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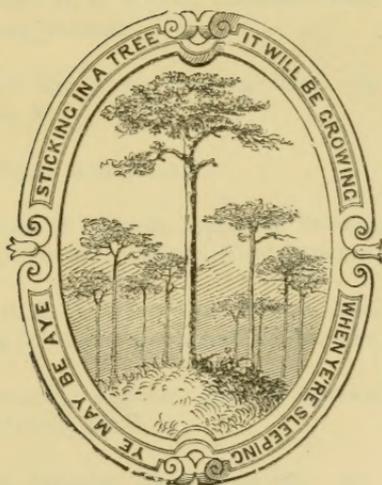
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TRANSACTIONS
OF THE
ROYAL
SCOTTISH ARBORICULTURAL SOCIETY.

LIEUT.-COLONEL F. BAILEY, F.R.S.E.,
HONORARY EDITOR.

ROBERT GALLOWAY, S.S.C.,
SECRETARY AND TREASURER.

VOL. XVI.



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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.

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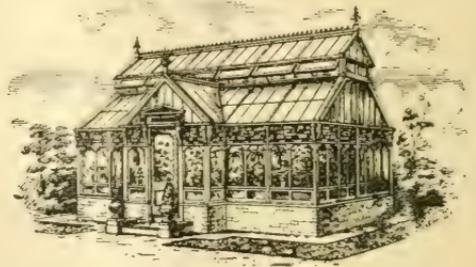
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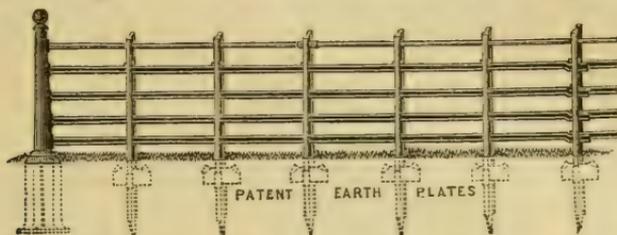
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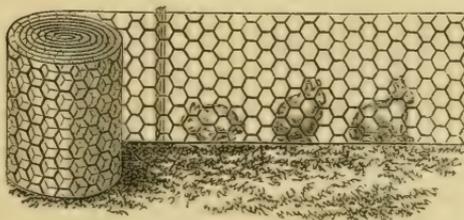
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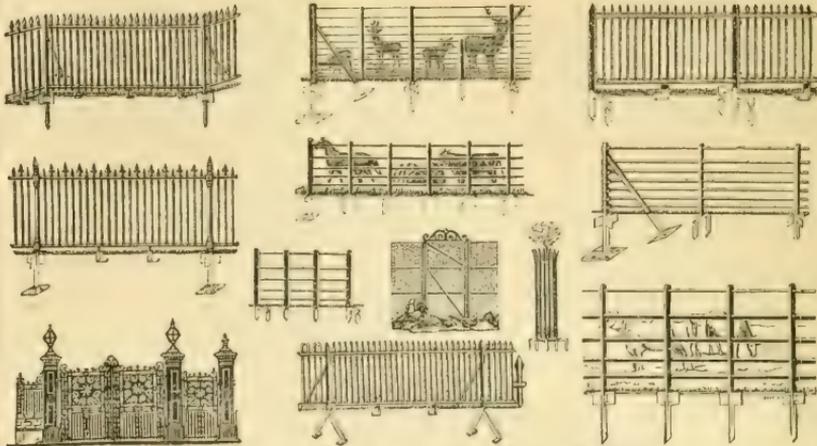
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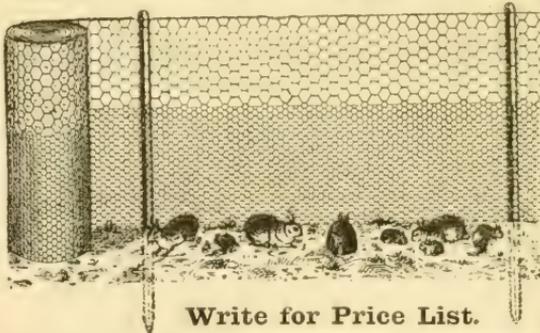


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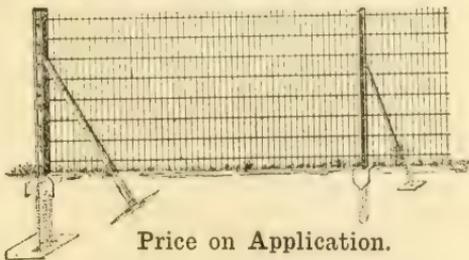
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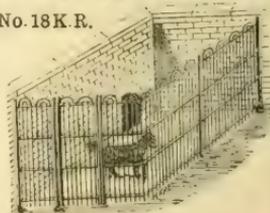
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Special Notices to Members.

HONORARY 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 6 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.

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 professional 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.

SPECIAL NOTICE.

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FORM OF PROPOSAL FOR MEMBERSHIP.

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Candidate's {
Full Name,
Designation,
Degrees, etc.,
Address,
Life, or Ordinary Member,
Signature,

Proposer's {
Signature,
Address,

Secunder's {
Signature,
Address,

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. Every Proposal for Membership shall be made on the FORM provided for the purpose, which must be signed by two Members of the Society as Proposer and Seconder, and delivered to the Secretary to be laid before the next meeting of the Council. The Proposal shall lie on the table till the following meeting of the Council, when it shall be accepted or otherwise dealt with, as the Council may deem best in the interests of the Society. The Proposer and Seconder shall be responsible for payment of the new Member's first Subscription.



Yours sincerely,
Malcolm Stuenkel

TRANSACTIONS

OF THE

ROYAL SCOTTISH ARBORICULTURAL SOCIETY.

J. Address delivered at the Forty-sixth Annual Meeting held on 24th January 1899. By Colonel F. BAILEY, President of the Society.

My term of office has now drawn to a close, and I desire to express my best thanks to the Council and Officials of the Society for the cordial support they have always given me, which has rendered my duties as President both light and agreeable. But before handing over office to my successor, I propose, with your permission, to offer a few remarks on some of the more important of the matters that have recently occupied our attention.

It is a common saying that woods here will not pay, though it is well known that in other countries they can be made to yield a handsome profit. It is said that our soil and climate are unfavourable to sylviculture; but no one has made clear to me what is wrong with either the one or the other. I have, however, heard it remarked that we have not sufficient sunshine for the development of close-grown crops; but I am not aware that we are worse off in this respect than the countries surrounding the Baltic Sea, with its northern and eastern extensions, whence we annually import a large proportion of the timber we use, which has obviously been grown in densely stocked woods.

It is a well-known fact that woods, and especially woods of fir, pine or larch, will develop vigorously on soil of very poor quality. I know forests in France, on the shores of the Bay of Biscay, growing on soil the mineral constituents of which, to the extent of 94 or 95 per cent., consist of pure flint sand; yet they produce pine timber of large dimensions, and large profits are made on the resin extracted from the trees. Is the soil that we complain of worse than that? Of course on our higher uplands, with their

exposed peaks and wind-swept ridges, a luxuriant forest growth cannot be looked for; but, with such exceptions, our comparatively mild and humid climate appears to be eminently suited for the growth of woods. Indeed, we have only to look at the magnificent isolated trees that adorn the parks and policies of our private estates, and in which we take so just a pride, to become convinced that there is not much wrong with either the soil or the climate which produced them.

The truth is that our woods are all private property; and that their owners, who have an unquestioned right to adopt any object of management which may appear to suit them best, have, generally speaking, wished to maintain them as game-coverts, or to enhance the natural beauty of their estates, rather than with a view to the realisation of the meagre profits which, alone, they believe them capable of rendering if devoted solely to the production of timber. That sporting and æsthetic considerations interfere most seriously with the practice of correct sylvicultural methods receives little or no consideration; and this can hardly be wondered at when, in the sale and purchase of landed estates, standing woods count for nothing, or next to nothing, in the price. But if landowners could be convinced that the growing of timber might be made a really profitable business, they would perhaps not be so ready to forego revenue derivable from this source, in respect, at any rate, of a portion of the vast area of the country which at present carries poorly developed woods, grown for other objects, or lies waste, yielding, at most, a small return from shooting rents.

For more than thirty years our Society has desired to demonstrate the extent to which improved—though well-known—sylvicultural methods might be suitably applied to our woods, where profit is to be the main object of management; and to train young foresters in the practice of these methods. In 1882, the foundation of a School of Forestry was recommended by the Council, and one of the objects of the Forestry Exhibition of 1884 was the promotion of this desirable aim. In 1889, the present course of lectures at the Edinburgh University was commenced. In 1891, subscriptions were invited and collected for the purpose of raising the lectureship to the status of a Chair, though the funds obtained proved insufficient.

But little real progress, however, resulted from these measures; and last year a representation was made by the Society to the

Minister of Agriculture, urging him to acquire and maintain a small State Forest which might serve the following, among other, objects, viz. :—

Firstly. To afford practical proof as to the sylvicultural methods best adapted to our natural conditions of soil and climate, and as to the profits they may be expected to result in.

Secondly. To provide a much needed object-lesson for the guidance of landowners and foresters.

Thirdly. To provide a practical training ground for students, in the absence of which theoretical instruction is ineffectual.

Fourthly. To provide a field of research for the compilation of forest statistics relating to our own country.

Unfortunately, the Minister does not see his way at present to do what we ask.

There is, perhaps, no science for the effective teaching of which practical demonstration is more essential than that of forestry. It is wholly impossible to convey a correct idea of many of the most important sylvicultural processes by the use of mere words and diagrams; and for instructional purposes it is absolutely necessary to have convenient access to woods which have been managed continuously, during a long series of years, in accordance with proper principles. This forms one reason why we have urged on the Government the necessity of providing a State forest; for the difficulties in way of continuously regular management on private estates is obvious. To all the great foreign Schools of Forestry are attached woods which are placed under the control of the director of the school, who takes care that all work is so arranged as to fall in with instructional requirements. Though neighbouring proprietors have most kindly made us welcome visitors to their estates, the classes at Edinburgh have not had the advantage of studying woods which have been systematically managed for a sufficiently long time, and the instruction given has unavoidably suffered in consequence.

We have not hitherto felt the want of a full supply of home-grown building timber, because we can readily obtain, almost at our doors, any amount of foreign pine and fir of better quality than the average produce of our own sparsely-stocked woods; and the price we pay for it is certainly low. But there is no doubt that, while the world's consumption of timber, as indeed of all or most other commodities, is increasing at a rapid rate, the

annual exports of several of the countries from which we draw our main supplies largely exceed the amount which their forests annually produce. In other words—in order to maintain their present high rate of export, they are cutting much more than they grow, and are thus dipping deeply into the wood-capital, which is their producing agent—the layer of their golden eggs! It is not difficult to see that this process cannot be indefinitely maintained. Indeed, experts are agreed that present over-consumption is undoubtedly leading to a wood-famine, or at best to a scarcity, which cannot fail to cause a rise in prices in the comparatively near future; and it will be to our advantage to place ourselves, as soon as possible, in a position to profit by such a rise whenever it may occur. It would evidently be to the interest of owners of land that we should occupy this position; and it would be no less to the advantage of those who make it their business to manage wooded estates, and who might reasonably expect that the efficient management of a more profitable business would entitle them to an improvement in their position and prospects. But we cannot reckon on occupying this advantageous position unless a considerable proportion of our woods is organised on business principles. A larch tree requires seventy or eighty years to attain its most profitable dimensions; and if, at the expiry of that time, the crop is to be a complete one, composed of sound trees of full size, the wood must be managed with this end in view throughout the entire period of its growth. Such management is best secured by means of a plan or scheme, called a Working Plan, which defines the object aimed at, lays down the general outlines of the means by which it is to be attained, and usually prescribes in some detail the work to be done during the first few years. Guided by such a plan, it is possible to avoid the changes too often introduced by new proprietors or managers, to the great prejudice of their woods, which, when thus treated, frequently present a disappointing appearance at the stage of growth when thinnings might be expected to yield a considerable profit.

Land devoted to the production of timber ought to be made to yield up to its full capacity, consistently with the provision of a sustained out-turn; but this cannot be looked for unless the factory contains a full complement of able-bodied and efficient workmen; or, in other words, unless the ground be fully stocked with healthy trees, each of which is adding duly to his own bulk

by the accumulations of successive seasons' growth. Again, the cost per cubic foot of fencing, working and controlling is less in fully stocked woods than in woods carrying a thin crop. Then, in regard to the fellings which the proprietor of the day is entitled to make. If his woods are fully stocked, he is evidently justified in taking, year by year, the amount of wood annually produced on his estate, a process which will leave the growing or producing stock undiminished. Indeed, he ought to take this amount, in order to nurse the market and avoid accumulations of growing stock, which are often inconvenient and unprofitable. But if he is without a plan, he is ignorant of the amount annually produced, and consequently of the number of trees it represents, or the area it entitles him to clear; and this ignorance may lead either to crops of trees standing long after they have ceased to occupy the ground profitably, or to the detriment of the property by over-cutting. Then again, as regards the markets, the regular out-turn of a certain fixed quantity of produce of a well-known class is sure to attract buyers, and thus to improve prices; while, at the same time, it encourages the establishment of wood industries in the neighbourhood, and thus secures the profitable disposal of inferior classes of wood for which there would otherwise be no local demand, and which it would not pay to export to distant markets. A regular out-turn, under a settled plan, further renders it possible to reduce the cost of transporting the timber to convenient sale-depots by the use of mechanical appliances, which could not be adopted for work conducted here and there in haphazard fashion, a method which, it may be observed, involves the maximum of cost; and a recognised plan of operations enables all work to be laid out, and sales to be arranged, in advance. All these things tend to increase receipts, to reduce outgoings, and thus to enhance the profit derivable from the business.

About 800 acres of pine and fir woods at Raith have recently been brought under the operation of a plan such as that above indicated; the object of management being the conversion of the produce into pit-wood, for which a practically unlimited demand exists in connection with the local coal-mines. A detailed examination of these woods has disclosed an almost complete break of twenty years in the work of planting; and this has indicated their classification into the "older" and the "younger" woods. The main feature of the scheme consists in the distribution of the fellings of the woods of the older class over

the number of years that must elapse before the oldest of the younger woods, now seventeen years of age, attain suitable dimensions. Here, in future, work will be carried out in regular fashion, the results of management being clearly recorded in books specially prepared for the purpose. The estimated profits much exceed those hitherto realised, this being due to the fact that on this part of the estate profit is now to be the sole object aimed at,—sporting and æsthetic considerations will occupy a subordinate place; but it should be added that the market rates are here exceptionally favourable, and that every stick grown can be either used on the estate or sold. Probably there are not many estates in Scotland so fortunately situated in this respect as Raith.

The proprietor has most kindly permitted the woods of the Pit-Wood Working Circle to be freely used for educational purposes; and although this fact does not relieve us from the duty of urging on the Government the necessity of establishing a small State Model Forest, our immediate requirements in the matter of a practical training-ground for students are effectually met. A Working Plan for the Novar woods is now under preparation on lines similar to those of the Raith plan; and the provision of a bursary to enable a student desirous of becoming a practical forester to attend the University class has been mentioned in the Report of the Council. The preparation of the Raith and Novar Working Plans, and the inauguration of this bursary, are important events of a most encouraging character. I feel confident that the start now made will have far-reaching effects, and will result in an unchallengeable affirmative answer being given to the question, “Can woods in Scotland be grown profitably?”

It is now my pleasing duty to propose that the Earl of Mansfield be elected as my successor. In doing so, I need not say more than that his ownership of extensive woodlands secures his interest in our work, and renders him an eminently desirable President of our Society. We esteem it an honour that he should be willing to undertake the duties of the chair.

At the close of the business meeting, Colonel Bailey gave a short address on the timber resources of Canada and the United States, and then showed a number of lantern slides illustrating a journey in Canada which he had made in the autumn of 1897. His remarks were to the following effect:—

The United Kingdom is the world's greatest importer of timber; we take something like £18,000,000 worth annually, and the figure is rapidly rising. From four of the countries that supply us we obtain produce to the value of £14,000,000, viz.:— from Sweden, £4,000,000; from Russia, £4,000,000; from Canada, £3,500,000; and from the United States, £2,500,000. Let us consider for a moment the position in Canada and the United States, which together provide us with one-third of our annual requirements.

As regards the former country, we have copious information in Johnson's "Report on the Forest Wealth of Canada," 1895. The forests are estimated to cover an area of 1,250,000 square miles, or about forty-two times the area of Scotland with all its islands. This is ample enough to grow wood for home consumption, as well as to supply the United States and the British Isles, and one might almost add, the world at large. But a considerable proportion of this vast area does not now contain marketable timber, and the remainder is not under conditions which will enable it to yield a permanent supply. There are already signs of exhaustion visible in the reduced size of the logs we receive as compared with those sent over a score or so of years ago. The White (Weymouth) pine of marketable size will have disappeared before many years have elapsed, while the young natural crops are being destroyed by fire; and the position of the spruce and the Douglas fir is not much better.

Fire is the great destroying agent, and there can be no doubt that although the uncontrolled rapacity of the lumberman is answerable for a good deal, fire consumes, or irretrievably damages, a vastly greater share of the forest wealth of the Dominion. Settlers in the "back woods" are responsible for perhaps the greater part of the destruction by fire. They get grants of forest land, covered with huge trees, which, so long as they stand or lie on the ground, form an effectual impediment to its cultivation. They must clear the ground; and to cut down and drag away timber for which there is no market is a practical impossibility for them. But the highly resinous pines and firs quickly succumb to the fierce flames which soon follow the kindling of a fire; and in this way the settler is able, without the expenditure of time and superhuman labour, to rid himself of a crop of magnificent timber, which represents to him nothing but an otherwise immovable impediment to the development of the "claim" for the support of himself

and his family. Unfortunately, the evil does not stop here ; for the fire once lighted gets at once entirely beyond his control, and it burns on until stopped by a river, a sheet of water, an area already burnt, or some other obstacle to its progress. Railway lines, again, have led to damage on an enormous scale. To facilitate their construction through the dense primæval forests, uncontrolled burning has been freely resorted to ; and during the hot and dry season of the year sparks from engines annually continue the work of destruction ; so that when travelling by rail through long stretches of country which it may take hours to traverse, one sees nothing, as far as the eye can reach, but the bare, blackened stems of pine and other trees, under which a second growth, usually of inferior species, is struggling up.

If Canada is to secure provision even for her own future wants, she must look to her resources before it is too late to do so. She should at least establish extensive reserves, and effectually protect them against fire. The present area of reserved forest is insufficient, and the measures taken to preserve it from burning are wholly inadequate. To the traveller across the continent by the Canadian Pacific Railway, the thought naturally occurs as to what effect the wholesale destruction of forests formerly covering the catchment basins of the great lakes may have on their water-levels. This is an important consideration, in view of the great inland water-way which they form.

In the United States the area reserved and effectually protected formed recently but a very small fraction of that needed for the permanent supply of the *existing* population. The States appear in the returns as exporters to us, but they take from Canada something like twice the amount of their shipments to this country ; and there is no doubt that before the lapse of many years they will require and take all that Canada will then be able to spare. Whenever this situation arises, we shall have to look elsewhere for the £6,000,000 worth of timber that now comes to us across the Atlantic, or to go without it ; and this fact alone is sufficient to warrant the opinion that a rise in the price of imported timber is to be confidently anticipated, and to give ground for urging the desirability of planting up a substantial portion of our own waste land with as little delay as possible.

At the close of these remarks Colonel Bailey exhibited his lantern slides.

II. *The Bo'ness Pit-Wood Trade.*¹ By Colonel F. BAILEY.

The importation into the port of Bo'ness, which commenced about thirty-five years ago, of pit-wood for use in Scottish mines, rose last year to 116,991 loads, representing rather more than that number of tons of wood.

For the first few years the timber was carried in small sailing vessels of from 150 to 200 tons. These took in their cargo at Christiansand, Christiania Fiord, and other ports on the south-western coast of Norway, whence freights were low, and the vessels carried back Scotch coal. Somewhat later, shipments began in sailing vessels of larger size from western Swedish ports, chiefly from Göttenborg, the terminus of the trans-peninsular canal, down which much pit-wood was, and still is, floated from the shores of lakes Wener and Wetter. Sailing vessels up to 600 or 700 tons burden still convey large cargoes of wood from Norwegian and western Swedish ports; but steamers up to 1500 tons burden are for the most part now employed in the Göttenborg trade. Pit-timber comes over chiefly in the form of round props, cut to lengths of from 2 feet to 8 feet, and having a minimum diameter at the small end of $2\frac{1}{2}$ inches for the shortest and 8 inches for the longest pieces. Pit-wood from the south-eastern coast of Sweden is, however, as a rule imported in the form of poles from 9 or 10 feet to 35 feet in length, with a minimum top-diameter of 3 inches; but a small consignment of heavier poles, up to a top-diameter of 6 inches, also reaches us from that region. Much of this longer timber is carted in by farmers from woods growing at distances up to ten miles from the loading ports; and large quantities of the shorter props are carted, sledged, or floated down to Swedish ports on the shores of the Gulf of Bothnia; while, during the last fifteen years, immense cargoes of produce of this class have been shipped from Russian ports on the northern shores of the Gulf of Finland, and on the eastern shores of the Gulf of Bothnia.

In both Norway and Sweden, growing forests from which mine-timber is still obtained are becoming as scarce near the sea-coast as they are on the banks and shores of rivers and lakes; and the principal shipments are now made in steamers from Finland, where vast forests exist, but where railways have not yet penetrated,

¹ Written from information kindly supplied by Mr D. K. Harrower, of the firm of John Denholm & Co., pit-wood importers and timber merchants, Bo'ness.

the wood having to be brought to the coast on carts or sledges, or floated down by river. How long these supplies may last cannot at present be estimated; but in the absence of an organisation limiting the quantity exported to that which the yearly growth of the forests can replace, and providing for the restocking of the ground by planting and sowing, or by duly protected natural regeneration, it is easy to see that the present rate of export cannot be permanently maintained.

