
Kent, . .	R. W. COWPER, Gortanore, Sittingbourne.
Lancashire, .	PETER GRANT, Forester, Hornby Castle, Hornby, Lancaster.
	D. C. HAMILTON, Forester, Knowsley, Prescot.
Leicester, .	JAMES MARTIN, The Reservoir, Knipton, Grantham.
Lincoln, .	J. ALEXANDER, The Gardens, Revesby Abbey, Boston.
	W. B. HAVELOCK, The Nurseries, Brocklesby Park.
Middlesex, .	Professor BOULGER, 34 Argyll Mansions, West Kensington, London, W.
	GEORGE CADELL, c/o The Secretary, Surveyor's Institution, Savoy Street, Victoria Embankment, London.
Norfolk, .	H. MUNRO, Garden Cottage, Holkham.
	JAMES RODGER, Forester, Morton Hall, Norwich.
Northampton,	F. MITCHELL, Forester, Harlestone, Northampton.
Northumberland,	JOHN DAVIDSON, *Secretary*, English Arboricultural Society, Haydon-Bridge-on-Tyne.
Notts, . .	W. MICHIE, Forester, Welbeck, Worksop.
	WILSON TOMLINSON, Forester, Clumber Park, Worksop.
Salop, . .	FRANK HULL, Forester, Lillieshall, Newport.
Stafford, .	ROBERT T. COLLINS, Forester, Trentham, Stoke-on-Trent.
Suffolk, . .	ANDREW BOA, junior, Sub-Agent, Great Thurlow.
Surrey, . .	PHILIP PEEBLES, Estate Office, Albury, Guildford.
Warwick, .	W. BERRIDGE, Forester, Stoneleigh Abbey Farm, Kenilworth.
	A. D. CHRISTIE, The Gardens, Ragley Hall, Alcester.
Wilts, . .	A. C. FORBES, Wood Manager, Bowood, Calne.
Yorks, . .	WM. FORBES, Forester, Swinton, Masham.
	ADAM MAIN, Forester, Rose Cottage, Loftus.
	D. TAIT, Estate Bailiff, Owston Park, Doncaster.

Wales.

Flint, . .	R. V. KYRKE of Penywern, Mold.
Glamorgan, .	ARCH. MITCHELL, Forester, Dunraven, Bridgend.
	GEO. WILSON, Forester, Penrice Castle, Reynoldston R.S.O.

Ireland.

Antrim, . .	JOHN SCRIMGEOUR, Land Steward, Shane's Castle.
Galway, .	THOMAS ROBERTSON, Forester, Knockboy, Recess.
Kildare, .	ROBERT M'KERROW, Manager, Carton, Maynooth.
Kilkenny, .	ALEX. M'RAE, Forester, Castlecomer.
King's County,	ARCH. HENDERSON, Forester, Clonad Cottage, Tullamore.
Monaghan, .	JAMES BRODIE, Land Steward, Glaslough.
Tipperary, .	DAVID G. CROSS, Forester, Kylisk, Nenagh.
Wicklow, .	ADAM JOHNSTONE, Forester, Coollattin, Shillelagh.

PHOTOGRAPHIC ARTIST.

GEORGE PAXTON, Richardland, Kilmarnock.

Admission of Members.

Mr Dunn, on behalf of the Council, submitted the following Resolution for the temporary alteration of Law XII. regarding the Admission of Members :—

"That every nomination for Membership of the Society must be made in writing, and must be signed by the proposer and at least one seconder; that such nominations be submitted by the Secretary to the next meeting of Council, and that they thereafter lie on the table until the immediately succeeding meeting of Council, when they shall again be read over and accepted or declined, as the Council deem best in the interests of the Society. That the Council shall at such subsequent meeting pass the accepted nominations to the effect that the Treasurer may accept the Annual Subscription or Life Composition, on payment of which the Candidate shall be admitted a Member of the Society, subject to the confirmation of the first General Meeting thereafter."

The Resolution was adopted.

Library and Museum.

The Secretary reported that the following presentations had been made since the General Meeting in August last :—

List of Presentations to the Society's Library.