Numerous cargoes of wood of a class which used formerly to be discarded as waste are now floated by canal to St Petersburg, whence they are shipped to Bo'ness and other ports as pit-wood; while large consignments of props in 7 feet to 8 feet lengths are brought over from the Gulf of Riga, and also from Stettin and other German ports. The vessels employed in this trade usually carry back coal.

The wood lying in the port of Bo'ness is chiefly spruce; but there is also a proportion of Scots fir, which, being more resinous, is considered to possess greater durability. The timber has been grown in dense forests, and has therefore narrow annual rings, and is comparatively free from knots, while it tapers but little, and has for the most part been barked. It is, generally speaking, sold to mine-owners "in the round"; but logs of 6 inches and upwards in diameter are sawn longitudinally into quarters and sold in lengths of $1\frac{1}{2}$ feet to $3\frac{1}{2}$ feet.

The usual dimensions of the shorter imported props, and the prices per 100 linear feet now charged for them "*ex ship*," are as follows:—

Top-Diameter. Inches.	Lengths. Feet.	Prices per 100 Linear Ft.	
		s.	d.
$2\frac{1}{2}$	2, $2\frac{1}{4}$, $2\frac{1}{2}$, 3, $3\frac{1}{4}$, $3\frac{1}{2}$, $3\frac{3}{4}$, 4	2	3
3	$3\frac{1}{4}$, $3\frac{1}{2}$, $3\frac{3}{4}$, 4, $4\frac{1}{4}$, $4\frac{1}{2}$, 5, $5\frac{1}{2}$, 6	3	3
$3\frac{1}{2}$	$3\frac{3}{4}$, $4\frac{1}{4}$, $4\frac{1}{2}$, 5, $5\frac{1}{2}$, 6, $6\frac{1}{2}$, 7	3	9
4	5, $5\frac{1}{2}$, 6, $6\frac{1}{2}$, 7, 8, 9, 10	4	10
$4\frac{1}{2}$	$5\frac{1}{2}$, 6, $6\frac{1}{4}$, $6\frac{1}{2}$, $6\frac{3}{4}$, 7, $7\frac{1}{2}$, 8	5	6
5	$5\frac{1}{2}$, 6, $6\frac{1}{4}$, $6\frac{1}{2}$, $6\frac{3}{4}$, 7, 8, 9, 10	6	6
$5\frac{1}{2}$ } 6 }	6, $6\frac{1}{2}$, 7, 8, 9, 10	{	7 6 8 6
$6\frac{1}{2}$ } 7 }	$6\frac{1}{2}$, 7, 8, 9, 10	{	9 6 10 6
$7\frac{1}{2}$ } 8 }	7, 8, 9	{	11 6 12 6

For long pit-wood of 3 inch top-diameter, running from 10 feet to 35 feet in length (average 15 feet to 16 feet), the price per 100 linear feet is now 4s. 6d.

The rates above quoted represent from 5¼d. to 5¾d. per cubic foot "*ex ship*," to which rate must be added from ½d. to ¾d. per cubic foot for shore dues, loading, and depot expenses, bringing the cost to purchasers at the port up to from 5¾d. to 6½d. per cubic foot. Railway freight to the mines forms, of course, an additional charge.

The Transactions of the Mining Institute of Scotland, vol. xx., part 2, 1898, contains an interesting paper by Mr George L. Kerr on "Timbering and Supporting Underground Workings." As regards the species of wood used, the author says: "The different kinds of wood used for mine-timbering in Great Britain are larch, Scotch fir, Norwegian pine, and sometimes oak and beech. In ordinary timbering Scotch fir is largely used, especially where the timber does not require to be heavy, and where the pressure is not great; but in drawing and main roads that have to be kept open for some time, larch has been found to be most efficient, both as regards durability and economy. Any woods that are long-grained and elastic, and will yield to thrust, are suitable for mine-timber, because props of such woods often serve the purpose for which they are used, even when partially fractured. Beech or oak props are short-grained, more or less brittle, and break off short under crushing strain. Their great weight, as compared with other woods, and the consequent difficulty in handling them, is against their use underground." He states that the cost of timber per ton of coal raised varies in different districts and different collieries from ½d. to 9d., according to the depth from the surface, the thickness of the seam, the nature of the roof, the inclination of the seam, and the method of working. He gives the crushing strain for ordinary larch props as 1½ to 2 tons per square inch, "according to the age of the wood and the seasoning that it has undergone." If the timber be cut when green, and allowed to season or dry in a gradual manner, it is said to be 49 per cent. stronger than "ordinary pit-props." The writer concludes his paper with the following remarks on the preservation of timber:—"Timber required for use underground, or indeed anywhere, should be cut in winter, when the wood has little sap in it, because the sap ferments and causes rapid decay; wood should also be well seasoned before being used; and if these two

points are carefully attended to, they constitute frequently the only preservative that the timber requires. The bark should also be removed before being used underground; and if this be done, there is less liability for the timber to rot, and the decay, when it sets in, is more easily detected." Creosoting has, he observes, the disadvantage that it renders the timber more inflammable, while it also diminishes its strength.

The dimensions and rates above given may prove a useful guide on estates where the preparation of pit-wood has not yet been attempted. On properties which are favourably situated, this trade might become very profitable, as, owing to the shortness of the rotation (which, in the case of pines and firs need not exceed thirty-five or forty years), the returns are comparatively early and the risk is proportionally reduced; while, up to that age, dense crops, even of Scots fir, can be maintained; and there can be produced, on each acre of ground, a large number of the tall, straight, clean and cylindrical poles, such as will yield the best possible class of timber for use in mines. Props sawn from larger stems of the rough quality grown in open crops of greater age, are not nearly so much liked, on account of the splinters from them which injure the miners' hands.

Even where the production of pit-wood does not form the main object of management, it is likely that, in many localities, the thinnings made between the ages of about thirty to forty-five years or more, in coniferous woods with a higher rotation, may be profitably disposed of for this purpose; and crops which have been destined to stand for a longer period, but which are found at these ages in an unpromising condition, might, in some cases, be cleared off and sold to the pit-wood merchants.

When considering the relative merits of the Scots fir and the spruce for use in mines, it should be remembered that, although the wood of the former is more resinous, and consequently more durable than that of the latter, spruce trees grown in dense crops, having narrow annual rings, yield timber of a much more durable quality than is ordinarily raised in open woods; and that the tendency of the spruce to throw out strong side-branches in youth being much less than that of the Scots fir, clean poles can be more easily grown of the former than of the latter species. At the same time, owing to the shade-bearing properties of the spruce, a considerably larger number of stems of that tree can stand in a healthy condition on an acre of ground than in the case of the light-loving Scots fir.

III. *Pure Forests and Mixed Forests.* Lecture delivered on 24th February 1899, by Sir DIETRICH BRANDIS, K.C.I.E., LL.D., late Inspector-General of Forests, India.

It is a great honour to be allowed to speak here for the first time before the Royal Scottish Arboricultural Society. As early as 1873 they did me the great honour of nominating me an Honorary Member of the Society. That was an honour which I value very highly. I have since then repeatedly sent contributions to the *Transactions* on general matters which, I was told, would interest your members; but I have not yet had an opportunity of speaking before you in this beautiful town of Edinburgh.

There are plants and trees which by nature, by their individual character, like to live in company of their kind. We call them "gregarious." There are other plants and trees which you find only scattered. Among the gregarious plants you will at once remember the heather, the flowers of which in August and September ornament your hills. It covers large areas, and where you have the heather there is little else besides. Among the trees you will at once remember the beautiful forests of Scots Pine at Rothiemurchus, and on the hills near the Strathspey valley. Those of you who accompanied Professor Schwappach on your tour through the forests of Northern Germany will recollect the extensive areas of Beech forest in that part of the country. Other trees however—for instance the Maple, the Sycamore, or the Ash—you will never find covering large areas by themselves.

Concerning the Oak, I must, with your permission, enter a little into detail. The Oak, which is commonly known as the British Oak, foresters in Germany and France classify as two distinct species—*Quercus pedunculata*, with the acorns on long stalks; and *Quercus sessiliflora*, with acorns on short stalks. The former, in Germany, grows in the plains, often on low ground along the banks of rivers, and here it forms pure or nearly pure forests, with an underwood of Hazel, Bramble, and other shrubs. *Quercus sessiliflora*, on the other hand, mostly grows on the hills, and, as a rule, in company with the Beech, the Hornbeam, or the Silver Fir. It is very remarkable that these two kinds of Oak, which are so nearly related to each other, that by English botanists they are generally regarded as belonging to one species, should be so different in their habits.

Doubtless you are disposed to ask the question, What makes

certain trees gregarious in their character, while others are only found scattered in forests of other trees? A complete reply to that question cannot be given at present, but perhaps we shall be able better to understand one of the factors which govern the habits of trees in this respect, if you follow me for a few minutes into a range of mountains called the Nilgiris, or Blue Mountains, which are situated in the peninsula of India. This mountain range is associated with the name of my dear late friend, Dr Hugh Cleghorn, who repeatedly has been the President of your Society, and whose services to Indian Forestry cannot be spoken of too highly.

These mountains have probably received their name from a shrub, a species of *Strobilanthes*, which covers extensive areas on the slopes, and which bears a profusion of blue flowers. Like this one, other species of *Strobilanthes* also are gregarious, some covering large areas in the open, while some form the underwood in the forest. It is a remarkable fact, that most of the gregarious species do not flower annually, but in periods, according to the species, of from five to ten years. There is an underground rootstock or rhizome, which annually sends up leaf-bearing stems. When the rootstock has attained a certain age, flower-buds instead of leaf-buds are formed on the branches, the plant is covered with flowers, and after the seeds have ripened, it dies. There seems to be a certain coincidence between gregarious habit and periodical flowering. In a marked manner this shows itself in the Beech, and in several coniferous trees, which are eminently gregarious. There are no large Beech forests in Scotland, and the circumstance may not be as familiar to you as it is to foresters on the Continent, that the Beech does not bear a good crop of seed every year, but that mast years occur at irregular intervals of from five to ten years. Those trees and shrubs, which flower periodically at regular or irregular intervals, on such occasions produce such an abundance of seed that the thickets of young plants kill out everything else, and thus grow up as pure woods.

These remarks must suffice by way of introduction. The question of gregarious and sporadically growing trees is a very large one, which may well claim the interest of foresters and botanists.

I desire now to draw your attention to several large areas stocked with pure forests in Germany. You will, I feel sure, excuse my speaking of the forests of my own country. In the first place, I am more familiar with them; and, in the second

place, the forests of Germany are so vast, so varied, and are managed in a manner so methodical and skilful, that the study of their management is exceedingly instructive.

In the first instance I wish to mention the kingdom of Saxony. That State, which extends on both sides of the Elbe river, is one of the most densely peopled in Germany. It is a small country, covering only 5700 square miles, which is less than the mean area of a district in the Presidency of Madras. There are 3,787,688 inhabitants, or 660 souls to the square mile. You would think that in Saxony every inch of land would be required to grow corn and cattle fodder, for it is a highly industrial, a manufacturing and mining country. Nevertheless it has no less than 26 per cent. of its area under forest, and it is this area of well-managed forests which, as a matter of fact, contributes largely to the prosperity of that country so densely populated. The State forests of Saxony comprise 435,000 acres, divided into 108 ranges. Each range is under the charge of an executive officer, and the mean area of a range is 4000 acres. That is the area which experience in that country has shown can most advantageously be managed by one man. These executive officers have received the very highest practical and scientific education. Above them are a number of high controlling officers, who are chosen from among those executive officers who have distinguished themselves by efficiency and ability.

A large area of these forests is situated on the northern slopes of the mountain range which divides Saxony from Bohemia. This mountain range, which rises to an elevation of 3000 feet, is known as the Erzgebirge; and the forests on the Erzgebirge are the largest and most important of the State forests of Saxony. They consist almost entirely of pure Spruce. However, it was not all pure Spruce formerly, but gradually, through the system of management adopted in that country, they have been converted into pure Spruce forests, because these have been found, in the circumstances, to be the best paying woods.

The management is exceedingly simple—it is clear cutting and planting, the system to which in many parts of Scotland you are accustomed to. The clearances, however, are made with the greatest care, so as to guard against damage. It is a hilly country, consequently the action of storms and heavy winds is often very dangerous. You know something of the action of storms, for a few years ago a very large area of fine forest was thrown down in

Scotland. It was a real calamity, for much of the timber, I understand, could not readily be sold. Well, in order to guard against such misfortunes precautions are taken. You know, when of a densely stocked wood, with a stand of say ten to twelve thousand cubic feet to the acre, a portion is cut down, if the side where it has been cut is exposed to the wind, it is blown down at once. In Saxony the cuttings are arranged so as always to go against the prevailing wind direction, so that no part of the wood fresh cut may be exposed to the wind. The prevailing wind direction in that part of Germany is from the south-west, and hence the cuttings in mature woods proceed in the opposite direction, except where the direction of the valleys and the general configuration of the country modifies the direction of the winds. True, occasionally, particularly in winter, storms come from the opposite direction. Such calamities do great damage, and against such no protection is possible.

These clearances are not massed together, but they are evenly distributed over the entire range. Nor are clearances made continuous in successive years. Not until the young wood on a clearance is several years old, is a fresh clearance made alongside of it. This is another necessary precaution under the system of clearing and planting. Though Saxony is a densely populated country, nevertheless wood and coal are so abundant that it does not pay to dig out the stumps and roots of the spruce, for they could only be utilised as fuel. They remain in the ground, and in them the pine weevil, *Hyllobius abietis*, breeds, which would destroy the young plantation, if a fresh area were cleared and planted, before stools and roots in the area adjoining had decayed. The Saxon forester therefore waits a number of years, so that there is always between two young adjoining woods a difference in age of from three to five years.

I regret that on the present occasion I cannot go further into the details of the management of these Saxon woods. The prevailing rotation is eighty years, which means, that the trees as a rule are not allowed to grow older than eighty years. In the State forests of Saxony a valuation of the land and of the crop growing on it is made every ten years, so as to take account of the financial result of forest operations. Every year, as you know, a tree grows in height and increases in girth, and therefore every year a certain amount of wood is produced in the forest. The question is what percentage does the money value of that

annual increase bear to the capital value of the forest—soil and growing stock.

You will readily understand that this question opens up a series of intricate problems, the study of which to a practical Scottish or English forester may seem a useless waste of time. Compared with an old wood, the selling value of a plantation which has attained the pole stage, say at the age of from thirty to forty years, is small. At that period of their life trees grow with great rapidity, and the annual increment represents a high percentage of the capital value of the forest. As the trees grow older the value of the timber increases, and the annual increment naturally represents a steadily diminishing percentage on the capital value of the soil and the timber crop standing on it. At last a stage is reached at which it would be more profitable to cut the wood and to invest the proceeds in Government securities, at say 3 per cent., than to let the forest stand and grow older.

In the State forests of Saxony, and in large areas of woodlands on private estates in Germany, which are managed on a similar system, the general rule is to cut the wood when that stage has been reached, that is when the annual increment falls below 3 per cent. on the capital value of the forest. Experience has shown that when Spruce forests in Saxony are over eighty years old, the proportion of the annual increment to the capital value of the forest has fallen below the rate at which money can be invested in Government securities. Hence woods that have attained the age of eighty years as a rule are cut. In that way these forests are managed, and the result, so far as money goes, is quite wonderful. The return of these pure spruce woods on the Erzgebirge, after deducting all outlay of whatever kind, is 32s. an acre. This is the average yield on an area of more than a hundred thousand acres. That is an instance of pure forests which I wished to mention to you.

But in spite of all precautions there are drawbacks. *First*, the wind plays havoc with spruce woods, when they are pure, to a much greater extent than is the case in mixed woods. *Secondly*, insects do an immense deal of damage. And here I may be allowed to mention a forest area in the kingdom of Bavaria, a much larger country than Saxony, but, like Saxony, exceedingly rich in forests, which, though as a rule managed on an entirely different system, are in splendid condition. Bavaria is not as densely inhabited as Saxony. South of Munich, not far from the

railway line which leads to Innsbruck and across the Brenner Pass to Italy, there is a large area of Spruce forest, called the Ebersberger Park, which I visited in 1889. It is one compact mass, covering about 16,000 acres. At the time of my visit the outskirts of that Spruce forest were well stocked and in good condition, but in the interior every tree was bare; a dense forest of tall trees, all leafless, like a huge churchyard. This was the work of the caterpillar of a moth known as the Nun, *Liparis monacha*. In moderate numbers this insect is found everywhere in forests of the spruce and of the Scots pine, but at times, when in a certain locality the seasons during successive years have been favourable for its development, and less favourable for the development of its enemies, it multiplies in an extraordinary manner. The moths are white, they were swarming about like the flakes of snow in a snow-storm. You will ask why the outside of the forest was not eaten bare by the caterpillars. They dislike wind, and love snug comfortable places, hence they avoid the outside of the wood; and in a hilly country they avoid ridges and exposed peaks.

In the "Ebersberger Park" 4700 acres had been eaten completely bare, not a vestige of a leaf being left on the trees; and a further area of about 7400 acres was severely attacked. Similar damage had been done by the "Nun" in other large forest districts in Southern Germany and in Austria. The forest is the property of the State, and nothing remained except to cut the whole of the timber at once. To wait and to cut the trees gradually was out of the question. The timber would have deteriorated and the bark beetles would have multiplied to such an extent as to endanger the existence of other forests in the vicinity. The calamity was met with wonderful skill and energy. A branch railway was built from the main line into the heart of the forest, and small forest tramways were laid through the different compartments. Saw-mills were erected, and the whole of the timber was sold only a little below its usual market price, and the loss, therefore, was not considerable. The timber of that forest has a good reputation. A great deal of it went to Italy, and the smaller stuff was taken up by those excellent allies of the German forester, the paper-pulp manufacturers. The newspapers of the present day, *The Scotsman* and *The Times*, are, as you know, printed to a great extent on paper made of the spruce wood. Some people imagine that with the steadily growing con-

sumption of paper, the use of wood to make paper-pulp will entail the rapid destruction of forests. Nothing of the kind. The paper-pulp manufacturer is a most powerful ally of the forester. The small stuff in spruce woods can always be sold, and hence the forester can thin regularly and frequently, as he is sure of a market for his thinnings. In this way this huge quantity, which amounted to 53,000,000 cubic feet, was sold without difficulty. When all the timber had been disposed of, there remained the task of replanting the area, and this also has been accomplished successfully. All this required systematic and methodical arrangements. The heads of the Bavarian State forests determined to diminish the cuttings in other forests, so as to throw the demand for timber more upon those which had been devastated by the Nun.

You will now understand the great risk to which pure Spruce forests may at any time be exposed. There were beech trees here and there, which had grown up with the spruce, and the caterpillars had not touched them. The Nun had destroyed many other forests, and it was found that mixed woods, where the spruce was associated with beech in large quantities, or with Scots pine, had not been attacked by the insect.

I could give you many other instances of large areas stocked with pure woods, but I believe you understand now what the advantages and what the disadvantages are of pure forests. The advantages are that the management is simple and easy, for you have to deal with one species only. The disadvantages are that pure woods are more exposed to damage by wind and snow, by fungus, and by insects. The tendency therefore, you may readily imagine, in Germany at the present day is towards mixed forests.

Some of the finest mixed woods are those of Scots pine and beech, the beech forming the lower story and the Scots pine the upper story. Other woods consist of oak and beech, the beech again forming the lower story and the oak the upper story of the wood. Trees have to be studied with reference to the amount of light they require, and the finest mixed forests are those where you have a tree that requires much light forming the upper story—standards, you may call them—and a tree that requires less light in the lower story. You all know that the Scots pine requires a great deal of light. It does not grow up in the shade nor does the oak.

You also know that young thickets of Scots pine and young thickets of oak shade the ground well. The surface soil under

those thickets is loose, and this means that the air can readily penetrate to the roots. When the wood is thin the ground gets hard and is covered with grass, bilberries, or heather; and you know that a hard surface of the soil is not conducive to the happiness of a tree. However, as the thickets of oak and Scots pine get older and approach the pole stage, they thin out, and the foliage no longer is dense enough to shade the ground completely.

It is different with the beech and with other species that require less light and can support shade. Whether in the stage of thicket, of pole woods, or of mature trees, the ground remains shaded completely. Hence it is an advantage to have a lower story of beech under a forest of oak or Scots pine. Nothing is more beautiful than such a two-storied wood. The soil is being fertilised by the leaves of the beech; the standards of the oak or Scots pine grow much more rapidly; they clear themselves of side branches; they form long, straight, and regularly shaped boles, and their value as timber is much greater than that from a pure oak or Scots pine forest.

And that applies not only to the oak or Scots pine, but equally so to the larch, a tree which is justly regarded with much favour in Scotland. Still, if you look at the larch forests of the Alps, where it has its home, you will find that it grows best where it has a lower story of beech, and sometimes a lower story of other species. When the ground is covered by a lower story of a suitable species, the larch forms tall, clean stems, and it is much less exposed to attack by fungus or insects. Foresters in Scotland may find it useful to bear this in mind.

As already stated, in Germany the tendency at present decidedly is to encourage the growth of mixed forests; and these mixed forests, as I have said, as a rule consist of an upper story of trees that require a great amount of light, like the oak or the Scots pine, and a lower story, which in most cases is beech. But you may say this is an utterly impracticable proceeding, because beech can only be used as firewood, as a rule, and it fetches much less than the wood of either the oak or the Scots pine. So it is, and for the present I am content to leave you under the delusion that the German plan of mixed forests is utterly impracticable.

Let me now take you to that beautiful forest in Bavaria, which, if any of you have ever time to visit, it will well repay the trouble—the Spessart. It is situated in a large bend of the Main river, one of the principal tributaries of the Rhine. The underlying

rock is the red sandstone of the Trias, and the soil is mostly poor and sandy. From time immemorial the Spessart has been a forest country. Formerly it was the haunt of famous robbers; there were no roads and few villages. That forest originally consisted entirely of beech and oak. In old times the oak was mainly wanted to make wine casks for the produce of the vineyards near the Rhine and its tributaries.