1. "New South Wales, the Mother Colony of the Australias." From the New South Wales Government Board of Exchanges.
2. Report of the Forest Department, Madras Presidency, 1895–96.
3. Report on the Forests of Western Australia, 1896. By J. Ednie Brown, Conservator of Forests.
4. Report of the Clerk of Forestry for Ontario, 1897.
5. Provincial Government Crop Report of Nova Scotia, 1897.
6. Kew Gardens Bulletin, 1896.
7. *Transactions of the English Arboricultural Society*, vol. i., parts 5 and 6 ; vol. ii., parts 2 and 3 ; vol. iii., part 3.

8. *Journal of the Royal Agricultural Society*, London, vol. viii., parts 3 and 4.

9. *Journal of the Royal Horticultural Society*, London, vol. xxi., part 2.

10. Report of the Council of the Royal Horticultural Society, London, 1897–98.

11. Arrangements of the Royal Horticultural Society, London, for 1898.

12. *Transactions of the Highland and Agricultural Society*, 5th series, vol. ix.

13. Report on the State of Agriculture in Scotland in 1878. From the Highland and Agricultural Society.

14. Report on the State Forest Administration of South Australia, 1895–96.

15. Report on the State Forest Administration of South Australia, 1896–97.

16. Agricultural Returns—Statistical Tables, 1897. From the Board of Agriculture.

17. Reprints :—

"Forestry in India." By Lieut.-Colonel F. Bailey, formerly Acting Inspector-General of Forests to the Government of India.

"The Entomology of the Oak." By A. T. Gillanders.

18. Pamphlets on Tuberculin Test and Wheat Experiments. From the Department of Agriculture, Victoria.

19. MS. Tables of Imports of Timber, 1881 to 1896 inclusive; and Exports from Foreign Countries and British Colonies during same years. From the Board of Trade.

Note.—Members may borrow from the Secretary any of the Books or Pamphlets belonging to the Society, provided they pay the cost of transmission, and guarantee their safe return within a reasonable time.

Excursion in 1898.

Mr Dunn suggested the Forest of Dean or the North of Scotland as a suitable district for next Excursion.

The President mentioned that Mr Hill, of the Indian Forest

Service, had recently prepared a Working Plan for the Forest of Dean, which would be published soon, and he recommended that the Society should visit that district. The matter was remitted to the Council, with powers.

Paris Exhibition in 1900.

Professor Somerville mentioned that there would be a Forestry Section in the International Exhibition proposed to be held in Paris in 1900, and suggested that the Society should consider whether it should be represented in some way on that occasion, and should visit the Exhibition and some of the State Forests of France in the course of that year. The meeting agreed to leave the matter in the hands of the Council.

Motions Disposed Of.

The following motions, which had been duly notified at last General Meeting, were put to the Meeting and adopted without discussion :—

1. That the Council be empowered to decide the class under which any Candidate for Membership shall be placed.
2. That the Council be empowered to appoint Correspondents in any part of the world.

Notices of Motion.

Mr Dunn gave notice that at next General Meeting the Council would move that Law XII., regarding the Admission of Members, should be altered permanently in terms of the Resolution adopted above.

Mr Clark, Haddo House, gave notice of the following motion, which will also fall to be discussed at next Meeting :—

> That the Society establishes at least four branches for the benefit of its Members—one at Inverness, one at Aberdeen, one at Perth, and one at Glasgow.

Papers Read.

The following Papers were then read, viz. :—

1. "Grouping *versus* Mixing." By C. Y. Michie, Forester, Cullen House.

2. "The Deterioration of Wire Fences." By Mr JAMES KAY, Forester, Bute.

3. "A Plea for a Special Organ devoted to Forestry." By Mr ALEXANDER M'RAE, Forester, Castlecomer, Co. Kilkenny.

The Papers were remitted to the Council for consideration.

EXHIBITS.

Mr GEORGE LEVEN, Forester, St Quinox, Ayr, exhibited several specimens of Douglas Fir affected by the fungus (*Phoma pithya*, Sacc.) referred to in the Report of the Society's Cryptogamist (Professor Somerville) on page 191 of Vol. XV. of the *Transactions*, and read a short description of the diseased plants. Professor SOMERVILLE mentioned that Mr LEVEN was probably the first person to observe the disease in this country.