When the trees were felled, they were split up into cask-staves, and these were taken down on mules or on men's backs. Large glass-works were in those days in the Spessart, the beech timber was burnt, and excellent glass was made of the potash and the pure sand, which collects in the stream beds. The demand at that time was greater for the beech than for the oak. In the soil and climate of the Spessart the beech grows with much greater vigour than the oak, and under ordinary circumstances the oak is apt to be suppressed and killed out by the beech. But the wholesale cutting of the beech for the glass-works in old times favoured the oak, and hence the great present value of these forests. The oak has grown up in company with the beech, and has formed fine tall stems.

I have selected the Spessart as an instance of mixed woods, because the principles which here regulate the cutting of the oak are entirely different from those by which, in the kingdom of Saxony, the management of the Spruce forests is governed. There is a large area in the Spessart of magnificent old oak woods. They are almost pure oak, with an underwood of beech. Their origin dates back to that terrible time in Germany, the Thirty Years' War. Happy is Great Britain because it never had a thirty years' war. Germany to this day is a poor country, and it is a poor country to a great extent because it was devastated from one end to the other between 1618 and 1648. Before that war the cattle in the fertile valleys that surround the Spessart had been in the habit of making the higher parts of these hills their high-level grazing-grounds during summer. These lands were to a large extent stocked with open oak woods, with excellent pasture under the scattered trees. The woods could not fill up by self-sown seedlings, because the cattle trod down or nibbled the young oaks. But during the Thirty Years' War the cattle were slaughtered or driven away, and the result was, that when the first mast year came round large masses of acorns were shed, and the ground got covered with young growth of oaks. That

is the origin of these beautiful oak woods, of which there are 1000 acres in one continuous block on the north face of the Geiersberg, the highest point of the Spessart. Under the old trees a great deal of beech has sprung up naturally, and in a portion of the area beech underwood has been sown and planted.

What I wanted to say regarding the management of the oak in the Spessart is this: In all valleys which descend from this mountain range are saw-mills, places where staves for wine casks are split, and other wood-working establishments. The demand for first-class oak timber is steadily increasing, and as the Spessart supply is not sufficient to satisfy this demand, timber from other parts of Germany and from Slavonia is brought to these saw-mills in large quantities, to be cut up. The Spessart oak, however, is the basis of this industry, which in these localities would come to an end if that source of supply were exhausted. Hence the Government of Bavaria have long ago decided to spread the cutting of the mature oaks in the Spessart over as long a time as possible, so as to maintain this source of wealth for the benefit of the country. The old oak trees mentioned above, as having sprung up after the Thirty Years' War, which are now about two hundred and fifty years old, will, under this arrangement, not be cut until they are well over three hundred years old. Until that time arrives the trees of greater age will be cut, large numbers of which stand scattered in the beech woods. At the age of two hundred and fifty years the annual rings in the timber are barely visible, and the increment is insignificant, in some trees, indeed, it may be more than outweighed by the deterioration of the timber. This is a case in which the increment of the standing crop had long ago fallen below the rate of interest yielded by Government securities.

Year after year, therefore, the Government of Bavaria deliberately sacrifices a very large sum of money, which might be saved, if, instead of letting these old trees stand, they were cut, and the proceeds devoted to the redemption of a portion of the national debt of the country. On this question all parties in the Parliament of the kingdom are unanimous. They unhesitatingly approve of the present system, which is dictated by a due regard for the future wellbeing of the country, but which is not at all in accordance with purely commercial principles.

But I fear that the management of the Spessart may be condemned by you on other grounds. The glass-works have long

ere this ceased to exist, and you will ask : How is the beech wood utilised ? The oak sells at two to three shillings per cubic foot, while the beech only fetches two to three pence. And it would not even sell at this rate if large factories had not been established near the Spessart, in which the beech wood is subjected to dry distillation. We imagine that the vinegar we have on our table is made at the brewery, or, better still, is from the vineyard. No such thing ! It is all produced by the dry distillation of beech wood in many parts of Germany. Do not, however, please forget that the excellent quality of the Spessart oak timber is due to a great extent to the presence of the beech in the same forests.

There is a great variety of mixed woods. *First*, woods which consist of trees which behave differently with regard to light, such as oak and beech, Scots pine and beech, and to these I will add oak and silver fir. On the western edge of the Schwarzwald are magnificent woods, in which oak forms the upper and silver fir the lower story. You ask how is the silver fir utilised ? We expect that the paper-pulp manufacturers will come to our aid, and will take the poles of the silver fir which form the under wood, so that afterwards the oak may be regenerated naturally without much expense. We, *secondly*, have mixed woods where the trees composing them are different in a different respect. You know that the spruce is very shallow-rooted. Its roots are near the surface, and that explains the great liability of pure Spruce forests to be thrown down by the wind. You also know that the Scots pine sends its roots much deeper down, and therefore it has been found that mixed woods of spruce and Scots pine are in places—of course the soil must be suitable—excellent, because, while the spruce gets its nourishment from the surface layer of soil, the Scots pine sends its roots deeper down.

You will ask how pure woods of oak and of Scots pine may be converted into mixed woods. An excellent system has been gradually developed in Germany. When the wood is in the stage of large poles, and about forty years old, a heavy thinning is made, and then an underwood of the beech is introduced by sowing or planting. The effect of this operation is most beneficial. Under the shade of the beech the ground is kept moist and loose, and is fertilised by the fall of the beech leaves. The effect of this, as well as of the thinning, is to stimulate the growth of the oak and Scots pine. Heavy and valuable timber is thus produced in less time than could otherwise be possible.

Such operations, however, require skill and care. The wood must first have grown up as a dense thicket, and must continue so in the earlier pole stage. Then, when the heavy thinning is made, the tallest, soundest, and best shaped trees must be left standing, and those that have the cleanest bole. Then, if the thinning has been made at the right time, the beech will go ahead, and it may be necessary to promote its development by a second thinning. It is a good thing to stimulate the growth of the beech, so that it may help to kill and clear away the lower branches of the oak or Scots pine.

The operation just described is equally applicable to forests of larch. Large areas have been planted with larch near Dunkeld and elsewhere in Scotland; the larch disease, however, has done much damage, and it seems to be the general opinion that, as a rule, the tree will not attain any great age, so as to form large and really valuable timber. Under these circumstances, and considering the fact that in its home the larch grows best when the ground is covered by beech, or another shading kind, I think I am justified in suggesting that experiments be made of under-planting larch woods in the advanced pole stage, when say about forty years old, in some areas with beech and in others with silver fir. A heavy thinning, the most promising trees being left standing, should, as a matter of course, precede the planting or sowing of the underwood.

These suggestions, I fear, may not commend themselves to the practical sense of the Scottish forester, for as a matter of course part of the ground will be taken up by beech, the timber of which is not marketable, or by silver fir, which may or may not, when it attains the stage of poles, be utilized for scaffolding. Nevertheless the experiment should be made, and to those members of the Society who are in a position to make such an experiment, I would recommend them to make it on areas of say 100 acres. You will readily understand that on the area thus experimented upon, there will be fewer stems of the larch per acre, for the beech and silver fir must have room. But it is not at all impossible that the better quality, the more rapid growth of the larch, and its immunity from larch disease and other calamities, may repay the trouble and expense which this experiment will entail. And with that suggestion I beg to close my remarks on pure forests and mixed woods. I thank you with all my heart for the attention which you have bestowed upon this rather special subject.

IV. *Plan or Scheme of Management of the Woods of the Novar Estate for twenty-five years, from 1899-1900 to 1923-24.*
By Colonel F. BAILEY, assisted by JOHN J. R. MEIKLEJOHN, Factor, JOHN D. B. WHYTE, Assistant-Factor, and WILLIAM MACKENZIE, Forester.

SITUATION, GEOLOGICAL AND CLIMATIC CONDITIONS.

The estate of Novar, owned by Mr Munro Ferguson, is situated on the north-western shore of the Cromarty Firth, between the river Skiack and Evanton on the south-west and the town and river Alness on the north-east. The woods, some scattered blocks of which lie but a few feet above the sea at high tide, rise on Cnoc Duchaire to a height of 1172 feet and on Cnoc Fyrish to a height of 1460 feet. The mass of them forms a continuous stretch of forest, covering well-drained slopes which face the Firth and extend inland to a distance of three or four miles. The general aspect of the woods is south-easterly; but in the northern portion of the estate they drain into the Alness river and there have a generally north-eastern exposure.

The principal rocks of the district round Novar are various crystalline schists, which form the higher parts of the parishes of Alness and Kiltearn. These are succeeded, to the east or south-east, by conglomerates and sandstones of Old Red Sandstone age. The conglomerates are developed chiefly in the hills immediately to the west and north-west of Novar House—the highest point being reached in Caishlan (1715 feet). The low grounds between Alness and Evanton are underlaid chiefly by sandstones. The superficial accumulations of the district consist in the hilly ground principally of a gravelly and sandy till. The same deposit covers considerable areas in the low grounds, but it is frequently overlaid or replaced by sheets and mounds and ridges of gravel. The ground below a level of 90 feet or thereabout is chiefly gravelly and sandy, or alluvial. These low-lying deposits appear to be relics of three old raised beaches, of which the uppermost occurs at a height of about 90 feet, the middle one at 50 feet, and the lowest at 25 feet above the present sea-level. Along the margins of the streams alluvial flats occur as usual.¹

¹ This statement of the geological characteristics of the locality was kindly furnished by Professor James Geikie.

The slopes are for the most part moderate and suitable to forest growth; but, owing mainly to the action of wind, the crop, especially the Scots fir, becomes stunted at altitudes above 700 or 800 feet in exposed situations and above 1000 feet in more sheltered places. This effect is specially observable in the higher parts of Creag Ruadh, Cnoc Fyrish and Cnoc Duchaire. The soil is for the most part light and of moderate but sufficient depth, rendering the locality eminently adapted to the growth of coniferous woods. Over portions of the ground the development of the younger crops is marked by great vigour, of which the following instances may be noted, viz.:—In Black Park Corner, the dominant stems of larch and Douglas fir, in mixture fourteen years old, attain an average height of about 40 and 39 feet respectively; in parts of Temple Park, larch, Scots fir and spruce, aged fifteen years, reach a mean height of 31, 28 and 25 feet respectively; in the eastern part of Cnoc-an-Eiliknaidh, larch and Scots fir, aged fourteen years, run to a mean height of 28 and 20 feet; while in Lower Assynt Belt, larch, Scots fir and spruce have grown in eleven or twelve years to heights of 32, 25 and 24 feet respectively. The trees composing these crops have, generally speaking, good girth and a flourishing appearance; but although actual disease is not prevalent among the larches, their foliage and bark are not everywhere in a healthy condition. The above have been selected for mention as being among the most promising of the young crops on the estate; but the rate of development of the majority of the younger woods, at moderate altitudes and where the larches are not seriously injured by disease, is very satisfactory.

At Cromarty on the Black Isle, the mean annual temperature, as recorded at an elevation of 60 feet above sea-level during a period of forty years, is $46^{\circ}6$. The lowest mean monthly temperature, which occurs in the month of January, is $38^{\circ}5$. The mean monthly temperatures in March, April and May are respectively $39^{\circ}5$, $43^{\circ}9$ and 49° ; while in September, October and November they are $53^{\circ}1$, $47^{\circ}2$ and 42° . The readings at Chanonry, on the eastern side of the Black Isle at an altitude of 40 feet, are almost identical with the above. Severe spring frosts in April and May, and autumn frosts in September, are experienced about once in five years, and caused considerable damage to young larches both in the spring and in the autumn of 1896.

The mean annual rainfall, as recorded during a period of twenty-five years, at Ardross near the northern limit of the Novar Estate,

at an altitude of 450 feet, is 37·78 inches; while at Invergordon, at an altitude of 25 feet, it is 25·85 inches. The rainfall is well distributed.

The prevailing winds are from the south-west and west; but damage by storms, which proved disastrous during the years 1893 and 1894, appears to be always caused by gales blowing from directions lying between north-west and north-east.

GENERAL DESCRIPTION OF THE WOODS.

The total area¹ of woodland on the estate, including ground temporarily unstocked, is as follows, viz.:—

A. INCLUDED IN THE WORKING PLAN.

	Acres.	Acres.
Older conifers—aged 47 to 122 years,	868	
Older hardwoods—aged 50 to 90 years,	56	
1. <i>Total of the older woods,</i>	<hr/>	924
Younger conifers—aged up to 19 years,	1813	
Younger hardwoods—aged 5 to 20 years,	6	
2. <i>Total of the younger woods,</i>	<hr/>	1819
3. <i>Temporarily unstocked,</i>		989
Total included in the Working Plan,		<hr/> <hr/> 3732

B. EXCLUDED FROM THE WORKING PLAN.

Older woods,	89	
Younger woods,	50	
Temporarily unstocked,	56	
Rabbit warren,	70	
Total excluded from the Working Plan,	<hr/>	265
Grand total,		<hr/> <hr/> 3997

Details of the above areas, which are indicated by distinguishing colours on the map, will be found in Appendix A; and a description of each wood, with suggestions for its treatment, is given in Appendix B.

¹ The areas given throughout the Report were furnished by the Estate Office, having been, with few exceptions, taken from the Ordnance Survey Area Books.

A. AREA INCLUDED IN THE WORKING PLAN.

1. THE OLDER WOODS.

The older woods are stocked as follows:—

(a) <i>Conifers.</i>		Acres.	Acres.
Scots fir, in about three-fifths of which larch are scattered,			657
Scots fir and larch in more equal proportions, . .	45		
Scots fir and larch, with some hardwoods, or with some spruce and hardwoods,	70		
Scots fir with a few hardwoods,	4		
	—		119
Larch with spruce,	3		
Larch with hardwoods,	3		
	—		6
Pure larch,			68
Miscellaneous crops of poor quality,			18
			—
Total,			<u>868</u>

The age of these woods ranges from 47 to 122 years, the average age being 84 years; and the result of a careful estimate, made¹ in respect of each wood, is that the average crop per acre, taken over the whole ground now stocked, does not exceed 117 trees of from 12 to 13 cubic feet each, or say 1500 (quarter-girth) cubic feet of timber, down to a diameter of 6 inches in the case of larch and of 7 inches in the case of Scots fir. This does not represent one-third of the amount that fully stocked woods, in this locality, ought to carry at 84 years of age.

The presence in parts of the estate of fine specimens of all the principal species serves to indicate the class of timber that the ground is capable of producing, though the trees now standing on a considerable portion of the area are, generally speaking, shorter and of a rougher quality than might have been grown in denser woods. But to the gales, which have cleared the crop from parts of the ground now bare of trees, may in great measure be ascribed the thinly stocked condition of many of the standing woods; while the growth of the Scots fir has been checked by squirrels, which have irretrievably ruined a number of extensive areas in which that tree forms the main element of the crop. At the same time there is reason to believe that in some places, at

¹ By Mr J. D. B. Whyte, assistant-factor, and Mr William Mackenzie, forester.

least, many of the most promising trees were removed during the course of thinning.

As before stated, Scots fir growing on the higher ground, in comparatively cold and exposed situations, is stunted in its development; but the timber of such trees is hard and fine-grained, and is, no doubt, of a very durable quality. Scots fir appears, as a rule, to form an unusually small heartwood, which in many instances does not occupy more than from one-third to one-half of the diameter of the stem at its base; it appears to develop most freely on the more open side of the tree. Except in Clash-na-buiac, Dail Gheal and Bog-a'-Phiòbaire, the larch trees now standing are for the most part affected by red-rot. Of the total area (868 acres) occupied by the older conifers, 518 acres, or about five-eighths of the whole, are closed, the remaining woods being grazed by farmers' flocks. The more lightly stocked portions of Evanton Wood, which have been closed for three years, show a very promising natural growth of Scots fir and larch; and a portion of this wood, which has been closed for one year only, is already beginning to fill up with natural seedlings of these species. A similar growth is to be seen in most of the thinly stocked parts of the older coniferous woods from which sheep and cattle are excluded, and where the growth of brackens and other herbage is not too dense for its development. This is notably the case in Black Park and Contullich, which were closed in 1898; but part of Evanton was closed earlier than any of the other woods. A fair but irregular growth of natural seedlings is found also in woods open to grazing, wherever the young growth is protected from sheep by coarse herbage—Incholtair Wood may be cited as an instance of this. In this light and favourable soil, natural seedlings of both Scots fir and larch spring up readily in heather of considerable height and density, but very few of them are to be found in grass.

(b) *Hardwoods.*

Of the older hardwoods (56 acres), about 17 acres contain a considerable proportion of oak, and in about 37 additional acres that tree forms one of the constituents of the crop. The average age of these woods ranges between fifty and ninety years. They are estimated to contain, on an average per acre, 65 trees of 11 cubic feet each, or about 715 (quarter-girth) cubic feet of timber, down to 5 inches in diameter. These very thin crops are, as might be expected, generally speaking of poor quality, and they do

not occupy the ground to advantage. They are, for the most part, unlikely to improve sufficiently to warrant their being left standing longer than necessary, though selected trees may remain as standards, to be subsequently under-planted with shade-bearing species, where they stand at all densely. The area closed to grazing is 20 acres. In Dail Gheal Belt there is a very satisfactory natural undergrowth of beech from one to fifteen years old.

2. THE YOUNGER WOODS.

The stock of the younger woods is composed as follows:—

(a) <i>Conifers.</i>		Acres.	Acres.
Scots fir and larch, in more or less equal proportions, with, frequently, a small admixture of spruce,	759		
Scots fir and larch, in which spruce, silver fir and Douglas fir are more strongly represented,	261	—	1020
Scots fir, in 175 acres of which larch occurs in small proportion,			526
Larch,			195
Spruce, with a few larch,			4
Douglas fir, pure, or mixed with larch, silver fir, Scots fir and hardwoods,			10
Larch, spruce, Douglas fir, Scots fir and hardwoods; about half the area mixed by single trees and the remainder by groups,			43
Miscellaneous mixtures of conifers and hardwoods,			5
Experimental area,	6		
Old nursery,	4	—	10
Total,			<u>1813</u>

A glance at the above statement shows that the principal tree in these woods is the Scots fir, larch occurring either as a pure crop or mixed with the Scots fir in varying proportions. Spruce, silver fir and Douglas fir are found for the most part in mixture with Scots fir and larch; but in a comparatively small area only has the error been committed of mixing numerous species together on the same ground. The age of these plantations ranges from one to nineteen years. As a general rule they are progressing satisfactorily, and examples have been given above of really phenomenal development. In places, however, the crops suffer damage by ground game, from deficient drainage or other causes; and most of the young crops of pure larch are suffering more or less from cancer.

The worst of the diseased larches have been cut out from part of Assynt Hill, as well as from Cross Hills and Novar Mains; side branches have been shortened where interfering with lower growth in Toll Belt, Novar Mains, Fyrish Upper Belt, Temple Park and Cnoc-an-Eiliknaidh; and hardwoods have been pruned in Toll Belt. With these exceptions, no thinning or pruning has been done in these woods.

(b) *Hardwoods.*

The small area (6 acres) of young hardwoods consists of alder, willow, horse-chestnut, beech and other species, from five to twenty years old. Of this area $1\frac{1}{2}$ acres are closed, and the remainder is open to grazing

3. AREA TEMPORARILY UNSTOCKED.

Of the unstocked area (989 acres), about one-eighth part was bared by the storms of 1893-94; and from the remainder the crop has been removed during the course of the annual fellings, but replanting has not yet been carried out. Over a considerable proportion of the ground, isolated trees or small groups of trees have been left for ornament; and these are gradually being overthrown by wind. More than one-third (381 acres) of the area is now open to grazing, but the rest of the ground is closed. Vigorous natural regeneration of Scots fir and larch from adjoining woods is seen in places, notably in Inchcholtair.

The small-sized, unmarketable wood (tops and branches) has, unfortunately, in many places, been left on the ground after felling, and has no doubt for a time encouraged the breeding of injurious insects; it now adds greatly to the risk of damage by fire. Between 700 and 800 acres are more or less covered with "brush" of this sort, which should be gradually burnt off as the work of planting progresses. Such dangerous accumulations of débris should not be permitted in future.

B. AREA EXCLUDED FROM THE WORKING PLAN.

An area of 195 acres in the vicinity of Novar House has, by desire of the proprietor, been excluded from the Plan, and an additional area of 70 acres has been fenced off as a rabbit-warren. It would be possible at any time to frame a separate Working Plan for these areas, with a view to their serving in the most effective manner possible the object on account of which they have been excluded from the present Plan.

PRINCIPAL INJURIES TO WHICH THE WOODS ARE SUBJECT.

The attacks most to be feared are those by storms, larch disease, squirrels and ground game.

STORMS.

The estate has suffered very severely from violent gales, blowing, usually, from directions ranging between north-east and north-west. During the years 1893-94 these winds did great damage, overthrowing no less than 55,000 trees, or more than half the number now estimated to stand in the older coniferous woods, and causing an immediate loss of £2000, owing to a fall in prices consequent on the flooding of the market. The woods which suffered most were Cnoc Duhaire, Moultaivie Belt, Contullich Wood, Cnoc Fyrish, Creag Ruadh, Cnoc-na-Coille, Meann Chnoc, Badger Hill, Dail Gheal, Evanton Wood, Blackrock Brae and Inchcholtair. As a precaution against the recurrence of such serious calamities, the outer margins of all woods, especially on the sides from which experience has shown that danger is most to be feared, should be strengthened by permanent shelter-belts, comprising Austrian, Corsican, Mountain or Cembran Pines, Norway Maple, Sycamore, Beech, Birch, or other wind-firm trees, according to locality. Intermediate belts should also be established within the larger woods, running in a direction perpendicular to that of the dreaded storms; and the outer trees on all sides should be left standing while fellings are in progress. The stock in permanent shelter-belts should be maintained by planting or sowing in all openings left by the gradual disappearance of the old trees.

LARCH DISEASE.