On the motion of the President, Mr LEVEN and Professor SOMERVILLE were thanked for bringing such an important matter under the notice of the Society.

OTHER VOTES OF THANKS.

Votes of thanks were also accorded to Mr MUNRO FERGUSON, the retiring President, for his services to the Society during his period of office; to Messrs MICHIE, KAY, and M'RAE for their Papers; to the donors of Books and Pamphlets to the Library; and to Colonel BAILEY, the President-elect, for presiding, which concluded the business.

THE ANNUAL DINNER.

After the Meeting the Members and their friends dined together in the Royal British Hotel. Colonel BAILEY, the President of the Society, was Chairman, and Messrs CHARLES BUCHANAN and ALEXANDER MILNE, Vice-Presidents, were Croupiers. The company numbered about fifty. The guests of the Society were Mr JOHN M'MILLAN, Treasurer of the Edinburgh Merchant Company; Rev. Dr CHARLES M'GREGOR, Lady Glenorchy's, Edinburgh; Bailie GULLAND, Convener of the Markets Committee of the Town Council; Mr JAMES MACDONALD, Secretary, Highland and Agricultural Society; Mr ANDERSON, Proprietor, and Mr D. YOUNG, Editor, of the *North British*

Agriculturist. Mr M'Millan proposed the toast, "The Royal Scottish Arboricultural Society," and the President replied. Mr John Methven proposed, "The Lord Provost, Magistrates, and Town Council," and Bailie Gulland replied. Other toasts were proposed and duly honoured, and a number of songs were excellently rendered by members of the company, which added very much to the enjoyment of the gathering.

THE GENERAL MEETING.

A General Meeting of the Royal Scottish Arboricultural Society was held in No. 5 St Andrew Square, Edinburgh, on Tuesday, 2nd August 1898, at 10 o'clock A.M. Colonel Bailey, President, in the Chair.

Change of Place of Meeting.

The Secretary intimated that, after the notices calling the Meeting had been issued, it was found necessary to change the place of meeting from the National Portrait Gallery, as originally intimated, to 5 St Andrew Square, as advertised in the newspapers.

Minutes.

The Minutes of the Forty-fifth Annual Meeting of the Society, held on 26th January 1898, were held as read and approved of.

Election of New Members.

The Election of the following twenty-one Candidates, whose names had previously been submitted to and approved of by the Council, was confirmed, viz.:—

Life Member.

Paton, Robert Johnston, Nurseryman, Kilmarnock.

Ordinary Members.

Armstrong, Thos. J., Factor, Glenborrodale, Salen, by Ardgour.
Bedford, Surgeon-Major Wm. James Guthrie, Kierfield House, Stromness.
Bell, David, Seed Merchant, Leith.
Carson, David Simpson, C.A., 209 West George Street, Glasgow.
Chalmers, James, Assistant Forester, Tayinloan, Kintyre.
Crichton, William, Manager, Castle Ward, Downpatrick.
Erskine, Henry, Seedsman, 80a George Street, Edinburgh.

GROVE, Richard, Silverbank Sawmills, Banchory.
HUGGAN, John A., Seed Merchant, 35 Market Street, Aberdeen.
JAMIESON, James, Forester, Crosswood Estate, Aberystwyth.
LIGHTFOOT, Francis P., Land Agent, Dunchurch, Rugby.
MACKAY, Æneas J. G., LL.D., Advocate, 2 Albyn Place, Edinburgh.
M'MANUS, Edmund, Timber Merchant, Randalstown, Co. Antrim.
MARSHALL, John, Wood Merchant, Killiecrankie.
MITCHELL, David, Forester, Drumtochty, Fordoun.
MITCHELL, James, Assistant Sawmiller, Philiphaugh, Selkirk.
NISBETT, J. S. More, The Drum, Liberton.
ROSS, Chas. D. M., Factor, Abercairney, Crieff.
SPENCE, Wm., Assistant Forester, Cluny, Kirkcaldy.
STEWART, James, Land Steward, Moncreiffe, Bridge of Earn.

ADDRESS BY THE PRESIDENT.