Larch cancer acts as a terrible scourge in many of these woods. In places—as in the lower part of Cnoc-na-Coille—trees seventy years old show marks on their boles of the disease, which is, however, no longer active; but the older larch crops appear, as a rule, to have escaped serious injury. Among the younger woods, disease is particularly prevalent in Cross Hills, where larch has been planted in a moist hollow, and in the 138-acre block of pure larch on Assynt Hill, especially towards its western end. The disease has also a strong hold on the young trees growing on ill-drained ground in Toll Belt; and few, if any, of the young larch woods are entirely

free from it. The three woods mentioned all lie on warm southern slopes, at elevations ranging from 50 to 900 feet above the sea.

It is a noteworthy fact that in parts of Claisdruim and of Contullich Belt, where self-sown larch, six to fourteen years old, stand in dense masses on the ground, the young trees suffer very little from disease, the bark having, generally speaking, a peculiarly healthy appearance. In parts of the lower portion of Temple Park and of the centre of Cnoc-an-Eiliknaidh, both of which have been previously noticed as carrying crops of remarkable vigour, aged respectively fifteen and fourteen years, the side-branches of larch are dead to a height of 8 or 10 feet; and these dead branches are sometimes loaded with spore-bearers of the fungus, while the stem and higher living branches appear quite healthy. This looks as though the fungus might have attacked the lower branches after their death; but the matter requires further observation and study. Throughout the plantations it is noticed that the stems of young trees standing in a free position, and in a generally thin crop, are frequently attacked by disease, the power of which seems to depend rather on unfavourable local conditions than on the degree of density of the crop. For example, in the open, breezy Acharn plantation, where the soil is unfavourable, the young trees are badly diseased; while, as before mentioned, the dense, self-sown crops in Claisdruim and Contullich Belt are comparatively healthy. It may turn out that fairly dense crops of healthy young larch can be raised on this estate, if none but the most suitable localities are selected for them.

Two years ago an experiment was tried in the low-lying Cross Hills plantation, where disease had attacked almost every stem, of making a thinning among the young trees, then twelve years old and of good height, by removing those of them which were most diseased; and the crop was under-planted this year with spruce, silver fir and Menzies fir. It remains to be seen whether the effect of this thinning will be to cause a more vigorous development of the remaining stems, and thus to enable the best of them to contend successfully against the fungus; but Cross Hills is a locality very unfavourable to the growth of larch. An experiment in under-planting with silver fir has also been commenced this year in the western, the most diseased, portion of Assynt Hill, where the crop is fifteen years old, and where it is not easy to account for the violence of the attack.

In such badly infected places, it is impossible to deal effectually

with the pest by merely cutting out the diseased stems, as this would leave too thin a crop on the ground; here simultaneous under-planting is necessary. But in comparatively healthy young woods, like parts of Cnoc-an-Eiliknaidh, Temple Park and others, it is desirable to check the further progress of the attack by at once removing, during the winter when the spores are inactive, all diseased stems from the least infected areas; and the enemy's advance may be met thus until the proportion of attacked trees becomes too great for this treatment, when, again, simultaneous under-planting must be resorted to. Such thinning and under-planting would not, ordinarily, in healthy woods, be done before from the twentieth to the twenty-fifth year of the crop's age; but the progress here made by the disease necessitates application of the treatment at an earlier stage. It would be an advantage if all parts of the diseased thinnings which cannot be utilised could be burnt. In plantations such as the two last-named, where larch occurs either as a pure crop or as the principal constituent of the stock, it might be worth while, as an experiment, to clear of larch, at intervals of from 200 to 300 yards, strips of ground about 25 feet wide, running in a direction approximately from north to south, and to plant these up with Douglas fir and rapidly-growing species of hardwoods; this might have some effect in impeding the distribution of the spores.

The prevalence of larch disease on the estate necessitates consideration as to whether the continued planting of larch otherwise than as a disseminated species is justifiable. The temptation to run some risk by growing it in pure crops up to a certain age is considerable, in view of the high prices obtainable for the timber, and of the fact that thinnings, consisting of badly diseased twelve-year-old stems, which were sold as "sheep-net stickings" from Cross Hills in 1897, realised a profit of £6, 2s. per acre. But this was an exceptional price; similar produce would not now bring in more than half the amount. There can be little doubt that at present the wisest general rule will be to restrict the raising of larch to localities which are not unfavourable to it, and to limit the number of plants to a small proportion of the stock, evenly distributed among the principal species. Any of these trees which may survive to the end of the rotation will add materially to the value of the final crop, while even if the majority of them should be lost, their disappearance would not seriously impair its density. But experiments in the growing of young larch as a pure crop, and as a

principal species mixed in various degrees with shade-bearers, should be continued on a limited scale, plots for this purpose being selected on northerly or north-easterly aspects, as remote as possible from existing sources of disease, and separated from each other by considerable stretches of ground stocked with other species. In these plots the raising of larch should be studied by varied treatment, pure crops being ultimately under-planted with shade-bearers. Should these experiments give satisfactory results, larch will no doubt again be grown on a more extensive scale.

SQUIRRELS.

Allusion has previously been made to the injury done by squirrels, which, unfortunately, are very numerous, in spite of the endeavours made to keep them down by shooting. The forester killed forty-one in Cnoc Duchaire in a single morning. They gnaw the tender portions of the bark of Scots fir, commencing their depredations in some cases when the trees are about seven years old, and they continue to attack the upper part of the stem and branches of trees which have reached a considerable age. They also eat out buds, and thus interfere with the development of the crown. The crops of Scots fir in Cnoc-na-Coille, Inchcholtair, Caistel Breac, Badger Hill, Lealty Belt, Baddan's Belt, Cnoc Duchaire and Contullich Wood, covering in all about 400 acres of ground, have been practically ruined by squirrels, a large proportion of the trees having lost their tops, the stems being scored with deep wounds, and the timber being greatly reduced in value. Young crops, aged fourteen and fifteen years, have also been severely attacked in Cnoc-an-Eiliknaidh, Broom Hill, Temple Park, Assynt Hill and other woods. The only way of dealing with these destructive animals appears to be to shoot them; but this would prove a much more effectual measure if neighbouring proprietors could be induced to make common cause against the enemy.

GROUND GAME.

A wire netting to keep out mountain hares is maintained round the higher or north-western boundary of the main block of woods; but the following areas have not the benefit of this protection, viz.:—on the west—Inchcholtair and Blarvorich; on the east—Cnoc Duchaire, Baddan's Belt, western part of Claisdrum, Dalreoch, Ardoch, Lealty Belt and Acharn. The young plantations are not specially protected by wire netting, trapping and shooting being relied on to keep down the stock of rabbits. Whether this method is adopted at a greater or a less cost than would be involved in fencing has not

been calculated in connection with the present Plan. But, as might be anticipated, a great deal of injury is done in places; and if the young crops are to be efficiently protected without resort to wire netting, strenuous efforts on the part of the gamekeepers must be sustained. The plantations in parts of which serious damage was noticed are the following, viz.:—Blackrock Corner, Assynt West Belts, Contullich Belt, Contullich Wood, Toll Belt, Black Park, Temple Park, the Old Nursery, Dalreoch, Cnoc-an-Eilikhnaidh, Badger Hill, Evanton Wood, Assynt Hill and Cnoc-na-Croige.

In some places, notably in Blackrock Corner, Assynt West Belt, Assynt Lower Belt and Contullich Belt, even the largest of the larches, eleven or twelve years old, have been freshly gnawed by rabbits; and it does not seem improbable that the wounds thus made may expose the attacked trees to the dreaded disease. Some plants have been cut down by hares in Ardoch Wood and Blarvorich, while roe-deer and blackgame have done serious damage in places.

OTHER SOURCES OF INJURY.

Spring and autumn frosts, as previously stated, cause occasional damage to young crops, but on the whole this is not usually of a very serious nature.

Of *insects*, those most to be feared are the Pine Weevils (*Hylobius abietis* or *Pissodes notatus*), which have attacked crops from one to four years old in Cnoc-na-Croige, Black Park, Bullockeshan, Contullich Wood, Evanton Wood, Blarvorich and Cnoc Fyrish; the Pine Shoot Moth (*Retinia resinella*) is also doing considerable damage in Bullockeshan; and the Pine Beetle (*Hylurgus piniperda*) injures both young and old Scots fir on many parts of the estate,—as, for example, in Claidruim, Cnoc Duchaire, Contullich Wood and Lealty Belt. Measures to meet these attacks must be taken, not only by the destruction of the insects, or of their eggs or larvæ, in the manner suggested in volume iv. of Schlich's "Manual of Forestry," but, especially as regards the weevils, by selecting the felling-areas of successive years in such a way as to enable the new crop on each such area to attain the age of four or five years before the crop adjoining it is felled and the ground restocked.

The young *silver firs* are badly attacked by disease. In Allt Duack some trees of this species, six or seven years old, which threw out fine shoots last year, are now very unhealthy looking, the stem and branches being covered with plant-lice and some of the terminal shoots being dead. Silver firs of like age in Fyrish Lower Belt are also showing similar signs of failure; and the same phenomenon has

been observed on neighbouring estates, where trees up to at least forty years of age have been attacked and killed. It has been noticed that death, which often occurs with some suddenness, follows two or three consecutive years of attack by lice.

Specimens of affected plants were submitted to Professor Bayley Balfour, who has kindly given the following opinion:—

“I have no hesitation in saying that the aphid is not the primary cause in the case of the diseased silver fir. The trees are covered besides with fumago, and their whole aspect is that which is very common in the case of trees which are grown in an unsuitable situation. I have seen plenty of trees in the state of those you send me, and like those you describe in your letter, and in every case I am satisfied the ailment is a constitutional one—the result of unsuitable environment. I cannot but think that Professor Schwappach was far wrong when he advised extensive planting all through Scotland of the silver fir. The aphid of the silver fir is, Dr MacDougall tells me, a different one from the ordinary spruce aphid.”

If this view be correct, endeavours must be made to ascertain what the unfavourable factors of the environment are. If similar conditions were found to prevail throughout the estate, all attempts to grow silver fir must be abandoned, and this would be very regrettable, as the tree is a very desirable one for the under-planting of larch and Scots fir. But healthy individual trees of all ages are found in places on the estate as well as elsewhere in the neighbourhood.

Insufficient drainage keeps back the crops in parts of Dail Gheal, Badger Hill, Cottage Wood, Evanton Wood, Cnoc-na-Croige, Toll Belt, Acharn Wood, Dalreoch, Claisdruim, Baddan's Belt and Blarvorich. This should be seen to.

A *dense growth* of brackens, and in places of whins, broom, raspberry or juniper, which covers an area estimated at 1000 acres, forms a serious impediment to the progress of the young crops, and renders the restocking of the ground both difficult and costly.

In Dalnahaun and Dail Gheal damage has been done to some of the standing trees by the wire ropes used with the *traction-engine* during the removal of logs. Trees which may be thus injured during future felling operations had better be felled and taken out before the engine leaves the wood.

Fires have not in recent years caused serious damage to woods on the estate; but during the current year about 70 acres of heather in Creag Ruadh were burnt. Measures should be taken to reduce

the risk of conflagrations in coniferous woods by establishing belts of hardwoods along the lines of greatest danger, and by reinforcing them with interior lines where such appear necessary.

PAST MANAGEMENT.¹

All woods which have now reached the age of ninety-five years or upwards were planted by General Sir Hector Munro, who also brought much waste land on the estate under agriculture. Most of the remainder of the older woods were planted by Mr Hugh Munro between about the years 1830 and 1850, from which latter year and up to 1881 no planting was done. In 1881, extensions were resumed by the present proprietor, who has planted the whole of the younger woods, covering an area of 1819 acres. The estate has, on the whole, been fortunate, in that out of five successive owners, Sir Hector Munro, Sir Alexander Munro, Mr Hugh Munro, Colonel Munro Ferguson and the present proprietor, all but Sir Alexander Munro, Colonel Munro Ferguson and the Trust which followed his death have been extensive planters; but the breaks which occurred render it impossible now to arrange for continuous fellings throughout the whole of the period that must elapse before the oldest of the younger woods has attained the felling age.

The fine old Scots fir trees, such as may still be seen in parts of Dail Gheal, Meann Chnoc, Cnoc Fyrish, Cnoc-na-Croige, Cat Hill and Badger Hill, must have been raised in a dense crop until at least the period of middle age, when the woods were probably thinned heavily in order to meet a demand for squared timber, which, forty or fifty years ago, realised from 10d to 1s. per cubic foot *f.o.b* on Foulis beach. It is said that in Mr Hugh Munro's time all woods were grown as dense crops; he would not permit the breaking of the canopy, and restricted thinning to the removal of dead, dying or damaged trees.

The worst of the older woods, such as Temple Park, were planted by Mr Hugh Munro after the previous crop had been cleared off; but weevil, rabbits and squirrels ruined his young plantations, which, the vacancies thus caused not having been regularly filled up, resulted in thin crops of low-crowned, branchy trees, grown in a more or less complete state of isolation.

The rough trees now keeping back younger crops in Claisdrum

¹ Compiled from information supplied by the Estate Office, and also, in part, by Mr D. Robertson, formerly forester on this estate, but now at Dunrobin.

and in Contullich Belt are self-sown seedlings which have always been isolated.

The average value of the timber (including wind-falls) cut annually from the estate during the eighteen years—from 1881 to 1898—which have passed since the present owner came into possession, has been about £5550; the maximum, £9800, having been reached in 1894, after the disastrous gales of that and the preceding years. During the first three years of the above period, the timber was sold entirely “in the round,” either standing or felled and logged; clean-felling being done by the purchasers, but thinnings being carried out by estate labour. During these three years many improvements to the agricultural land and buildings were effected; and in order to provide timber for farm steadings and other purposes, it became necessary to employ a steam saw-mill. The results attained by its use led the proprietor to begin selling manufactured timber, for which a considerable local demand existed; and the system thus begun was continued and developed, until it almost entirely superseded the former practice of selling timber in the log.

During the years from 1893 to 1896, vast numbers of trees were blown down, and after the gales of 1893 the market for home-grown timber all over the country became glutted. More wood was offered for sale than the timber merchants wished to buy; prices fell rapidly, and it was almost impossible to dispose of wind-falls in the form of logs. But, on this estate, experience previously gained in manufacture enabled the proprietor to meet the difficulty promptly and effectually. Four additional steam saw-mills were purchased, by which the wind-fall trees were rapidly cut up and sold, for use, principally, in local buildings, or on English railways or street pavements; but a considerable quantity of the finer class of timber was shipped to Sunderland, where, owing to cheap sea-freights, it was delivered at but little more than one-half of the sum it would have cost to transport it 25 miles by rail to Inverness. The smaller stuff was disposed of as pit-wood or for fencing.

The creosoting plant, erected during the summer of 1893, has proved very useful; with it, fencing-posts have been rendered as durable, or more so, as similar posts of larch, and they have been turned out at a cheaper rate. A large quantity of creosoted Scots fir boarding has also been prepared for use on the estate as well as for sale.

An 8-horse-power traction-engine was added to the plant in

1897, and has been the means of effecting important savings, both in the carriage of sawn timber and in the haulage of logs on the felling-areas. In 1898 a Universal Wood Worker and a band-saw were purchased.

There can be no doubt that during the period of depression above referred to, when timber in the log was almost unsaleable, the system of manufacturing it for the market proved highly successful. Mr Meiklejohn estimates that during 1897 and 1898 the profits on manufactured produce were, on an average, nearly 86 per cent. higher than they would have been had the timber been otherwise sold.

The following statement, furnished by the Estate Office, shows the average annual income and expenditure in connection with the woods of the estate during the past five years:—

<i>Timber Works.</i> —Realised by the sale of 93,537 cubic feet (average annual gross revenue),	£8368
<i>Deduct for Outlay on the above, and on 13,751 cubic feet used on the Estate,—</i>	
Felling and logging,	£203
Manufacture, transport and share of management charges,	4820
Creosoting,	139
Cost of plant,	400
	5562
Average annual nett profit on timber works,	£2806
<i>Deduct Expenditure on Maintenance of Woods,—</i>	
Loss of grazing rents,	£110
Rates and taxes,	8
Draining,	33
Roads and fences,	59
Fire insurance,	14
Nursery expenses,	£173
Less plants sold,	160
	13
Restocking ground, including forester's salary,	545
	782
Average annual nett revenue,	£2024

From the above figures it may be gathered that the *gross revenue* on timber sold during the past five years has been at

the rate of nearly 1s. 9½d. per cubic foot; and that if £300 be credited as the value of timber used on the estate, the *nett revenue* (obtained by deduction of the outlay on timber works) was at the rate of 7d. per cubic foot of the out-turn; while, if the cost of maintaining the woods be also deducted, the *nett cash profit on the business* amounted to nearly 5½d. per cubic foot of the out-turn. When considering the above rates, the fact should not be lost sight of that the volume of timber (which, with the exception of 4000 cubic feet, was all manufactured) is given in statute cubic feet, and that a considerable amount of wood in slabs, etc., remained unsold. Had the produce been sold in the log, these slabs would have increased the volume disposed of; but, on the other hand, the unit (quarter-girth) of measurement would have been larger, and the nett result of these modifications does not materially affect the rates above given as "nett revenue" and "nett cash profit on the business."

Before 1890, in which year the manufacture of timber was first undertaken on a considerable scale, the trees were sold either to local traders of Kiltearn, Assynt and Invergordon, or to others from Inverness, Larbert and Glasgow. Larch, oak and elm timber went to Sunderland for boat-building, while Scots fir and larch were taken to Wick for the manufacture of herring barrels. Small-sized oaks were purchased by cartwrights, and wood of rough quality was sold for conversion into brush-backs. But since 1890 the bulk of the manufactured wood has gone either to Aberdeen, in the form of boards, for box-making; to Sunderland or Newcastle for railway-sleepers, pit-sleepers or paving-blocks; to the Highland Railway for sleepers, fencing or the construction of waggons; or for other uses to various parts of Scotland or England. Sales have usually been effected on orders received, or as local cash transactions, auction sales not being much resorted to.

The prices per cubic foot now prevailing for standing timber are as follows:—Oak and ash, 1s. to 1s. 6d.; sycamore, 1s. to 5s.; horse-chestnut and elm, 1s.; beech, 6d. to 1s.; lime, 4d.; larch, 1s. to 1s. 2d.; Scots fir, 3d. to 6d.; spruce, 3d. These prices are obtainable for timber growing in fairly accessible places; for trees less favourably situated the rates are lower, and in some localities their value is at present extremely small.

Abundance of local labour is available for planting work at the rate of 17s. or 18s. a week; men employed in the manufacture of

timber receiving from 18s. to 20s. a week. In order to avoid loss of time in going to and from work, the building and furnishing of suitable bothies near some of the more remote woods has been undertaken.

FUTURE MANAGEMENT.

In the future, as in the past, the main object of management will be the production of timber grown in High Forest; and the treatment of the growing woods in all stages will be regulated by a desire to develop a *final crop* consisting of fine healthy trees in large numbers, so that the timber may be of first quality, and that the crop as a whole may realise the highest possible price per acre.

In all forest management, it is important to place upon the market annually, or at regular intervals, an approximately equal supply of timber. Were these woods in full bearing, a regularly graduated series of age-classes being on the ground, it would be easy to make provision for annual cuttings which would yield such an out-turn permanently from the present time. Such, however, is by no means the position, as may be seen by a glance at the abstract given on p. 27. There are 924 acres of "older" woods, ranging in age from 47 to 122 years, and 1819 acres of "younger" woods, the oldest of which is only 19 years of age; crops between 20 and 46 years old are absent, and 989 acres of ground are unstocked. As regards the younger woods, which consist mainly of Scots fir, the age at which they will be cut need not be prescribed now; but there is little doubt that a rotation of 80 years will ultimately be decided on, as this is financially the most favourable age, while on other grounds it is in every way suitable. Assuming that 80 years will be fixed as the age for felling, it follows that a period of 61 years must elapse before the first crop from the oldest of the younger woods will be available for the market. But in view of the present age and condition of the older woods, it is not possible to extend the cutting of them over so long a period as 61 years; they must be felled much earlier, and 25 years has been fixed upon as the limit of time within which they should disappear. Hence 25 years is the period for which the present Plan provides. The average annual out-turn during the past five years has been 107,000 cubic feet, but the arrangement of fellings now proposed will reduce it to about 52,000 cubic feet.

When the last of the older crops has been removed, the oldest of the younger woods will still be 36 years below felling age

(assumed to be 80 years), and during this interval no final fellings in High Forest of mature age can be made; but an increasing amount of timber, the result of thinning the younger woods, will annually become available; the 265 acres of woods now excluded from the Plan will no doubt yield something; and, as time goes on, it must be considered whether some of the more backward portions of the younger woods (the oldest of which will, 25 years hence, be 44 years of age) should be cut for pit-wood or some other purpose, rather than be allowed to stand for another 36 years to attain the normal felling age. This question may be considered and decided in twenty years' time; but it is probable that the produce of early thinnings in the coniferous woods will, in any case, be sold as pit-wood or for the manufacture of wood-pulp, and the bark of young larch and spruce trees may prove saleable as tanning material when a regular supply of it can be offered.

Consideration has been given to the question whether it would be good policy to purchase standing crops of trees from neighbouring proprietors in order to maintain the present out-turn of manufactured produce from the saw-mills, during at any rate a portion of the time that must elapse before the younger woods become available for the market; but the conclusion arrived at is that the proprietor would not be justified in incurring the risks that this course would involve.

Here, as everywhere else, it is difficult to reconcile sporting and grazing interests with those of forestry. Shooting rents over the whole area of the estate yield a nett income to the proprietor of about 1s. per acre; grazing brings in from 6d. to 5s. per acre, according to quality. The growing of timber will be a much more profitable business than either of these; but although grazing can be stopped wherever it appears likely to injure young woods, the preservation of game cannot be considered from a purely financial standpoint, and a *modus vivendi* for the game and the woods must be found. Speaking generally, the gamekeepers do not object to forest work of any kind from the close of the shooting season up to about the middle of April, and efforts should be made to get through as much as possible before that time.