The President intimated that, owing to the Excursionists having to start for the Forest of Dean earlier than was originally intended, the time at the disposal of the Meeting was limited, and it had been arranged to postpone his address on "Canada."

He subsequently mentioned that he was preparing a Working Plan for part of the Raith woods, which he believed would be the first Plan of the kind prepared for a private estate in this country, and which he hoped Mr Munro Ferguson would allow to be printed in the *Transactions*. He then proceeded to make a few remarks on the subject of Working Plans, with special reference to the Plans prepared by Mr Hill for the Forest of Dean and High Meadow Woods, which the Excursionists were about to visit.

JUDGES' REPORT ON ESSAYS.

The Chairman, as Convener of the Judges, submitted the Report on the Essays received in Competition, and the following Awards were made in accordance therewith,—the sealed envelopes accompanying the Essays being opened, and the names of the successful competitors announced to the Meeting:—

CLASS I.

I. On the Erection and Maintenance of a Sawmill and other Wood-working Machinery suitable for Estate Purposes. (Motto, "Silva.")

No award.

II. On the Spring Growth of Forest Trees. (Motto, "Mercury.") By A. C. Forbes, Wood Manager, Bowood, Calne, Wilts.

Award, a Bronze Medal.

Class II.

I. On Planting and Propagating Trees. (Motto, "Fir Cone.") By James Gillespie, Lochton Lodge, Inchture.

Award, a Bronze Medal.

II. On the Thinning of High Forest Plantations for Profit. (Motto, "Worker.") By Hampton C. Lock, Moss-side Cottage, Lynedoch, Perth.

Award, a Bronze Medal.

Model of New Wire Fencing.

The Chairman intimated that, owing to a misunderstanding, a Model of a new kind of Wire Fencing, with relative Report and Drawings, had reached the Secretary too late to be submitted to the Judges and dealt with in their Report, and that the Council had appointed a Special Committee to examine the Model, and report upon it. This was approved of, and the matter was remitted to the Council, with powers.

State Model Forests for Scotland.

The President reported that, as empowered by last Meeting of the Society, the Council had adopted the Scheme for the Establishment of State Model Forests for Scotland, which had been prepared by Professor Somerville and himself, and had sent it, with a covering letter, to the Right Hon. W. H. Long, President of the Board of Agriculture. The Scheme has been duly acknowledged by Mr Long, and was under his consideration. Copies of the pamphlet, and of the letter to Mr Long, have also been sent to the Chancellor of the Exchequer, the Secretary for Scotland, all the Scottish Members of Parliament, selected Members of both Houses of Parliament, all the newspapers of importance in Scotland, and the leading Agricultural and Country newspapers in England and Ireland.

Excursions.

Mr Dunn, Convener of the Excursion Committee, reported that between seventy and eighty Members had intimated their intention of taking part in the Excursion which was about to be made to the Forest of Dean. He said that Ross-shire has been suggested as a suitable district for next year's Excursion. Another suggestion was that, instead of having an extended Excursion, they should visit a few places which could each be reached in a day from Edinburgh, and that in order to suit the convenience of all the Members, and to afford each an opportunity of being present at one or other of the visits, the Excursions should take place at different times in May, June, and July. The matter was remitted to the Council, with powers.

Paris Exhibition in 1900.

The Chairman mentioned that, at the request of the Council, Mr Munro Ferguson, the Honorary Secretary, was attending to the interests of the Society in this matter, and that at present there was nothing of importance to report.

Mr Dunn said it was understood that the Society would visit France on that occasion, and added that as there would be considerable difficulties to overcome in connection with the arrangements, Members need not be surprised if they are asked to give about six months' notice of their intention of joining the Excursion. The matter was remitted to the Council, with powers.

Library and Museum.

The Secretary intimated that the following publications had been received since the Annual Meeting in January:—

List of Presentations to the Society's Library.

1. *Transactions of the Highland and Agricultural Society* for 1891.
2. *Transactions of the Highland and Agricultural Society* for 1898, 5th series, vol. x.
3. Report of the Clerk of Forestry, Ontario, 1898.