In this connection, it may be useful to consider the position in respect of each item of work during the next twenty-five years:—Felling in the coniferous woods, with the extraction of timber, is carried on all the year round, and it would be difficult to complete the work before 15th April; but the average annual felling-area

will be limited to about 37 acres, and this is so small a portion of ground that much inconvenience to the game interest is not involved. Thinnings, which will before long become necessary in some of the young woods, can be completed before 15th April. Burning the coarse heather and other herbage is usually done in February and March of the year before that in which the ground is planted. Burning the "brush," or branches and tops left on the ground after felling, can be carried out before 15th April by the system of "feeding the fire"; and this plan should be adhered to except in localities where, later in the season, fire can be allowed to run over the ground without prejudice to the game; but the gamekeeper's consent should be obtained in each such case of late burning. There remains the question of keeping parts of the young crops, up to six or seven years old, free from suppression by striking off the young shoots of brackens with a stick. This operation, which is carried out between June and August, is very strongly opposed by the gamekeepers, on account of the disturbance it causes to the birds during the breeding season and while the broods are still young. In future, when the felling of the younger woods has been commenced, and when the ground is systematically restocked immediately after the crop has been removed, there will be but few brackens to impede the growth of the young trees; but even during the period for which the present Plan provides, there will be very little trouble from them after the bracken-covered portions (say 330 acres) of the younger plantations have grown up sufficiently to suppress the objectionable growth, and after the bare ground, with its 400 acres of brackens, has been restocked, and the crop on it has attained the age of six or seven years. After that time, the ground to be restocked annually will average only 37 acres; and assuming the bracken-covered area in the older woods to be 270 acres, it is estimated that not more than, on an average, 60 or 70 acres of brackens, now established beneath their open stock, need be under treatment at one and the same time. The period during which the greatest difficulty will be encountered is, then, that during which the crops existing and to be raised on 330 acres of young plantations and on 400 acres of ground now unstocked will be growing out of danger from brackens, or, say, during the next fifteen years. These 730 acres will not all come under treatment at once. Brackens on the unstocked area need not be taken in hand until the ground they occupy is about to be planted up; and, with a little help, the existing young plantations will gradually outgrow and suppress the

weeds. The experiment may at once be tried, in a locality suited to the Douglas fir, to plant up some patches of brackens with this tree, in order to ascertain whether, and within what time, it can overcome the objectionable growth, either without aid or otherwise; the Douglas fir grows rapidly, and stands a considerable amount of shade.

When once the woods are all fully stocked, there will be no room for grazing; but in the meantime it is probably more in the interest of the game to keep the farm stock off the ground than it would be to prohibit the keeping down of brackens, which in some places are dense and tall enough to render it extremely difficult to establish young trees among them. Unless the weeds in such places can be effectually dealt with, one-fourth part of the woods of the future may be little better than bracken-covered blanks; and some sacrifice of the shooting interests for a few years seems called for in order to avoid the loss which this would entail. Planting work is completed before 15th April, and does not interfere with the game.

Existing conditions do not warrant the immediate abandonment of the present system of selling manufactured produce; but the disposal of trees as they stand in the woods has many advantages which are likely to prevail in the future, when the constant yield of the younger woods has had time to develop an improved local trade, capable of undertaking the work of bringing the timber to depot (with the aid, on suitable terms and conditions, of the estate appliances), and of converting it to suit the varying demands of the market. It may here be repeated that during the past five years, the average annual nett revenue on converted timber, without deduction of maintenance charges at $1\frac{3}{4}$ d., has been about 7d. per statute cubic foot (see p. 41).

ANNUAL FINAL FELLINGS IN THE OLDER WOODS.

It has already been stated that under the present scheme the felling of the older woods will be spread over a period of twenty-five years. Under this arrangement the average annual felling-area will be about 37 acres; and it will yield about 4220 trees (mostly conifers, but with a few hardwoods), measuring about 52,200 (quarter-girth) cubic feet. In this calculation no addition has been made for the growth of the woods during the progress of the fellings; in some cases the crops will not improve by standing, and

the increase of the remainder may be held in reserve as a factor of safety.

A Table of Annual Fellings has been drawn up for the older woods, and will be found in Appendix C. In its preparation the following aims have been kept in view:—(1) To avoid the restocking at one time of large continuous areas, such being always unfavourable to young crops; a maximum limit of 15 acres has been fixed. (2) To allow an interval of time, not less than four years, to elapse between the restocking of adjacent areas; this being done in order to reduce the danger from insects, such as pine weevils, which habitually attack very young crops. (3) To give an approximately constant annual out-turn of produce, with a mixture of comparatively good and of inferior qualities; and at the same time to avoid considerable variations in the extent of the areas to be annually restocked after felling. (4) To avoid the necessity for carrying on the felling work of any year at two or more points separated by very inconvenient distances.

It will be readily understood that when dealing with irregular crops such as these, it was not found possible to fulfil all of the above conditions; and where interests were found to be conflicting, preference has been given to the principle of limited continuous areas, to a four years' interval between adjacent plantings, and to an approximately equal annual out-turn. The arrangement actually made was rendered possible only by establishing two cutting-series in Meann Chnoc and in Contullich Wood (Scots fir portion), and four such series in Cnoc Ducaire. In the working of these cutting-series, great care must be taken to avoid risk of damage by storms. The lines of severance should be selected at once, and should, where possible, be laid where the cover, in the desired direction, is already thin; the crowns of a belt of trees at this place should then be lopped so as to reduce their liability to be blown down when deprived of the protection of the crop now standing to windward of them. These belts may be at once under-planted with Douglas fir or some other species which will grow rapidly and will soon afford some shelter against wind.

In cases where the entire wood is not felled in a single year, the felling-area should, when possible, consist of a narrow strip, cut on the side opposed to that from which the most dangerous wind blows, and running at right angles to its direction. It has been previously said that the outer trees on all sides should be left standing until the last portion of the crop is removed; and it is, of

course, of great importance to thus guard those sides from which danger is most to be feared.

When carrying out the fellings, it will be desirable, in view of the irregular constitution of the crops in many of the woods, to have regard, in such woods, rather to the *number of trees* the cutting of which is prescribed in the Table, than to the extent of the area from which the removal of the crop is prescribed. Should, unfortunately, any considerable number of trees be blown down on ground not included in the felling-area of the year; or should fellings, not provided for by the Plan, have been made in consequence of the occurrence of fire, or to take advantage of a seed-year or otherwise; a corresponding reduction in the number of cubic feet removed from the felling-area of the year should be made, in order to adjust the yield account.

Save in very exceptional places, the practice of leaving a few old trees or groups of trees standing for ornament should be discontinued. Such trees make no useful growth, and therefore occupy the ground unprofitably; they are usually, sooner or later, blown down, and either lost or brought in at unnecessary cost; while, when the new crop has once been established, they are likely to injure it by their shade while they stand, and to crush and break the young plants when they fall or are cut down. Such trees are now standing in Bullockeshan, Broom Hill and other woods, to the detriment of the young crops, and they should be carefully removed as soon as possible, the crowns being reduced before they are felled. Work of this kind is expensive and should be avoided. The tops and branches left after each annual felling should be removed or burnt without delay; they should on no account be allowed to remain long on the ground.

There will be no final fellings in the younger woods during the period provided for by the present Plan.

Much of the ground on which the woods stand is favourable to the use of wet or dry timber-slides, tramways and other labour-saving and expense-saving appliances, which, when the crops of the fully-stocked younger woods come under the axe, will almost certainly be employed for conveying timber from them to the estate depot or to the railway line. But although the present cost of bringing in timber from the more remote woods and from the higher elevations is excessive, extensive engineering works for moving timber from the older woods would not now be justified, on account of their scattered situation and light stock. It must

also be remembered that after the expiry of the period to which the present Plan relates, there will, throughout an interval of about thirty-six years, be no regular fellings on the estate. But no opportunity should be lost of cheapening the cost of moving timber; and temporary slides, etc., should be constructed wherever they can be profitably employed.

RESTOCKING.

The average felling-area during the next twenty-five years will be 37 acres, of which 35 acres will be in coniferous woods and the remainder in hardwoods. In order to enable the new crop to establish itself before an increased growth of briars, brackens and other coarse vegetation has had time to develop into a serious obstacle to its progress, as well as for other reasons, the ground should be restocked as soon as possible after felling.

On this light and favourable soil, indications of successful natural regeneration of Scots fir and larch are very encouraging. The larch seeds well almost every year, and plentiful crops of Scots fir seed are produced at intervals not usually exceeding five or six years. Advantage should be taken of each seed-year of Scots fir to obtain as complete a crop of natural seedlings as possible on the felling-area of the year, by leaving a few—not more than twenty-five to the acre—evenly distributed, full-crowned trees standing as seed-bearers, to be subsequently removed within two or three years, preferably when the ground is protected by snow. In some places it may be necessary to loosen the soil, or at least to clear away coarse herbage in horizontal strips with a wide-toothed iron rake. Such strips might be $1\frac{1}{2}$ foot wide and 3 feet apart, the mineral soil being exposed; they would be interrupted where not required, or where obstacles, such as stumps or rocks, intervened. In broken ground patches might be substituted for strips. Coarse herbage and débris might also be got rid of by carefully conducted burning. Some portions of the four or five areas next in order for felling may perhaps, on the occurrence of a seed-year, be found thinly enough stocked to enable a partial young natural crop to be secured by similar treatment of the soil and its covering; and in other portions of these areas the removal of a comparatively small number of trees might suffice to afford the needful degree of light. Thus, by a judicious and very moderate anticipation (to be subsequently adjusted) of the yield during seed-years of Scots fir,

it may be possible to secure the regeneration of a considerable portion of the older woods by natural seedlings. This would be a very interesting experiment, which, if successful, would result in a saving of capital expenditure; and it is by no means improbable that a dense crop of such seedlings might be less retarded by the attacks of ground game than a crop of young planted trees standing conspicuously at regular intervals. It will be necessary to rigidly exclude farm stock from all areas actually under natural regeneration; but as an irregular growth of more or less isolated young trees, self-sown long in advance of the felling, is a doubtful advantage, it is not desirable to forego any considerable amount of grazing revenue in order to obtain it. Hence, as regards woods which are not to be felled within four or five years, the question of closing must, in each case, be decided on its merits. A heavy crop of Scots fir seed is expected in 1900.

Portions of felling-areas which, two years after the felling, are found to be insufficiently stocked by natural seedlings, should be at once filled up by direct sowing or by planting, as may be considered best in view of the varying condition of the soil and its covering. Wherever the old crop has been dense enough to keep down coarse herbage, the sowing of Scots fir seed in strips or patches may be resorted to; or where the soil is at the same time sufficiently loose, two-year-old Scots fir and larch seedlings may be put in with a peg; but where the state of the soil and its covering is otherwise, older transplants must be used. Young plants are to be preferred to older ones whenever the conditions admit of their use.

When hardwood crops are felled, a few of the best trees only will be left here and there, and the restocking of the ground by natural seedlings is not likely to occur to any important extent; but, after felling, a new crop should be raised without delay, and this may be done by a combination of direct sowing and planting, according to the nature and condition of the soil and its covering. In places suited to oak, acorns may be dibbled in at 1 foot intervals; or young oak or other species, such as ash or sycamore, may be planted in pits 4 feet apart, existing brushwood, other than promising young seedlings, being cleared away where necessary.

Carefully conducted and recorded experiments should be undertaken in order to ascertain what system of planting is, in this locality, the best, from a consideration of the comparative success or failure of the young crop and its rate of early development, as well as of the initial outlay involved. The method hitherto followed

in the planting of conifers has, almost universally, been that of "notching," the cost of which, per acre stocked, has thus been compared with that of pitting:—

	Pitting.			Notching.		
	£	s.	d.	£	s.	d.
Digging 3500 pits,	2	3	9	...		
Putting in plants,	0	15	9	0	12	3
Purchase of 2 year-1 year Scots firs, at 10s. per 1000,	1	15	0	1	15	0
	<hr/>			<hr/>		
	£4	14	6	£2	7	3

That is to say, the initial cost of pitting has been exactly double that of notching. But this fact alone does not suffice to decide the question, for all parts of the estate, in favour of notching; for in places where either the soil is very shallow or the sod is very thick, there are obvious objections to that system. In such places, at any rate, the filling up of death-vacancies must cause a serious addition to the initial cost; while, especially if one or two dry seasons should occur before the young plants have fully established themselves, the rate of growth of the young crop will probably be slower than it would have been had the plants been pitted. Then again, by the use, where the soil-covering is low, of two-year seedling plants of Scots fir and larch, put in with a peg where the soil is light; as well as by the adoption of an improved pattern of planting spade, suited for small-sized plants; a reduction may be effected in the average cost of putting plants into the ground with their roots disposed naturally, as contrasted with the position they are forced into under the notching system. And further, if advantage be taken of all natural growth that can be raised, and if this be supplemented, in suitable places, by direct sowing, the savings thus effected may enable a thoroughly successful system of planting to be adopted in less favourable localities, without increasing the present *average* cost per acre taken over the whole area annually restocked. In other words, if the work can be cheapened in some places, more may be spent in others without thereby increasing the total expenditure.

The advantages of securing the effective restocking of the ground *at the first effort* are obvious; and it is clearly permissible to make some initial pecuniary sacrifice in order to secure that most desirable end. On this estate a large amount of "beating up" (filling

of death vacancies) has now to be done, the young woods where the stock is most defective being the following, viz. :—

Name of Wood.	Years Old.	Area in which Vacancies have to be Filled up. <i>Acres.</i>
Dail Gheal,	17	2
Acharn,	16	150
Cnoc-an-Eiliknaidh,	15-9	30
Broom Hill,	14	3
Toll Belt,	11	4
Contullich Belt,	11	5
Claisdruim,	11	4
Ardoch,	10	75
Badger Hill,	9-7	50
Dalreoch,	9-6	300
Bullockeshan,	4	10
Blarvorich,	3	15
Cnoc-na-Croige,	3	16
Evanton,	3-1	30
Contullich,	1	58
Black Park,	1	112
Cnoc Fyrish,	1	64
Total,		<u>928</u>

Vacancies, to an important extent, do not exist on this entire area, but the ground has all to be gone over. Many of these young woods have now passed the age at which deficiencies might be made good by putting in plants of the original species. In some cases, as for instance in parts of Cnoc-an-Eiliknaidh, Toll Belt and Dail Gheal, the stock might now be made good with silver fir (if its healthy growth could be relied on) or with beech, both of which stand shade well; or with Douglas fir, which, though it stands less shade, grows faster in youth; and this would to some extent mend matters; but if not completed, these crops will suffer throughout life from their too open condition in youth. In the more recently planted of the young Scots fir and larch crops, it will be possible to fill a portion of the vacancies with the original species; but where deaths have been caused by brackens or other coarse growth, a shade-bearer should be substituted for Scots fir or larch. The cost of this work will be heavy; and this circumstance, so far as failures may be attributable to the system adopted in planting, must be set against the advantage of a small initial outlay.

In view of the ravages worked by cancer in the larch woods, the principal tree will, for the present, continue to be the Scots fir; but in most parts of the woods larch may be evenly distributed among the Scots fir, to the number of about seventy trees per acre. Over limited areas, Scots fir, in even-aged mixture with either beech, silver fir, Weymouth (or White) pine, or with Douglas fir, may be grown; but the mixture of Scots fir with spruce in an even-aged crop is not recommended. Spruce may be raised as a pure crop in low and moist localities with comparatively stiff soil. The Douglas fir presents a very encouraging appearance at Novar; and in order to determine its ultimate value here as a forest tree, the species should be grown to a moderate extent, both as a pure crop and mixed with others. It has been attacked by a fungus in some parts of Scotland; when young, it suffers from spring and autumn frost; and it is liable to lose its leading shoot when grown in exposed situations. It appears to stand a considerable amount of shade, and will probably succeed well as an under-crop below larch and Scots fir. In Black Park Corner, at the age of fourteen years, it forms a valuable associate at even ages for the larch, though in this mixture its own lower branches remain, for the most part, green. The Weymouth (or White) pine might be grown to a limited extent. The Austrian or the Corsican pine may replace Scots fir in exposed situations; and these two trees, with Cembran pine and Mountain pine, will be valuable additions to permanent shelter-belts at the higher elevations. Experiments may be made with other species, as, for example, the redwood (*Sequoia sempervirens*), the white cedar (*Librocedrus decurrens*), the hemlock (Albert) and the Menzies spruces, the Grandis silver fir, Lawson's and the Monterey (*Macrocarpa*) cypresses, and the Canadian cedar (*Thuja gigantea*). Hardwoods, such as oak, sycamore, beech, ash and others, will as a rule be confined to the lower ground.

The advantages of mixed woods as compared with woods composed of a single species are universally admitted; but the number of species planted together on one and the same piece of ground should not ordinarily exceed two, and should never be more than three. Here, where the Scots fir is raised as a pure crop or mixed with larch, the stock will, as a rule, in course of time, be under-planted or under-sown with silver fir, beech, spruce or Douglas fir. These shade-bearing species will profit, in youth, by the shelter of the lighter-crowned Scots fir and larch, which will protect them from frost, while they in return will keep the stock dense after the stage at which pure crops of the last-named species naturally

become too thin; and they will add considerably to the value of the final crop. They will also lessen the risk of failure which attaches to all stock composed of a single species.

The permanent nursery was formerly situated between Broom Hill and Temple Park, at an altitude of 500 feet, and at a distance of half a mile from the present site, which is 300 feet lower, and close to the gardens of Novar House. The change was effected in 1893, on account of the injury done to the young plants by blackgame, and the cost of carting manure up the hill.

The site of the present nursery is somewhat low, but the ground has recently been well drained, and but little damage is done by frost. Nearly all the plants required on the estate are raised here, very few being purchased, and surplus plants are sold to neighbouring proprietors. The experiment may be tried of raising the plants required for some of the more distant woods, at higher elevations, in temporary nurseries near to the ground on which the plants are to be put out. When pricking out seedlings into nursery lines, care should be taken to avoid turning the roots to one side by putting them into too shallow trenches. The stock in the nursery is much in excess of the probable requirements of the next few years. An area of 6 acres was set aside in 1897 for certain planting experiments. But a series of systematic experiments, of the nature indicated at pp. 34, 35, 49, should now be undertaken and completely recorded; plots of ground suitable for larch may be found in Meann Chnoc and Cnoc Duchoire, while in Dail Gheal other species will be grown.

The work of restocking to be undertaken during the period of twenty-five years for which the present Plan provides will be as follows:—

	Acres.
1. Sites of the successive annual fellings in the older woods to be restocked artificially, save where natural seedlings may have been raised in sufficient numbers. Average area to be dealt with annually, 37 acres (Details in Table of Annual Fellings, Appendix C),	924
2. Filling blanks in existing plantations (see p. 51). Total area about	928
3. Planting up ground now temporarily bare of trees [Details in Appendix A, (3)], less 40 acres in Cnoc Duchoire which are unsuited for forest,	949
Total,	2801

In addition to the above work, the under-stocking of the younger woods will be taken up as suggested hereafter. The restocking of the successive annual felling-areas must on no account be allowed to fall into arrear.

The filling up of vacancies in existing young plantations should be undertaken at once, as an urgent work of first importance, the most advanced crops being given the preference; it can probably be completed within a period of four years, at the rate of about 230 acres a year. Every year that the imperfectly stocked portions of these plantations are allowed to grow on in their present condition, the task of filling them up becomes more difficult.

The planting up of the ground temporarily unstocked, though also a work of urgency, must give way to the above; and except when, the whole of the existing plantations on low ground having been filled up, the high ground is not in a workable condition, no bare ground should be restocked until the filling up of vacancies in all existing plantations has been completed.

This having been accomplished, the 949 acres of unoccupied ground might be restocked in six years, that is at the rate of about 158 acres a year. Of the above area, about 440 acres are situated on high ground, and about 509 acres are on low ground. Weather permitting, about one-sixth part of each class of ground (73 acres of high and 85 acres of low) may be stocked each year. In carrying out this work within the time mentioned, it is unavoidable that large continuous stretches of land will, for some years, be stocked with young trees. But the planting-area of each year should be distributed so as to reduce this evil to a minimum; strips of unstocked ground should be left as long as possible between the newly stocked areas; and these should, when the conditions of soil and slope are suitable, be protected from weevils by isolating trenches, as described at p. 154 of Schlich's "Manual of Forestry," vol. iv. The insects should also be trapped and caught in the manner suggested at pp. 204 and 205 of the same volume. If, in spite of these precautions, serious damage is done by weevils, the restocking of the bare ground must be extended over a longer period than six years, and a more complete isolation of the successive planting-areas must be maintained.

Vacancies occurring in new plantations must be steadily filled up as they occur, so that the young crop may, as soon as possible, outgrow the stage at which it is most liable to injury, and may develop to the best possible advantage.

Planting work should not be extended beyond the limits of the area included in the present scheme until the whole of the existing young plantations have been filled up, so far as their condition permits of this being done, and until all the ground now bare has been planted up; that is to say, not until after the lapse of about ten years. When this stage has been reached, planting and sowing will, for a period of about fifty years, be confined to the restocking of the annual felling-area (for fifteen years only), and to the gradual under-stocking of the younger woods.

THINNING.

It is impossible to lay down in advance the exact age at which the thinning of the young woods should begin, to prescribe the number of stems then to be taken or to be left, or to fix the length of the intervals that should elapse between subsequent thinnings; and the more so as the stock will not everywhere be complete. These matters must be decided with reference to the changing condition of the growing stock; but it is, nevertheless, possible to indicate the principles that should guide the manager in dealing with them. A plantation of Scots fir will start with about 3550 plants ($3\frac{1}{2} \times 3\frac{1}{2}$ feet) to the acre; and the forester's object will be to have standing, upon the best class of soil, at the age of eighty years, about 250 tall, sound, well-shaped trees, such as may realise the highest market price. In inferior localities, where the trees do not attain such large dimensions, the number per acre may exceed 250. To attain this end, it will, from time to time, become necessary to execute a "thinning," which Broilliard defines to be "a lessening of the crowded condition of the crowns of the best trees in a canopy, so as to favour their development." The leaving and favouring of the best trees in a crop, and the removal of those which are inferior to them, does not lead to the stems removed during thinnings being always worthless. Undoubtedly the early thinnings of Scots fir will, for the present at any rate, be of small value; but the advantage of clearing out young trees of the class that will at first be cut, and of allowing the best representatives of the stock to stand, will be subsequently felt, not only when the final crop is realised, but intermediately, by a gradual improvement in the quality of the poles removed at each successive thinning, the last of which will yield material approaching in quality to that of the final crop. Say, for example, that after a thinning made on this principle when the crop of Scots fir was forty years

of age, 700 to 750 of the best of the stems remained standing; then, ten years later, some 200 to 250 of these might be taken out. Most of these would, it is true, be the worst stems then found in the crop; but in consequence of the previous thinning, which left but few inferior trees, they would bring in a good revenue. And so for subsequent thinnings.

Up to the age of about forty years, as a rule, little need be done in a Scots fir plantation but to remove stems which, having been crowded out by their more vigorous neighbours, or from other causes, are either dead or dying. At about that age the thinnings will become somewhat heavier, in order to permit the trees, which have hitherto been encouraged to grow tall, straight, and cylindrical, to develop their girth; and by timely repetition of such moderate thinnings the final stock will attain the desired condition. If, however, the crop of Scots fir is to be understocked, this should be done at that stage in its development (usually between the thirtieth and the fortieth years of age), when the shade given by the canopy of crowns begins naturally to lessen, and thus permits the reappearance of grass in place of the moss which formed the chief soil-covering during the previous period of denser shade. At this time a special thinning must be made, sufficient to enable a young under-crop of shade-bearing species to be successfully introduced by planting, or by sowing in patches; and thereafter, during the progress of thinnings, the light-requirements of this crop must receive due consideration. The under-crop keeps the soil well shaded after the period at which the Scots fir begins to fail in this respect; and it thus promotes the further development of the remaining trees of the principal species, while it also adds considerably to the value of the final crop. When the time for felling the Scots fir arrives, the under-crop, which will then be from forty to fifty years old, may either be cut with it and sold as pit-wood, or be allowed to grow on to larger size, as may then seem best.

The same principle should guide the thinning of young larch woods, the shade given by which usually begins to lessen about ten years earlier than that by Scots fir, and sooner or later becomes so much reduced that, through impoverishment of the soil, the trees composing the crop may begin to fall off in their growth, and may fail to attain the required dimensions. For this reason it is, generally speaking, desirable, in the case of a pure larch crop, to introduce an under-crop of shade-bearers between the twentieth and the thirtieth year. But in view

of the prevalence of larch disease, and of the condition to which some of the young woods have been reduced by it, the question arises whether these woods should be under-stocked at an earlier age. No general rule can be laid down; but it is certainly desirable, especially where the disease is most prevalent, to commence at once, in the older of the young larch woods, the cutting out of those stems which from the effects of disease or other causes are evidently incapable of competing any longer with their more successful neighbours. Such a thinning may do good. Where it results in a cover thin enough for the introduction of an under-crop, such a crop may be established by planting or by sowing; but under other conditions the process of under-stocking may be postponed until the usual time, as above indicated. At the time of under-stocking, all but the most healthy and vigorous of the young trees will be removed, and these latter will be allowed to grow on to full dimensions, standing over the under-crop, which will promote their development. It has been said at p. 34, that where the disease is less prevalent, infested young trees should be removed; but this will not, as a rule, involve such a thinning as would lead to early under-planting.

Crops which are now to be raised of oak, ash, sycamore and other hardwoods, giving light or moderate shade, will usually, between about the twentieth and the fortieth year of their age, be under-sown with beech.

From what has been said above, it will be seen that the details of work in connection with the thinning and under-stocking of the younger woods during the next twenty-five years cannot now be laid down. On the expiry of that period, the oldest of the young Scots fir woods will be only forty-two years of age; and should under-stocking before the fortieth year prove unnecessary, only three woods, covering 272 acres, will have to be so treated within the time named. But should it become desirable to under-stock at thirty years of age, the area to be so dealt with under the present Plan would be raised to 1341 acres. Each wood must be dealt with on its own merits, and no general rule can be laid down. But the whole of the existing young larch woods, covering 195 acres, will probably have to be under-stocked within the next twenty-five years, and similar treatment may perhaps be applied to a portion of the new hardwoods. It is not thought desirable to under-stock any of the existing older Scots fir or larch woods.

Throughout the young woods, the removal of dead and dying trees should be carried out at short intervals, commencing from the time that such trees begin to be produced in considerable numbers.

FINANCE.

When considering the financial results of the foregoing proposals, it should be borne in mind that they are limited to the period of twenty-five years, within which the whole of the older woods will be cut down.

The average felling-area during that period will be 37 acres; and it has been estimated that the average annual out-turn from this area will be 52,200 (quarter-girth) cubic feet. The felling-area will be promptly restocked (where natural seedlings do not exist in sufficient numbers); and, in addition, vacancies will be filled up on 928 acres of thinly-stocked plantations, during four years, at the average rate of about 230 acres a year. During a further period of six years, the restocking of 949 acres of bare ground will be effected, at the annual rate of about 158 acres. After the expiration of these ten years, and for the remaining fifteen years of the period for which the present Plan provides, the work of restocking will be limited to the annual felling-area of 37 acres. The thinning and under-planting of the young larch woods will, however, become necessary before the close of the twenty-five years; and a portion, at any rate, of the young Scots fir woods will, no doubt, come under similar treatment.

The estimates for carrying out the above work are as follows:—

(1) *For the four years ending with 1903.*

Annual nett profit on 52,200 cubic feet of timber at 7d. per cubic foot,	£1522
<i>Deduct,—</i>	
For draining, fencing, planting, forester's salary, share of management, and all other maintenance charges,	934
Annual nett revenue,	<u>£588</u>

(2) *For the six years ending with 1909.*

Annual nett profit on timber, as above,	£1522
<i>Deduct,—</i>	
Maintenance charges, as above,	682
Annual nett revenue,	<u>£840</u>

(3) *For the fifteen years ending with 1924.*

Annual nett profit on timber, as above,	. . .	£1522
<i>Deduct,—</i>		
Maintenance charges, as above,	. . .	330
		<hr/>
Annual nett revenue,	. . .	£1192
		<hr/> <hr/>

It is impossible to make any useful estimate of the amount of the annual nett revenue for the period of thirty-six years which must elapse between the year (1924) in which the last of the older woods will be felled, and that (1960) in which the oldest of the younger woods will attain the age of eighty years. If the thinnings from woods of the latter class yield sufficient to pay the expenses of management, that is, perhaps, as much as can be expected.

In regard to the younger woods and new plantations, which will come into full yield about the year 1960, it may be confidently anticipated that timber of the high quality they will yield must secure a good return, according to the scale of prices that may then prevail; and that in consequence of the inevitable falling off of our importations from abroad, prices will without doubt be higher than they are now. But assuming that they are merely maintained at present rates, a rough estimate of the financial results of working the woods on the estate, from and after the year 1960, might be made somewhat as follows, on the assumption that the annual felling-area will be 50 acres:—

Final yield per acre, 5000 cubic feet at 7d.			
= £145, which × 50	=	£7,250	0 0
Thinnings from the whole area, equivalent to			
1900 cubic feet per acre on 50 acres, at 7d.,	=	2,750	0 0
		<hr/>	<hr/>
Gross annual receipts,	=	£10,000	0 0
<i>Deduct Expenses,—</i>			
Draining, planting, fencing			
50 acres at £4,	=	£200	0 0
Tending and management of			
whole area (4000 acres) at			
3s. per acre,	=	600	0 0
		800	0 0
		<hr/>	<hr/>
Annual nett revenue,	=	£9,200	0 0
		<hr/> <hr/>	<hr/> <hr/>

This sum, which includes neither the considerable value of the under-stock of shade-bearing species, nor the higher price obtainable for larch, is equivalent to 46s. per acre per annum. But allowing for crops at the higher elevations and unforeseen contingencies, it will be safe to estimate a nett surplus of £2 per acre per annum, which represents an income from the woods of £8000 a year. If these 4000 acres of land were not to be occupied by woods, they could not be expected to yield more than, on an average, 3s. 6d. per acre from grazing and shooting.

CONCLUSION.

CONTROL BOOK.

A Control Book will be instituted for recording the revenue derived from sales, as well as the expenditure under all heads, so that the financial results of the business may be clearly seen, and may form a reliable guide to the framing of future Plans for the estate.

ORDNANCE MAPS.

A set of the sheets of the 25-inch Ordnance Map, on which the boundaries of the woods included in the present Plan are all clearly and accurately shown, should be kept in a bound atlas as one of the records of the Plan.

MUSEUM.

A small museum for specimens of the wood of various species grown on the estate; of injurious insects and of the damage they cause; of the effects of disease and of unfavourable influences; as well as of tools, implements, and other objects connected with forestry at Novar, has already been commenced. It should be further developed.

The thanks of the writer are due to Mr John J. R. Meiklejohn, factor, Mr J. D. B. Whyte, assistant-factor, and Mr William Mackenzie, forester, all of whom gave cordial assistance in the work which has now been concluded.

The Plan has been sanctioned by the proprietor, and is now in operation.

APPENDICES.

APPENDIX A.
CLASSIFIED LIST OF WOODS INCLUDED IN THE PLAN.
I. THE OLDER WOODS.

No. on Map.	NAME.	Mean Age in 1899.	ESTIMATED STOCK.					Principal Kinds of Trees; and Remarks.	Grazed or Otherwise.
			Acres.	Per Acre.		Total.			
				Trees.	Cubic-ft. (1-girth.)	Trees.	Cubic-foot. (1-girth.)		
(a) <i>Conifers</i> (on map—dark green).									
22	Choc Fyrish,	122	{ 22-000 8-000 45-000 20-000	50 190 45 60	900 3,420 2,925 2,840	1,100 1,520 2,020 1,200	19,800 27,360 131,620 16,800	Scots fir; attacked by red rot. South side. } Scots fir; attacked by red rot. North side. }	...
31	Meann Chnoc,	122	{ 15-000 35-000 10-000	45 90 100	2,700 850 1,400	670 3,150 1,000	40,500 29,750 14,000	Scots fir; ruined by squirrels. Scots fir; being blown down. Scots fir; not unhealthy.	...
32	Badger Hill,	121	{ 27-003 41-206 45-000	55 150 100	1,375 2,270 2,000	1,480 6,180 4,500	37,120 92,700 90,000	{ Scots fir and larch with a few hardwoods; } } not unhealthy. Scots fir with scattered larch; not unhealthy.	...
28	Creag Ruadh,	117	{ 3-310 41-000	128 70	1,470 1,120	420 3,080	4,850 49,280	Mostly hardwoods; bad condition. Scots fir with scattered larch; not unhealthy.	...
64	Blarvorich,	116	{ 23-933 4-410	60 75	1,020 1,125	1,430 330	24,380 4,950	{ Scots fir and larch with a few hardwoods; } } stocked unevenly. Scots fir with a few hardwoods; not unhealthy.	Grazed.
58	Blackrock Brae,	81	{ 55-396 5-000	130 65	3,875 490	7,200 320	100,830 2,450	Scots fir. Scots fir; damaged by squirrels. }	...
13	Ballachraggan Belt,	81	{ 10-881 5-902	60 75	840 900	650 440	9,160 5,310	Larch; attacked by red rot. Scots fir, larch and spruce with hardwoods.	Grazed.
21	Fyrish Upper Belts,	81	{ 14-397 4-630	60 90	930 1,800	860 410	13,390 8,280	Do., do., { Little but inferior hardwoods left; crop not } } improving. Larch; in healthy condition. }	...
62	Incheolhair,	79	{ 43-000 87-000	180 180	1,620 1,620	7,470 15,660	69,660 140,940	Larch; attacked by red rot. Scots fir; damaged by squirrels. }	Grazed.
54	Assynt Lower Belt,	77							...
56	Assynt Upper Belt,	77							...
53	Dalnahaun,	77							Grazed.
17	Clash-na-buaie,	76							Grazed.
10	Contallich Wood,	75							...

30	Choc-na-Coille,	71	{ 15-000 52-228	80	760	1,200	11,400	Larch; attacked by red rot. } Scots fir; damaged by squirrels. } Scots fir. Scots fir; damaged by squirrels. { Larch, attacked by red rot; and Scots fir, } damaged by wind and squirrels. Larch and hardwoods. Higher part. } Scots fir and larch; damaged } Lower part. } by squirrels. Scots fir, larch and spruce. Scots fir and larch; ruined by wind and squirrels. Scots fir and larch with a few hardwoods. Scots fir and larch.	...
24	Temple Park,	70	2-000	50	300	6,260	56,380		
29	Caisteal Breac,	70	15-000	100	1,500	1,500	22,500		
3	Lealty Belt,	70	1-500	100	500	150	750		
27	Bullockshan,	70	3-000	45	125	130	1,270		
6	Choc Duchaire,	69	{ 88-786 80-000	150	825	13,320	73,260		
8	Montlavie Belt,	65	3-000	75	712	220	2,140		
5	Baidan's Belt,	60	19-420	10	220	780	4,270		
55	Ballavoulin,	51	2-181	100	806	220	1,760		
36	Cross Hills,	47	14-802	100	900	1,480	13,320		
...	Total,	...	867-863	101,950	1,273,140	...	

Average age, 84 years; average stock per acre 118 trees, of 12½ cubic feet each, or, approximately, 1540 (¼-girth) cubic feet.

(b) *Hardwoods* (on map—burnt sienna).

15	Toil Belt,	90	3-557	56	900	200	3,150	Oak, beech, lime, etc. Oak and beech. Oak and other hardwoods, with a few larch. Oak, beech, elm. Oak, beech, etc., with a few conifers. Oak, beech, etc. Beech, oak, ash, elm, etc. Ash, elm, Scots fir, larch. Oak, beech, elm, ash and a few larch. Elm, oak, beech. Oak. Ash, elm, oak, etc.	...
52	Evanton Wood,	81	6-000	80	560	480	3,360		
13	Ballachragan Belt,	80	2-168	80	240	170	530		
46	Tendallon Belt,	80	3-285	40	600	130	1,980		
63	Cottage Wood,	77	3-794	60	720	230	2,740		
41	Dail Gheal Belt,	60-80	7-840	100	1,000	780	7,800		
51	Coulaigs,	70	500	25	500	10	250		
48	Lower Park Belt, West,	70	1-792	40	400	70	720		
47	Skiack Belt,	70	9-969	70	1,180	700	11,900		
49	Lower Park Belt, East,	70	3-145	40	600	150	1,860		
50	Chucairn Belt,	52	7-21	150	820	110	570		
42	Newton River Belts,	50	13-371	45	430	600	5,760		
...	Total,	...	56-142	3,630	40,620	...	

Average age, 69 years; average stock per acre 65 trees, of 11 cubic feet each, or, approximately, 715 (¼-girth) cubic feet.

2. THE YOUNGER WOODS.

No. on Map.	NAME.	Mean Age in 1899.	Acres.	Principal Kinds of Trees; and Remarks
(a) <i>Conifers</i> (on map—light green).				
20	Novar Mains Belts, . . .	19	1-788	{ Larch with a few Scots fir; a few Scots fir standards.
37	Dail Gheal,	17	12-000	Scots fir, larch and spruce.
1	Acharn Wood,	16	139-012	Scots fir and larch.
21	Fyrish Upper Belts, . . .	16	498	Larch.
61	Assynt Hill,	15	{ 137-666 110-000	Larch. Scots fir.
18	Clash-na-buiac Clump, . .	14	{ 600 70-000 40-000	Scots fir, Douglas and hardwoods. Scots fir and larch. Scots fir.
23	Cnoc-an-Eiliknaidh, . . .	14	{ 20-000	{ Scots fir and larch, with <i>Laricio</i> , Douglas and hardwoods.
12	Black Park Corner,	14	1-000	Larch and Douglas fir.
35	Cross Hills,	14	16-327	Larch with some spruce.
26	Broom Hill,	14	34-500	{ Scots fir with a few larch; a few Scots fir standards.
24	Temple Park,	14	36-000	{ Larch with some Scots fir, Douglas, spruce and hardwoods; a few groups of Scots fir standards.
29	Caistel Breac,	14	{ 45-916 5-000	Scots fir. Scots fir, larch and Douglas fir.
54	Assynt Lower Belt,	11-12	7-990	Scots fir, larch and spruce.
60	Blackrock Corner,	11	1-500	Scots fir and larch with a few spruce.
57	Assynt West Belt,	11	4-835	Scots fir, larch and spruce.
15	Toll Belt,	11	26-870	{ Larch, spruce, Douglas, Scots fir and hardwoods; partly mixed, partly in groups.
20	Novar Mains Belts,	11	3-865	Larch, Scots fir, Douglas and hardwoods.
45	Newton River Belts,	11	991	Scots fir, larch and Douglas fir.
7	Claisdruin,	11	70-937	Scots fir.
9	Contullich Belt,	11	30-858	Scots fir and larch.
2	Ardoch Wood,	10	81-294	Scots fir and a few larch.
21	Fyrish Upper Belts,	9	1-254	Douglas fir, with a few hardwood standards.
32	Badger Hill,	{ 7-9 (average 8)	{ 50-000	{ Larch, Scots fir, silver fir, Douglas and hardwoods, with a few Scots fir standards.
4	Dalreoch,	{ 6-9 (average 8)	{ 471-000	Scots fir, larch and a few spruce.
25	Old Nursery,	7	3-400	Various conifers and hardwoods.
56	Assynt Upper Belts,	{ 3-9 (average 6)	{ 1-297	Conifers and hardwoods.
19	Fyrish Lower Belts,	6	2-994	Douglas and silver fir under oak standards.
27	Bullockeshan,	4	37-000	Scots fir, with some Scots fir standards.
52	Evanton Wood,	3	47-000	{ Scots fir and larch with some spruce; a few hardwood standards.
64	Blarvorich,	3	45-501	Scots fir.
16	Cnoc-na-Croige,	3	16-157	{ Larch, spruce, Douglas and hardwoods in groups, with a few hardwood and Scots fir standards.
22	Cnoc Fyrish,	1	64-000	Scots fir and larch.
11	Black Park,	1	{ 101-882 4-000 6-000	{ Scots fir, spruce and larch in groups with a few hardwood standards. Spruce with a few larch. Experimental areas.
20	Novar Mains Belts,	1	1-000	Douglas fir with a few Scots fir standards.
10	Contullich Wood,	1	58-000	Scots fir, larch and spruce.
52	Evanton Wood,	1	3-000	Douglas fir.
...	Total,	...	1812-932	

(b) *Hardwoods* (on map—burnt sienna).

45	Newton River Belts,	20	3-957	{ Alder, willow and conifers, with a few older trees; grazed.
50	Culcairn Belt,	8	500	{ Alder coppice, with a few standards 20 years old; grazed.
56	Assynt Upper Belt,	5	1-500	Horse chestnut, beech, etc.
...	Total,	...	5-957	

3. AREAS TEMPORARILY UNSTOCKED (on map—yellow).

No.	NAME.	Acres.	Principal Species to be Raised.	Remarks.
22	Choc Fyriah,	238·000	Scots fir with a few larch,	{ Groups of Scots fir standards for seed, "Brush" over whole area.
28	Creag Ruadh,	185·000	{ Scots fir, with a few larch in places and spruce in moister parts,	{ A few Scots fir standards, "Brush" over whole area. Grazed.
10	Contullich Wood,	124·000	Do.	"Brush" over whole area.
31	Meann Chnoc,	92·023	{ Scots fir with a few larch. Plot of pure larch on north side,	{ Scots fir standards for seed. "Brush" over 30 acres.
6	Choc Duchaire,	{ 30·000 } { 40·000 }	Do.	"Brush" over 30 acres. (Grazed.)
11	Black Park,	45·500	Top of hill to remain unstocked,	{ A few hardwood standards. "Brush" over 40 acres.
37	Dail Gheal,	45·000	Spruce, larch and Douglas,	
52	Evar-fon Wood,	{ 39·000 } { 5·038 }	{ Experimental areas. Rest of ground, Scots fir and spruce.	
62	Inch-pholtain,	40·000	Scots fir with a few larch,	A few Scots fir and hardwood standards.
64	Blarvorich,	37·264	Oak, beech, ash,	A few hardwood standards. "Brush" over whole area. (Grazed.)
8	Morltavie Belt,	22·786	Do.	Do.
30	Choc-na-Coille,	20·000	Do.	Do.
32	Badger Hill,	20·000	Do.	{ A few Scots fir standards. "Brush" over whole area.
51	Coulaigs,	3·942	Oak and beech,	{ A few Scots fir standards. "Brush" over 10 acres.
16	Choc-na-Croige,	1·000	Scots fir with a few larch,	A few hardwood standards. Grazed.
21	Fyriah Upper Belts,	·211	Douglas.	{ A few Scots fir and hardwood standards. "Brush" over whole area.
	Total,	988·764	of which 40 acres will remain unstocked.	

THE FOLLOWING AREAS HAVE BEEN EXCLUDED FROM THE WORKING PLAN (on map—red).