4. Kew Gardens Bulletin, 1897.
5. Reports of the Conservators of Forests, Cape of Good Hope, 1897.
6. *Proceedings and Transactions of the Nova Scotian Institute of Science*, 1896–97, vol. ix., part 3.
7. *Transactions of the Massachusetts Horticultural Society*, 1897, part 1.
8. Report of the Secretary for Agriculture, Nova Scotia, 1897.
9. Agricultural Returns from the Board of Agriculture, 1897.
10. *Journal of the Royal Agricultural Society*, London, vol. ix., parts 1 and 2.
11. *Journal of the Royal Horticultural Society*, London, vol. xxi., part 3; and vol. xxii., part 1.
12. Reports of Conferences of the Scottish Chamber of Agriculture, 1897.

Note.—Members may borrow from the Secretary any of the Books or Pamphlets belonging to the Society, provided they pay the cost of transmission, and guarantee their safe return within a reasonable time.

The Chairman remarked that such Models and Books as came into the possession of the Society, and were not required by the Secretary, might be of service to the Lecturer on Forestry in connection with his class in the University, and suggested that the Council should consider whether they ought to be sent to him. The matter was accordingly remitted to the Council.

Cleghorn Memorial Library.

The Secretary read the following letter, received by the President from the Director of the Edinburgh Museum of Science and Art, which it was agreed should be embodied in the Minutes of the Society.

Edinburgh Museum of Science and Art,
11*th March* 1898.

Dear Sir,—As you are aware, a number of the friends of the late Dr Cleghorn subscribed a sum of money, which they decided should be devoted to the purchase of suitable books to be placed

as a "Cleghorn Memorial Library" in this Museum, the expenditure of the money being entrusted to Colonel P. Dods and myself. The total amount available, viz., £197, 4s. 10d., was deposited with Mr J. A. Wenley of the Bank of Scotland, by whom the accounts for the books purchased were periodically paid. With your kind assistance and advice, the whole Fund has now been expended. There is no Committee of Subscribers to whom a report can be made of the manner in which the money has been spent. It occurs to me, however, that such a report may be of interest to the Royal Scottish Arboricultural Society, some of whose Members were among the chief contributors to the Fund.

Full details of the titles and prices of the books purchased will be found in Section VIII., pages 165–200, of the enclosed Museum Catalogue (recently published) of "Books, etc., on Botany and Forestry, including the Cleghorn Memorial Library." The price of each book is stated on the left-hand margin, and the totals are carried on from page to page, the final total (p. 200) amounting to £197, 4s. 10d., the vouchers for which are in Mr Wenley's hands. The books against which no price is marked were presented to the Cleghorn Memorial Library.—I am, dear Sir, yours faithfully,

R. Murdoch Smith, Maj.-Gen.,
Director Edinburgh Museum of Science and Art.

Colonel F. Bailey, R.E.,
President Royal Scottish Arboricultural Society.

Motions Postponed.

It was decided that the discussion of the Motions standing in the name of the Council regarding the Admission of Members, and of Mr John Clark, Forester, Haddo, Aberdeen, regarding the establishment of branches of the Society, should be postponed till the Annual Meeting in January.

Votes of Thanks.

On the motion of Professor Somerville, a hearty vote of thanks was accorded to the Chairman, which closed the business of the Meeting.

NOTICES BY THE COUNCIL.

ILLUSTRATIONS FUND.

The Council beg to direct special attention to this Fund, the object of which is to obtain contributions to defray the expense of illustrating the Society's *Transactions.*

Subscription received in 1898:—

J. K. Milne, Kevock Tower, Lasswade, . . £1 1 0

THE SOCIETY'S ALBUM.

The Council wish it to be known that the Society has an Album for the Photographs of Members, and the Secretary will be glad to receive contributions.

THE READING OF PAPERS.

Members are invited to read short practical papers on any subject connected with Forestry at the Annual General Meeting in January, or at the General Meeting to be held at the time of the Excursion. Those who intend to do so are requested to intimate, in writing, the Title of their subject to the Secretary, not later than 15th December 1898 or 1st June 1899; stating the time they may require for reading the paper.

SYLLABUS OF SUBJECTS FOR ESSAYS.