No.	NAME.	Acres.				Total.	Present Crop; and Remarks.
		Old Woods.	Young Woods.	Temporarily unstocked.	Total.		
32	Badger Hill,	15·000	...	...	15·000	Scots fir, with a few larch, beech and oak.
37	Dail Gheal,	*22·997	...	18·000	40·977	Scots fir. Grazed.	
38	Cathill,	51·000	...	...	51·000	Scots fir.
14	Teaminich Belt, East, . . . . .	...	6·053	...	6·053	Oak, beech and natural birch. Grazed.
14	Teaminich Belt, West, . . . . .	...	6·572	...	6·572	Mixed hardwoods, with larch and Douglas. Grazed.
34	All Duack, . . . . .	...	7·000	...	7·000	Mixed conifers.
35	Gardener's Burn, East, . . . . .	...	9·093	...	9·093	Mixed hardwoods, with larch and Douglas.
"	Gardener's Burn, West, . . . . .	...	7·343	...	7·343	Scots fir with a few Douglas, larch and mixed hardwoods.
40	The Plot, . . . . .	...	·314	...	·314	Scots fir, with a few limes and sycamores.
39	Polley Park Strip, . . . . .	...	2·500	...	2·500	Scots fir, larch, Douglas and spruce.
42	Newton Belt (1), . . . . .	...	3·649	...	3·649	Scots fir, larch and hardwoods.
"	Newton Belt (2), . . . . .	...	3·481	...	3·481	Beech, oak, larch and Scots fir.
43	Tallysow Belt, . . . . .	...	4·535	...	4·535	Scots fir, oak, ash, horse-chestnut, beech. Grazed.
33	Bog-a'-Phioinne, . . . . .	...	...	108·000	108·000	70 acres enclosed as a rabbit-warren.
	Total,	88·997	50·540	126·000	265·537		

APPENDIX B.

DETAILED DESCRIPTIONS OF THE WOODS INCLUDED
IN THE PLAN.

NOTE.—*The nature of the rock in the various localities has been stated at p. 25. The points of the compass are indicated by the letters N., S., N.E., S.W., etc.*

No. 1.—ACHARN WOOD.

Young Conifers, 139·012 Acres.

CONDITIONS OF LOCALITY.—Elevation, 650 to 690 feet; gentle N.W. slope. Soil, shallow, mossy, and in parts stony; hard on the higher S. portion. Drainage defective in places. Exposed to S.W. winds. Outside the line of wire netting.

CROP.—Age, 16 years. *N. Portion.* Mixed Scots fir and larch; the former in lines about 15 feet apart, with numerous vacancies; larch between the lines have for the most part failed. In spite of the breezy situation and open crop, the larch—even isolated trees—are badly diseased, and the locality does not appear to suit this tree except near the road, where the soil is deeper and more loamy. In hollows, the Scots fir has suffered from snow. In places there are a few natural seedlings of Scots fir, resulting from seed produced by the present young crop.—*S. Portion.* Pure Scots fir, stunted on S.W. side from exposure to wind. Throughout the wood, some damage has been done by hares, and squirrels have already begun to attack the young trees. A strong growth of heather has kept back the crop in places.

TREATMENT.—Fill up vacancies at once with Scots fir and shade-bearers, so as to secure as even a crop as possible. Look to the drainage. Permanent shelter-belts are required on the S. and W. sides; birch, Mountain pine and Cembran pine may be added to the present crop, and a row of spruce may run down the centre of the belt.

No. 2.—ARDOCH WOOD.

Young Conifers, 81·294 Acres.

CONDITIONS OF LOCALITY.—Elevation, 660 feet; moderate slope to N. Very hard, stony and shallow soil, with exposed boulders. Drainage defective in places. Exposed to S.W. winds. Outside the line of wire netting.

CROP.—Age, 10 years. Scots fir with a few larch; quality very variable. Crop very poor and thin on the W. side, the larches being for the most part dead or dying, and the Scots fir not forming more than one-fourth to one-third of a full crop. Elsewhere, the larch is doing fairly well, having healthy bark, and being comparatively free from disease. Wherever the soil is thin and

hard the larches are poor, while on deeper soil they look much better. A few self-sown Scots fir, 10 to 15 feet high, and older than the main crop, are scattered over the area. In a few places, self-sown birch are interfering with the growth of the young Scots fir. The older Scots firs are attacked by squirrels, and some damage has been done by hares.

TREATMENT.—Vacancies should be filled up at once with Scots fir and shade-bearers, larch being added only where this species now shows good growth. Cut out diseased larch and replace by Scots fir. Relieve the young Scots fir from injury by birch. Establish shelter-belts on the S. and W. sides. Look to the drainage.

No. 3.—LEALTY BELT.

Old Conifers, 1.5 Acre.

CONDITIONS OF LOCALITY.—Elevation, 650 feet; steep N. slope. Soil, light sandy loam of moderate depth to deep. Open to grazing. Outside the line of wire netting.

CROP.—Age, 70 years. Estimated stock, 100 trees per acre, each of 5 cubic feet. Larch "royed," and the entire crop has suffered severely from squirrels and beetles (*Hylurgus*).

TREATMENT.—Crop making no progress. Cut it down and restock with Scots fir only.

No. 4.—DALREOCH.

Young Conifers, 471 Acres.

CONDITIONS OF LOCALITY.—Average elevation, 650 feet; gentle slope to N.E., with steep fall to the Alness river. Soils various; in parts deep loam, elsewhere hard and stony. Drainage defective in places. The N.W. winds are those most to be feared. Outside the line of wire netting.

CROP.—Age, 6 to 9 years. Scots fir and larch mixed; larch more numerous in the deeper soil; some spruce in the hollows. Crop thin, but doing well on the whole. A strong growth of brackens, broom, whins and heather seriously interferes with the young crop in some places. When the crop was cut ten years ago from a part of the area, 500 Scots fir trees were left standing for ornament; with the exception of some half-dozen, all of these were blown down in 1893 and did considerable damage to the young crop. The young trees have suffered severely from roe-deer, hares, rabbits and blackgame; and for the first few years they were much damaged by weevil, especially on the site of the old wood. A few young larches, injured by roe-deer in 1896, and marked, were found in 1897 to be attacked at the injured spot by larch disease.

TREATMENT.—Fill up vacancies at once with Scots fir and shade-bearers, except in the moister parts, where spruce may be used, and at the river-side, where birch has recently been cut, and where larch may be planted. Douglas fir may be added in sheltered places. Look to the drainage. Establish permanent shelter-belts along the W. side, and along the N. side down to the stream.

No. 5.—BADDAN'S BELT.

Old Conifers, 19·420 Acres.

CONDITIONS OF LOCALITY.—Elevation, 650 feet; gentle slope to E. For the most part shallow, poor and mossy, but fairly good in the lower parts. Drainage very defective. Much exposed to N.W. winds. Open to grazing. Outside the line of wire netting.

CROP.—Age, 60 years. Scots fir and larch. Estimated stock, 40 trees, of $5\frac{1}{2}$ cubic feet each, to the acre. A very thin, poor and stunted crop; much damaged by wind and by squirrels. A strong growth of coarse heather covers the ground, but there are a few natural Scots fir seedlings in places.

TREATMENT.—Fell as soon as possible and restock the ground with Scots fir mixed with a few larch. Look to the drainage. A permanent shelter-belt is much needed on the N.W. side.

No. 6.—CNOC DUCHAIRE.

<i>Old Conifers</i> ,	168·786 Acres.
<i>Unstocked</i> ,	70·000 „
	<hr/>
<i>Total</i> ,	<u>238·786</u> „

CONDITIONS OF LOCALITY.—Elevation, from 800 to 1170 feet; ground slopes down in all directions from the summit of the isolated peak, near which it falls steeply, but has a moderate inclination lower down. Soil very shallow and poor on and near the summit, as well as on the N. side, but deep in the lower part. The summit of the hill is exposed to wind from all quarters. The wood is open to grazing. It is outside the line of wire netting.

CROP.—Age, 69 years. Estimated stock—80 acres of the lower ground on the S. side carry 190 trees, of 10 cubic feet each, to the acre; the remaining 88·786 acres carry 150 trees, of $5\frac{1}{2}$ cubic feet, to the acre. The summit shows a few scattered and very stunted trees, the worst of which grow where the ground is covered with grey moss. The growth on the N. side is poor, but improves on the S. side. Throughout the wood great damage has been done by squirrels; no less than 41 were killed here in a single morning. The trees have also suffered much from attack by Pine Beetle. Considerable areas are covered with dense brackens. Some young self-sown seedlings are found in places. Of the unstocked area, 40 acres (the summit of the hill) are unsuited for planting, and the remaining 30 acres are covered with the débris of the old crop which was blown down in 1893-94. Young seedlings are springing up where they escape the sheep and are not kept back by a too dense growth of brackens.

TREATMENT.—The old wood is not improving, and should be cut down as soon as possible. A new crop of Scots fir, with a small proportion of larch, should be raised on the ground, as far as possible by natural regeneration. The 30 acres of bare ground should be similarly stocked. All existing trees at the higher elevations should be preserved on account of the shelter they afford.

No. 7.—CLAISDRUIM.

Young Conifers, 70·937 Acres.

CONDITIONS OF LOCALITY.—Elevation, 600 to 700 feet; formed by the gently sloping sides of a valley running N.E. and S.W. Soil, shallow on higher ground, but of good depth lower down; though, generally speaking, somewhat hard and stony. Drainage defective. Exposed to N.E. winds. W. portion outside the line of wire netting.

CROP.—About 20 acres of the W. portion carries a thin stock of natural Scots fir, averaging 25 years of age; the trees are in a very poor condition, having grown in a free position, and having suffered much from squirrels. Part of this thin crop was underplanted with Scots fir in 1888, the plants being now incommoded by the trees standing over them. The rest of the area carries a planted crop of Scots fir, 11 years old, intermixed along the S.E. margin, next to Moultavie Belt, with self-sown Scots fir and larch, about 16 years of age. The larch, which form a practically pure and very dense crop in places, are, generally speaking, remarkably healthy. The young crop, as a whole, is going on very well, but in a few places, where the ground is covered with grey moss, it does not succeed. Roe-deer, rabbits and Pine Beetle have done some damage.

TREATMENT.—The older and inferior trees should be removed where they interfere with the young crop, and blanks should be filled up with Scots fir and shade-bearers. The drainage should be looked to. A permanent shelter-belt is required on the N.E. margin.

No. 8.—MOULTAVIE BELT.

<i>Old Conifers,</i>	3·000	<i>Acres.</i>
<i>Unstocked,</i>	22·786	„
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<i>Total,</i>	25·786	„

CONDITIONS OF LOCALITY.—Elevation, 630 to 680 feet; gentle slope to S. and S.W., but steep down to the burn. Soil, shallow, hard and mossy above, but deep near foot of slope. Much exposed to N.E. winds. Open to grazing.

CROP.—The three acres of standing crop lie chiefly on the sheltered S. slope, and consist of Scots fir, larch and spruce, 65 years of age. The stock is estimated at 75 trees, of 9 to 10 cubic feet each, to the acre. This is the only portion of the old crop left standing after the gales of 1893-94. The larch are “royed.” The Scots fir formerly standing on the unstocked area was stunted owing to damage by squirrels. On the unstocked area, which is thickly covered with the debris of the old crop, a good many natural seedlings of larch are springing up, in spite of the sheep, those which escape being protected by the debris. There are a few patches of dense brackens.

TREATMENT.—Cut down the remainder of the old wood, and restock with Scots fir on the higher part and spruce near the burn. Plant up the bare ground with Scots fir mixed with a few larch. A permanent shelter-belt is required on the E. side.

No. 9.—CONTULLICH BELT.

Young Conifers, 30·858 Acres.

CONDITIONS OF LOCALITY.—Elevation, 400 to 550 feet; gentle N.E. slope. Soil, hard and shallow in the higher part, deeper and of better quality lower down. Exposed to N.E. winds.

CROP.—Age, 11 years. Scots fir and larch. On the higher ground there is a scattered crop of natural Scots fir, age about 30 years; this was interplanted in 1888 with Scots fir and a few larch, which are being kept back by the older crop. The lower part carries a fine young wood of Scots fir and larch, which form a dense and promising crop of, for the most part, healthy young trees. Some of them have, however, been attacked by rabbits, which gnaw even the largest of the young trees. There is a dense crop of self-sown larch on the S. side, next to Contullich Wood, and these are, generally speaking, healthy. There is a very dense growth of whins in the lower part, but the crop is well above them.

TREATMENT.—Cut out the older Scots fir on the higher ground; they will not develop into good trees. Plant up the ground with Scots fir and shade-bearers, and with spruce on the moister places. Cut out the diseased larch. Keep down the rabbits. A permanent shelter-belt is required on the N. and E. sides.

No. 10.—CONTULLICH WOOD.

<i>Old Conifers—Scots Fir,</i>	. 87·000	
<i>Larch,</i>	. 43·000	
	—————	130·000 Acres.
<i>Young Conifers,</i>	. . . . .	58·000 "
<i>Unstocked,</i>	. . . . .	124·000 "
		—————
<i>Total,</i>	. . . . .	312·000 "

CONDITIONS OF LOCALITY.—Elevation, 200 to 600 feet; gentle S. slope. Soil, shallow, hard and gravelly above, with mossy strips at intervals; good depth below. Much exposed to N.E. wind, from which the crop suffered severely in 1893-94.

CROP.—*Old Wood.* Age, 75 years. Scots fir 87 acres, larch 43 acres, including a few hardwoods near the road. Estimated stock, 180 trees, of 9 cubic feet each, to the acre; a few of the trees measure 40 cubic feet each. The Scots fir appears to have been over-thinned, and has also been much damaged by squirrels; but there are still many good trees. The larch are mostly "royed." A good growth of natural seedlings has appeared since the wood was closed two years ago, except where dense brackens have kept them back over extensive areas; but natural seedlings of both larch and Scots fir readily push their way through heather up to 2 feet. in height. The old trees are attacked by Pine Beetle.—*Young Wood.* Planted in 1899 with Scots fir, larch and spruce, which form groups on the harder, the deeper, and the moister parts respectively. About two-thirds of the area are covered with dense brackens, which form a very serious obstacle to the growth

of the young trees. Elsewhere they are doing well, except in the N. part, along the edge of Contullich Belt, where the plants are kept down by rabbits. They also suffer slightly from weevil.—*Unstocked Portion.* A few Scots fir standards still left; ground covered with débris from former crop. About one-half of the area is covered with dense brackens, but many natural seedlings are springing up near the old wood.

TREATMENT.—Of the old crop, the larch should be removed as soon as possible, but the Scots fir may stand for a time. Their removal should be conducted with a view to natural regeneration. A belt of trees should be allowed to stand as long as possible on the S.W. margin, as a protection to Black Park against wind. Injury to the young wood by rabbits should be put a stop to, and where vacancies occur, the crop should be kept steadily filled up. The bare ground should be stocked like the young wood. The permanent shelter-belt already commenced on the S.E. side should be completed.

NO. 11.—BLACK PARK.

<i>Old Conifers,</i>	. . . . .	45·000	<i>Acres.</i>
<i>Young Conifers,</i>	. . . . .	111·882	,,
<i>Unstocked,</i>	. . . . .	45·500	,,
		<hr/>	
<i>Total,</i>	. . . . .	202·382	,,

CONDITIONS OF LOCALITY.—Elevation, 200 to 500 feet; gentle S.W. slope. Soil, generally speaking, good, deep loam, with shallow and hard portions on the higher ground. Lower ground wet, though recently drained. Exposed to N.E. and S.W. winds.

CROP.—*Old Wood.* Age, 91 years. Scots fir and larch with a few hardwoods. Estimated crop, 100 trees, of 20 cubic feet each, to the acre. Larch mostly “royed”; Scots fir very fine, but has been damaged by squirrels, and turns out knotty when cut up. One acre has been under-planted with beech, silver fir, spruce and Douglas fir. There are some dense patches of brackens; but where the ground is not thus encumbered, a promising natural growth has sprung up since the wood was closed two years ago.—*Young Wood.* Age, 1 year. A few hardwood standards still remain. 101·882 acres in the upper part have been stocked with Scots fir on the drier and shallower soil, and with larch where the soil is deeper. Four acres in the lower part were this year stocked with spruce and a few larch. An area of 5 acres was set apart in 1897 for experiments; it is stocked as follows:—1 *Acre.* Larch, half pitted, half notched, at 20 feet apart; the intervals filled up with notched Scots fir. 1 *Acre.* Larch as above, but filled up with spruce instead of with Scots fir. 1 *Acre.* A mixture of larch, beech, silver fir and spruce—all pitted. 1 *Acre.* A mixture of larch and spruce—all notched (spruce to kill the bracken). 1 *Acre.* Beech, silver fir, spruce and Douglas fir—all pitted. 1 *Acre.* Larch, pitted at 5 feet intervals.—*Unstocked Area.* Débris from former crop covers most of it. A few hardwood standards remain. Large areas are covered with dense brackens.

TREATMENT.—The old wood should be felled as soon as possible; and the ground should be planted up with Scots fir, mixed with a few larch. Vacancies in the young wood should be steadily filled

up. Of the unstocked ground, the higher parts, which are to a great extent covered with dense brackens, should be stocked with larch and Douglas fir, the brackens being kept clear of the young trees, especially of the larch. The low ground should be stocked with spruce. Permanent shelter-belts are required on the W., S. and E. sides.

No. 12.—BLACK PARK CORNER.

Young Conifers, 1 Acre.

CONDITIONS OF LOCALITY.—Elevation, 180 feet ; gentle S. slope. Soil, deep, strong loam.

CROP.—Age, 14 years. Larch and Douglas fir. The crop has been slightly thinned to relieve the Douglas fir, which had been outgrown by the larch. The Douglas kept ahead of the larch for the first ten years. The larches are splendid young trees, being tall and straight, and having their lower branches killed off by the Douglas. The latter tree, when in contact with its own species, is clearing the bole well : less well when in contact with larch. The crop is very dense. The larches average 40 feet and the Douglas 39 feet in height. Disease is present to a slight extent among the larch.

TREATMENT.—Cut out diseased larch. Knock off dead lower branches as soon as this can be done easily.

No. 13.—BALLACHRAGGAN BELT.

<i>Old Conifers,</i>	. . . . .	4.410	<i>Acres.</i>
<i>Old Hardwoods,</i>	. . . . .	2.168	„
		<hr/>	
<i>Total,</i>	. . . . .	6.578	„

CONDITIONS OF LOCALITY.—Elevation, 20 to 50 feet. The conifers form a belt, 15 yards wide, running N.W. and S.E., with a gentle slope to S. Soil, generally, a good, deep, sandy loam. The hardwoods form a triangular plot ; the soil is of moderate depth and poor quality ; the drainage is defective.

THE CROP.—*Conifers.* Age, 81 years. Scots fir with a few birch. Estimated stock, 75 trees, of 15 cubic feet each, to the acre. There is a strong growth of whins on the ground, and the trees have been damaged by squirrels.—*Hardwoods.* Age, 80 years. Oak, with a few larch and other species. Estimated stock, 80 trees, of 3 cubic feet each, to the acre. The trees are of poor quality. The ground carries much coarse grass, whins and broom.

TREATMENT.—*Conifers.* Thick cover is required as soon as possible for shelter and for game. The present thin crop should be felled early, and the ground should be restocked with Scots fir, a few rows of spruce being planted down the centre.—*Hardwoods.* Remove the worst of the trees, prune up those which are left, and under-plant with silver fir or beech. Look to the drainage.

No. 15.—TOLL BELT.

<i>Young Conifers,</i>	26·870	Acres.
<i>Old Hardwoods,</i>	3·557	„
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<i>Total,</i>	30·427	„
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CONDITIONS OF LOCALITY.—Elevation, 50 to 70 feet; ground undulating, with general gentle slope to S. Soil, strong, deep loam, sandy in parts. A large proportion of the area very wet, though the drainage is undergoing improvement. Exposed to N.E. winds.

CROP.—*Conifers* in eastern portion. Age, 11 years. Stock consists of larch, Douglas fir, spruce, Scots fir, with some alder, ash, hornbeam, poplar, elm, oak, beech and a few Lawson's cypress. The species are mixed, partly singly partly in groups. Larch badly diseased, and whole crop suffers from excess of moisture. There is a dense crop of whins and coarse grass in places. The young crop suffered severely from injury by rabbits and hares. Vacancies partly filled up in 1897 with Douglas fir, spruce, Scots fir and ash. In 1898, the young hardwoods were pruned, and side shoots were cut from the larger Douglas fir, Scots fir, spruce and birch, where they were found to be interfering with younger plants. Birch was also cut out in places.—*Hardwoods* in western portion, with three clumps of old trees, chiefly beech, in the eastern portion. Age, about 90 years. Crop in western portion, oak, beech, lime, horse-chestnut, ash. Estimated stock, 56 trees, each of 16 cubic feet, to the acre. An undergrowth of whins and broom has recently been cut to promote natural regeneration, and a vigorous crop of beech and ash has been thus produced.

TREATMENT.—*Conifers*. Thoroughly drain as soon as possible; cut out unhealthy and misshapen young trees, and fill up with spruce. In the first thinning, the number of species should be reduced by removing those which appear least suited to the locality. Permanent shelter-belt required on the N.E. side.—*Hardwoods*. Group of old hardwoods in eastern portion to remain untouched. In the western strip, the old crop, except the marginal trees, to be cut out as soon as the new self-sown crop, supplemented where necessary by planting or sowing, has become established.

No. 16.—CNOC-NA-CROIGE.

<i>Young Conifers,</i>	16·157	Acres.
<i>Unstocked,</i>	1·000	„
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<i>Total,</i>	17·157	„
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CONDITIONS OF LOCALITY.—Elevation, 100 feet; a low ridge running N.E. and S.W., with some low flat ground on the N. side. Soil, shallow and stony on ridge, deep and sandy below; low ground very wet, and plants exposed to frost. N. winds dangerous.

CROP.—*Conifers*. The ridge still carries a few old standard trees. Ground has been restocked with larch, among which are groups of Douglas fir, silver fir and Scots fir, aged 3 years. The low ground is stocked with larch, spruce, Douglas fir and hardwoods of similar

age. There is a dense crop of brackens on the S. slope of the ridge, with wild birch, whins and raspberry on the low ground. The larch has suffered severely from frost and rabbits; the spruce in the low ground does not look healthy, and much damage has been done by weevils.—*Unstocked Ground*, to the W. of the road, carried a crop of fine Scots fir, which have nearly all been cut down; there remain some standards, chiefly hardwoods, inside as well as on the margin. The ground is partly covered with débris, and there are some patches of broom and whins.