The following subjects are offered for competition in 1899 :—

[*The Judges are empowered to fix the value of the Prizes to be awarded according to the respective merits of the Essays.*

All Essays, Reports, Models, or other Articles intended for Competition must be lodged with the Secretary not later than 1st June 1899. All Collections of Cones, Seeds, and Rustic Work, intended for exhibition only, must be in the hands of the Secretary not less than three days before the Annual Meeting, to be held on 24th January 1899. Each Essay, Report, Model, or Article must bear a MOTTO, *and be accompanied by a sealed envelope bearing outside the* SAME MOTTO, *and the Class to which the Competitor belongs, and containing inside, a* CARD *with the* NAME *and* ADDRESS *of the Competitor.*

Essays should be written on one side of the paper only; the left-hand quarter of each page should be left as a blank margin. The lines should not be crowded together.

Judges cannot compete during their term of office.

Successful Competitors may either have the medals or their converted values, which are as follows:—Gold, £5; No. 1 *Silver*, £3; No. 2 *Silver*, £2; *Bronze*, 10s.]

CLASS I.—FOR OPEN COMPETITION.

I. For an approved Report showing the Financial Results of the Cultivation of Woods and Plantations. (*Ten Guineas* offered by Isaac Bayley Balfour, M.D., D.Sc., Professor of Botany in the University of Edinburgh, formerly President of the Society.)

> It is not necessary that the names of the estates on which the woods grow should be published, but the reporter must give the annual value of the land previous to planting; statistics of the cost of forming the plantations, including draining and fencing; the expenses of management, the income derived, and the present value of the Woods.

II. For an approved Essay on the best methods of realising Forest Products. (*Silver Medal* offered by Wm. M. Welsh, Esq., of Messrs Dicksons & Co., 1 Waterloo Place, Edinburgh.)

III. For an approved Account of measures successfully adopted for the Extermination of Insect Pests affecting Forest Trees.

(*Two Guineas* offered by John Methven, Esq., of Messrs Thos. Methven & Sons, 15 Princes Street, Edinburgh.)

Full particulars of the pests and treatment must be given, and also the name of the estate.

IV. For an approved Report on the Gales of November 1893 and December 1894, their results and consequences. (*A Medal.*)

V. For an approved Report detailing the methods employed to bring about the Natural Regeneration of a Wood, and the subsequent Treatment as regards Artificial Assistance, should such have been rendered necessary owing to the Natural Sowing having been irregular, insufficient, or too dense. (*A Medal.*)

The author must cite some particular case, and give the results of a systematic attempt at natural regeneration, bearing in mind the fact that a patchy imperfect restocking cannot be regarded as satisfactory or successful.

VI. For an approved Essay on the Valuation of Woods or Plantations for the purpose of Transfer. (*A Medal.*)

The writer to describe the method (*a*) of valuing matured woods, (*b*) middle-aged woods, (*c*) park trees and others that may be, in addition to their value as timber, considered as ornamental, (*d*) young woods, and (*e*) coppice.

VII. For an approved Report on the Plantations of which the competitor is Forester. Reporter to state the extent of plantations, the kinds of timber grown, soil, situation, age, management, etc. This is a standing subject. (*A Medal.*)

VIII. For an approved Report on the Present State and Future Prospects of Arboriculture in Ireland. (*A Medal.*)

IX. For an approved Report on the Present State and Future Prospects of Arboriculture in the North of Scotland. (*A Medal.*)

X. On the best Method of Procedure in growing a continuous Crop of Timber in Woods or Plantations. (*A Medal.*)

The Essay should deal with the different kinds of Woods, the ages, and proportion per acre of the trees at different stages, and whether these have been raised by natural or artificial means. Reference may be made to any system practised abroad which might prove applicable in this country.

XI. For an approved Report, based on results, on the advantage of Under Planting. (*A Medal.*)

XII. For an approved Essay on the best method of Preventing the Inroads of the Pine Saw-fly—*Lophyrus pini* of Curtis. (*A Medal.*)

XIII. For an approved Essay on any Disease incidental to Forest Trees. A standing subject. (*A Medal.*)

XIV. For an approved Report on the most advantageous methods, not generally practised in this country, of Transporting Timber. (*A Medal.*)

The reporter specially to describe any means, other than by horse-power, of moving felled timber from the interior of woods to their margins, or to roads.

XV. For an approved Essay on the best methods of utilising Small-wood in the manufacture of Fancy-wood articles, Turnery, Wood Wool, etc. (*A Medal.*)

XVI. For an approved Essay on the erection and maintenance of a Saw-mill and other wood-working Machinery suitable for Estate purposes. (*A Medal.*)

The writer should fully describe the saw-mill or other machinery to which his essay relates, giving estimates of out-turn and of cost.

XVII. For an approved Essay or Report on any other subject connected with Arboriculture. (*A Medal.*)

XVIII. For an instrument or method for expeditiously obtaining the diameter of trees at a given height, or for any other useful invention or marked improvement on any of the implements used in Forestry. Models or implements to be accompanied by a report. (*A Medal.*)

Class II.—For Assistant Foresters only.

I. For an approved Report, based on personal observation, on the Propagation of Forest Trees and Shrubs. (*A Medal.*)

II. For an approved Report, based on personal observation, on any disease affecting Trees, or injuries caused to Trees, by insects or animals. (*A Medal.*)

III. For an approved Essay on the Peeling and Harvesting of different kinds of British Bark used in Tanning. (*A Medal.*)

IV. For an approved Essay on the best method of protecting Trees from injury by Ground Game. (*A Medal.*)

V. For an approved Essay or Report on any other subject connected with Arboriculture. (*A Medal.*)

VI. For the best and approved Model in Rustic, or Ornamental Woodwork, of any subject designed and executed by the competitor. Model not to exceed six feet in length. (*A Medal.*)

The Council invite the attention of young Foresters to the foregoing subjects, as they wish to encourage their literary efforts.

ROBERT GALLOWAY,
Secretary.

5 St Andrew Square,
Edinburgh.

RAITH ESTATE

MAP OF THE PITWOOD WORKING CIRCLE

To accompany the Working Plan

1916

Scale 6 inches to 1 Mile.

Woods included in the Working Circle

Woods not included in the Working Circle

AREA STATEMENT

No.	Name.	A.	R.	P.	No.	Name.	A.	R.	P.
1	Raith Muir	78	1	24	21	Castlemains	3	2	28
		4	3	0	22	Sunnyside	4	0	0
2	Dogton Keagh Field	3	0	0			0	0	20
3	Clunie Mains Strips	3	0	0	23	Tullycroft	3	0	0
4	Ballfield	55	1	24	24	Carnbrieham	3	0	0
5	Clunie Muir	54	3	16	25	Torbain Moss	3	0	0
6	Easter Fosterton	34	1	32	26	Easterbridge	3	0	0
7	Fosterton Dsn	3	0	0	27	Fosterton Wood	3	0	0
		0	2	20	28	Burnhead	3	0	0
8	Fosterton Plantation	12	3	0	29	Torbain Quarry Belt	3	0	0
9	Sandyhall	3	0	0	30	Torbain Quarry Park	3	0	0
		0	2	12	31	(unlisted)	3	0	0
10	Begg Strips	3	0	0			0	0	20
		0	2	0	32	Shawwell West Fields	3	0	0
11	Begg Muir	3	0	0	33	Knockhaly	3	0	0
		0	0	6	34	Haughton	3	0	0
12	Dothan Strips	3	0	0			0	0	20
		0	3	0	35	Blackhead	3	0	0
13	Muir Strips	3	0	0	36	Shortland Quarry	3	0	0
		0	1	0	37	Smithy	3	0	0
14	Clunie Strip	3	0	0	38	Fenwyld Strip	3	0	0
15	Keagh Park	3	0	0	39	Fenwyld Moss	3	0	0
		0	2	0	40	Dundonald Moss	3	0	0
16	Clunie	3	0	0	41	Dundonald Square Wood	3	0	0
		0	1	0	42	Cotterhill	3	0	0
17	Square Wood	3	0	0	43	Blackhead	3	0	0
18	Cardenden Colliery	3	0	0	44	Buckhead Park	3	0	0
19	New Garden	3	0	0			0	0	20
20	Hyndloup	3	0	0					
21	Castlemains	3	0	0					
		0	2	0