TREATMENT.—*Conifers*. All but marginal trees should be cut out; replace damaged larch by Scots fir; drain low ground, and fill up with spruce as soon as the drains have taken effect. A permanent shelter-belt is required on the N.W. side.—*Unstocked Ground*. Treat old trees similarly; plant Scots fir mixed with a few larch.

No. 17.—CLASH-NA-BUIAC BELT.

Old Conifers, 4·630 Acres.

CONDITIONS OF LOCALITY.—Elevation, 150 feet; a low ridge with gentle slopes to N.W. and S.E. Soil, deep sandy loam. Open to grazing.

CROP.—Larch, aged 76 years. Estimated stock, 90 trees, each 20 cubic feet, to the acre. Straight, clean-boled trees, free from disease in the stem. Ground covered chiefly with moss.

TREATMENT.—Crop may stand for some years. A few years before felling it should be closed to grazing. A thinning will then, no doubt, suffice to stock the ground naturally; and when this has been effected, with the aid, if necessary, of planting and sowing, the remainder of the trees can be removed.

No. 18.—CLASH-NA-BUIAC CLUMP.

Young Conifers, 0·600 Acre.

CONDITIONS OF LOCALITY.—Elevation, 130 feet; a small hillock in a cultivated field, with gentle slopes in all directions. Soil, deep, light, sandy to gravelly.

CROP.—Age, 14 years. Scots fir, with Douglas fir and a few hardwoods. Plants taken from nursery with balls at five years old; all growing well. A strong growth of whins, which are cut to facilitate rabbit-killing.

No. 19.—FYRISH LOWER BELTS.

<i>Old Conifers</i> ,	3·310 Acres.
<i>Young Conifers</i> ,	2·994 „
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<i>Total</i> ,	6·304 „

CONDITIONS OF LOCALITY.—Elevation, 150 to 220 feet; gentle slope to the S.E. Soil, deep sandy clay, with gravel or sandstone subsoil.

CROP.—*Old Conifers* (thus classed because the new stock will be conifers). Age, 90 years. A crop of poor, ill-shaped oaks, beeches

and other hardwoods, with a few good larches. Estimated stock, 128 trees, each of $11\frac{1}{2}$ cubic feet, to the acre. Patches of whins and raspberry here and there. — *Young Conifers*. The former crop of oak and beech, 91 years old, was very thin. A portion was cut out, and the remainder was under-planted with Douglas fir and silver fir. Some of the old trees left should have been removed. The Douglas firs are doing well, but the silver firs have recently shown signs of failure. Patches of whins and broom are found in places.

TREATMENT.—*Old Conifers*. In the S.E. portion the existing stock should be cleared out early, except marginal trees and any hardwoods that may improve by standing. These latter, which will be very few in number, should be carefully pruned, and the ground should be restocked with Scots fir and a few larch. In the central belt the existing crop should be similarly treated, and the ground should be restocked with Scots fir, a line of spruce running down the centre. If, in places, the remaining old trees give too much shade, a shade-bearer must be substituted for the Scots fir.—*Young Conifers*. The failing silver fir must be carefully watched, and vacancies should be promptly filled up with Douglas fir.

No. 20.—NOVAR MAINS BELTS.

Young Conifers, 6·653 Acres.

CONDITIONS OF LOCALITY.—Elevation, 280 to 310 feet. The E. portion is slightly undulating. Soil, deep sandy loam. The W. portion consists of a ridge running E. and W. Soil, sandy loam, shallow above, deep below.

CROP.—*Eastern Portion, 3·865 acres.* Age, 11 years. A mixture of larch, Scots fir, Douglas fir, spruce, silver fir, birch and poplar, with a few very fine old Scots firs standing amongst them. The crop has suffered much from defective drainage, which has now been remedied. The larch is somewhat diseased. The ground was beaten up in 1897 with spruce and poplar. Side shoots were shortened in 1898, where overgrowing smaller plants. There is a good deal of very rank, coarse grass, and there are also patches of brackens and broom; but the crop is now doing well.—*Western Portion.* Age, 19 years. A narrow and exposed strip, covering 1·788 acres, carries larch, with a few old Scots fir amongst them. The larch are a good deal diseased. A thinning was made in 1898 by taking out dead and diseased trees. An acre at the W. extremity, stocked with Douglas fir in 1898, is doing well.

TREATMENT.—In the E. portion cut out diseased larch and keep the drains clear. In the W. portion the larch will ultimately be under-planted with a shade-bearer.

No. 21.—FYRISH UPPER BELTS.

<i>Old Conifers,</i>	. . . . .	0·875	<i>Acres.</i>
<i>Young Conifers,</i>	. . . . .	1·752	„
<i>Unstocked,</i>	. . . . .	0·211	„
		2·838	„
<i>Total,</i>	. . . . .	

CONDITIONS OF LOCALITY.—Elevation, 300 to 320 feet; gentle slope to the S.E. Soil, for the most part, deep sandy loam. The area occupied by old conifers is open to grazing.

CROP.—*Old Conifers*. Age, 81 years. Chiefly Scots fir of fair quality. Estimated stock, 35 trees, each of $11\frac{1}{2}$ cubic feet, to the acre.—*Young Conifers*. An area of 1.254 acres is stocked with Douglas fir, mixed with some silver fir, sycamore, maple and poplar, now 9 years old. Side shoots of hardwoods have been shortened where they injured the Douglas fir. The crop is doing extremely well. A few old hardwood standards remain. An area of 0.498 acre, aged 16 years, is stocked with larch. The trees are much exposed to wind in a narrow belt, and they are a good deal diseased.

TREATMENT.—The old wood may be cut down at any time, the ground being restocked with Scots fir mixed with a few larch. From the plot of larch the most diseased among the trees should be cut out; later on the crop will be under-planted with shade-bearers. The unstocked ground is in the plot of Douglas fir; it should be filled up with that species.

No. 22.—CNOC FYRISH.

<i>Old Conifers</i> ,	30	<i>Acres.</i>
<i>Young Conifers</i> ,	64	„
<i>Unstocked</i> ,	238	„
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<i>Total</i> ,	332	„
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CONDITIONS OF LOCALITY.—Elevation, 600 to 1460 feet; situated on the face of a hill facing from S.W. to S., S.E. and E.; slope steep. Soil, deep sandy loam at bottom, and generally hard above; very shallow and rocky in upper portion, with loose, shingly surface in parts of the slope. About 30 acres are unsuited for planting. Very much exposed to winds from the N.E.

CROP.—Age, 122 years. Scots fir. With the exception of scattered groups of trees left by the wind, the old stock now standing is situated at the N.W. corner. Estimated stock, on 22 acres 50 trees, on 8 acres 190 trees, each of 18 cubic feet to the acre. The trees are stunted from exposure in the higher parts; they have been much damaged by squirrels, and many of them are “royed.” Patches of dense brackens are found all over the area, especially in the lower parts. A few natural seedlings exist throughout. 61 acres were planted in 1899 with Scots fir and a few larch, and 3 acres above Black Park were planted in 1898 with larch mixed with a few Scots fir. The young crops have been attacked to some extent by weevil and rabbits.

TREATMENT.—The remainder of the old wood should be felled as soon as possible. Where there is a good prospect of natural regeneration from the trees still standing, promote this by burning the refuse on the ground. Plant up the unstocked ground with Scots fir mixed with a few larch. Carefully preserve all trees on the upper margin, and complete the shelter they afford by adding birch, Cembran and Mountain pines. Establish intermediate shelter-belts of these trees with beech, running vertically up and down the face of the hill at intervals of 500 to 600 yards.

No. 23.—Cnoc-an-Eilikhaidh.

Young Conifers, 130 Acres

CONDITIONS OF LOCALITY.—Elevation, 500 to 1000 feet; moderate slope to S.W. Soil, mostly sand, of moderate depth in higher portion, deep lower down. Dangerous winds, W. and N.E.

CROP.—Scots fir, 40 acres on the higher ground; lower down larch and Scots fir 70 acres; and 20 acres of Scots fir and larch, mixed with Corsican pine, Douglas fir and hardwoods. Age of original crop, 14 years. This was much damaged by rabbits and weevil; and by Pine Beetle along the N. edge, near the old wood. Beaten up nine years ago with larch, Scots fir, with a few Corsican pine, with some groups of hardwoods near the S. margin. About 5 acres at W. end beaten up again this year with Douglas fir and larch. There is a good deal of larch disease towards the E. end; but otherwise the crop is, generally speaking, going on well, and there are some fine larches, running to 28 feet high, mixed with Scots fir of 20 feet. The crop at the E. end is very dense, and the trees are losing their lower side branches. The Scots fir are being much injured by squirrels. In places the side branches have been shortened in the interest of lower plants. There are some blanks caused by bringing timber down from above, and others here and there due to various causes. Brackens kept back parts of the crop for some years; these are now becoming suppressed, but some dense patches of them remain.

TREATMENT.—Fill up larger blanks with Scots fir and larch; smaller ones with shade-bearers. Beginning from the W. side, cut out all diseased larch, and thus endeavour to arrest the spread of the disease. Do this in winter when the spores are inactive. Kill squirrels. Dead and suppressed trees will probably be cut out at the E. end in four or five years' time. The larch will in due course be under-planted with shade-bearers. Strips running N. and S. should be cleared of larch and replanted with other species in order to give control over the disease (see p. 34). Permanent shelter-belts are required on the W. and on the N.E. sides.

No. 24.—TEMPLE PARK.

<i>Old Conifers,</i>	. . . . .	2	<i>Acres.</i>
<i>Young Conifers,</i>	. . . . .	36	„
		—	
<i>Total,</i>	. . . . .	<u>38</u>	„

CONDITIONS OF LOCALITY.—Elevation, 400 to 700 feet; gentle slope, varying from N.E. to S. Soil, generally of fair depth; good sandy loam on S. and W. sides, hard and mossy towards N.

CROP.—*Old Crop.* Aged 70 years. Stock, about 50 Scots firs, of 12 cubic feet each, to the acre. There is a dense crop of broom on the ground.—*Young Wood.* Age, 14 years. Principally larch, with some Scots fir, Douglas fir, spruce and hardwoods. Side shoots have been shortened in the interest of lower plants. A good deal of damage has been done by rabbits, and the young crop is attacked by squirrels. The larch is a good deal diseased on the higher ground, but less so lower down, where the crop has attained

magnificent dimensions for its age—larch 31 feet, Scots fir 28 feet, and spruce 25 feet. There are a few groups of old Scots fir standards.

TREATMENT.—The old wood should be cut as soon as practicable. Cut out diseased larch, and later on under-plant with shade-bearers. Clear strips of larch, and replant with other species, as described at p. 34.

No. 25.—OLD NURSERY.

Young Conifers, 3·4 Acres.

CONDITIONS OF LOCALITY.—Elevation, 500 feet; gentle slope to S. Soil, sandy loam, from shallow to deep.

CROP.—Age, about 7 years. Abandoned as a nursery on account of damage by blackgame and difficulty of carting manure up the hill. *N. part.* Elm, ash, hornbeam, beech, plane. *Centre.* Silver fir, cypress. *S. part.* Douglas fir, with a few *Nobilis*, *Grandis* and hardwoods. The clearing of the lower branches in a dense, pure crop of Douglas fir may here be studied. There is a very strong growth of whins. Much damage is done by rabbits.

No. 26.—BROOM HILL.

Young Conifers, 34·5 Acres.

CONDITIONS OF LOCALITY.—Elevation, 500 to 600 feet; gentle S. slope. Soil, in lower part, deep sandy loam; shallow higher up, and hard in places.

CROP.—Age, 14 years. Scots fir, with a few larches, doing well, though some damage is done by squirrels and roe-deer. There are about 200 old Scots firs standing, more or less in groups, over the young crop. These should have been removed when the old crop was cut down; they are now injuring the young crop, and will gradually be blown down and do still more damage.

TREATMENT.—The old trees could be cut out now without excessive damage to the young crop, and this should be done at once. The ground thus opened might be planted up with Douglas fir, which will soon overtake the young crop and grow up with it.

No. 27.—BULLOCKESHAN.

<i>Old Conifers,</i>	.	.	.	.	.	.	.	.	3 Acres.
<i>Young Conifers,</i>	.	.	.	.	.	.	.	.	37 „
									—
<i>Total,</i>	.	.	.	.	.	.	.	.	40 „
									—

CONDITIONS OF LOCALITY.—Elevation, 700 to 900 feet; moderate slope from N.E. to S.E. Soil, light sandy loam, generally of good depth, but shallow in places.

CROP.—*Old Wood.* Age, 70 years. Larch and hardwoods. Estimated stock, 45 trees, each of $9\frac{1}{2}$ cubic feet, to the acre. The E. slope, down to the burn, carries a few old larch of excellent quality.—*Young Wood.* Age, 4 years. Scots fir, with two small clumps of hardwoods. The plants were put out at $2+2+1=5$ years, and are growing in very coarse heather. They have

suffered from weevil, and are now attacked by a moth (*Retinia resinella*) and by roe-deer, but on the whole are doing well. There are a few old Scots fir standards.

TREATMENT.—The old trees should now come out, and their places might be filled with larch and Douglas fir. Vacancies in the young stock should be filled up without delay. A few larches may be introduced.

No. 28.—CREAG RUADH.

<i>Old Conifers</i> ,	35 Acres
<i>Unstocked</i> ,	185 „
	<hr/>
<i>Total</i> ,	220 „

CONDITIONS OF LOCALITY.—Elevation, 900 to 1100 feet; moderate slope from S. to E. Soil, in lower part, deep sandy loam; becomes shallow higher up, and near the top is very shallow and rocky. Drainage defective in places. Much exposed to winds from N., N.E. and N.W. Open to grazing.

CROP.—Age, 117 years. The remnant of the crop blown down in 1893. Except on slope to Dog's Burn, trees small and stunted. Estimated stock, 90 trees, each of about $9\frac{1}{2}$ cubic feet, to the acre. Timber very close-grained and of durable quality; it should be very valuable for many purposes, but heartwood very small. A great deal of damage has been done by squirrels. There are some patches of dense brackens in the lower part. There is a fair crop of self-sown Scots fir seedlings here and there, in spite of the fact that the wood is open to grazing. Except where burnt over by the fire of 1899, the *unstocked ground* is covered with debris of the old crop which was blown down in 1893, a few standards only being left. There are dense patches of brackens in the lower part. The ground is open to grazing, but there are natural seedlings in places.

TREATMENT.—Cut the remaining stock as early as possible; they are being gradually blown down; but preserve trees on upper margin as a permanent shelter-belt, adding birch, Cembra and Mountain pines. Intermediate shelter-belts should be established running up and down hill. To these latter beech may be added. Look to the drainage.—*Unstocked Ground*. Burn refuse and restock with Scots fir, mixed with a few larch, and with spruce in the moister places. Some Austrian and Corsican pine may be substituted for Scots fir in the most exposed situations.

No. 29.—CAISTEL BREAC.

<i>Old Conifers</i> ,	15·000 Acres.
<i>Young Conifers</i> ,	50·916 „
	<hr/>
<i>Total</i> ,	65·916 „

CONDITIONS OF LOCALITY.—Elevation, 600 to 900 feet; moderate slope to S.W. Soil, hard and stony above, but deep in lower part. Exposed to wind on N.E. and N.W. sides.

CROP.—*Old Wood*. Age, 70 years. Scots fir. Estimated stock, 100 trees, each of 15 cubic feet, to the acre. Quality of stock inferior, chiefly owing to damage by squirrels and by pine beetle. There are patches of dense brackens in places, and some natural seedlings.—*Young Wood*. Age, 14 years. 45·916 acres of Scots fir; and 5 acres in the lower part a mixture of larch, Scots fir, Douglas fir and spruce. There is a strong growth of wild juniper and of dense brackens in places. Damage by roe-deer has been severe, and pine beetle has done considerable harm near the old wood.

TREATMENT.—Fell the old wood early. Establish permanent shelter-belts on the N.E. and N.W. sides.

No. 30.—CNOC-NA-COILLE.

<i>Old Conifers—Scots Fir</i> ,	52·228	Acres.
<i>Larch</i> ,	15·000	„
<i>Unstocked</i> ,	20·000	„
	<hr/>	
<i>Total</i> ,	87·228	„

CONDITIONS OF LOCALITY.—Elevation, 620 to 900 feet; moderate S. slope. Soil, light, sandy loam; very shallow above, deep below.

CROP.—Age, 71 years. The Scots fir would have proved a valuable crop had it not been completely ruined by squirrels. Estimated stock, 120 trees, each of 9 cubic feet, to the acre. It will not improve much by standing. The larch is fairly good; but the trees show signs of disease, not now active, near their base, and many of them are crooked and deformed. Estimated stock, 80 trees, each of 9½ cubic feet, to the acre. Tall, dense heather, with patches of whins and brackens are found in places. The unstocked area is due to the storm of 1893-94. In spite of the rank grass and heather on the ground, numerous self-sown seedlings of Scots fir and larch are establishing themselves.

TREATMENT.—The standing wood should be removed as soon as possible. Natural regeneration would probably be successful. The unstocked ground is covered with debris, and there are a few Scots fir standards. Before regeneration, the refuse, including overturned stumps, should be burnt. The most suitable stock would be Scots fir with a few larch.

No. 31.—MEANN CHNOC.

<i>Old Conifers</i> ,	65·000	Acres.
<i>Unstocked</i> ,	92·023	„
	<hr/>	
<i>Total</i> ,	157·023	„

CONDITIONS OF LOCALITY.—Elevation, 500 to 1000 feet. An isolated peak forms the centre of the N. portion. Slope moderate to the S., steeper to the N. Soil, good deep loam in lower S. part; higher up and in N. part, more shallow and hard. Exposed to N.E. winds.

CROP.—Age, 122 years. Scots fir. Much of the crop was blown down during the storms of 1893-94; and 15 acres of the remainder were felled in 1899. Of the remaining stock, that on the S. side, 45 acres, is well-grown and of fine quality, but is attacked by red-rot. Stock estimated at 45 trees, each of 65 cubic feet, to the acre; that on the N. side, 20 acres, is estimated at 60 trees, of 14 cubic feet, to the acre. During the recent cuttings, standards of Scots fir, healthy, full crowned, 9 to 12 to the acre, have been left as seed-bearers. This operation has been well done. Part of the ground is covered with very dense brackens, but there are a few self-sown seedlings. There is some débris on the unstocked ground, with much dense bracken and coarse heather; but very few self-sown seedlings.

TREATMENT.—The old wood should be felled early, and the ground, including the unstocked portion, should be stocked with Scots fir and a few larch. Permanent shelter-belts are required on the N.E. and N.W. sides.

No. 32.—BADGER HILL.

<i>Old Conifers,</i>	.	.	.	.	.	15	<i>Acres.</i>
<i>Young Conifers,</i>	.	.	.	.	.	50	„
<i>Unstocked,</i>	.	.	.	.	.	20	„
<i>Excluded,</i>	.	.	.	.	.	15	„
						100	„
<i>Total,</i>							

CONDITIONS OF LOCALITY.—Elevation, 400 to 600 feet; moderate S. slope. Soil, light, sandy loam below, to hard pan in the higher parts. Drainage defective in places.

CROP.—*Old Wood.* Age, 121 years. Scots fir. Stock estimated at 45 trees, each of 60 cubic feet, to the acre. Ruined by squirrels. A considerable area covered with very dense brackens.—*Young Wood.* Age, 7 to 9 years. Larch (pure in places), Scots fir, silver fir, Douglas fir, elm and ash. Groups of Douglas fir have been inter-planted with larch, which will probably disappear. Larch also planted, in places, under trees of the old crop, where they will not succeed. Very dense brackens interfere with the crop in places, and damage is done by roe-deer and by rabbits. About one-half of the *unstocked* area is covered with débris. A few Scots fir standards remain. In places the brackens and coarse heather are very dense, but some self-sown seedlings are forcing their way through it.

TREATMENT.—Cut down the old wood as soon as possible. Fill vacancies in the young wood with Scots fir and shade-bearers. Restock, including bare ground, with Scots fir mixed with a few larch.

No. 36.—CROSS HILLS.

<i>Old Conifers,</i>	.	.	.	.	.	14.802	<i>Acres.</i>
<i>Young Conifers,</i>	.	.	.	.	.	16.327	„
						31.129	„
<i>Total,</i>							

CONDITIONS OF LOCALITY.—Elevation, 180 to 210 feet. The old wood, on ridges, alternating with young wood in hollows. Soil,

generally light and sandy ; shallow on ridges, deep and loamy in the hollows. The dangerous winds are those from the S.W. and N.E.

CROP.—*Old Wood*. Age, 47 years. Scots fir and larch, the latter “royed.” Ground apparently ill-suited to larch. Estimated stock, 100 trees, each of 9 cubic feet, to the acre. Much damage done by squirrels. There are dense patches of brackens ; but the germinating bed being generally good, and the wood being closed, many self-sown seedlings appear wherever they find enough light.—*Young Wood*. Age, 14 years. Larch, with some spruce five years younger. Larch very badly diseased, owing no doubt to unsuitable natural conditions, and formerly defective drainage. The ground might have been stocked with spruce. The worst of the larch were taken out in 1897, and yielded over £100 as “sheep-net stickings.” In spring of 1899, half the ground was, as an experiment, underplanted with spruce, silver fir and Menzies fir. Damage has been done by rabbits.

TREATMENT.—*The Old Wood* will, in due course, no doubt, be regenerated naturally.—*The Young Wood*. Watch effect of underplanting. A further cutting out of diseased trees will shortly be necessary.

No. 37.—DAIL GHEAL.

<i>Old Conifers</i> ,	27·003	<i>Acres</i> .
<i>Young Conifers</i> ,	12·000	,,
<i>Unstocked</i> ,	45·000	,,
<i>Excluded</i> ,	40·997	,,
	<hr/>	
<i>Total</i> ,	125·000	,,
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CONDITIONS OF LOCALITY.—Elevation, 180 to 220 feet ; ground undulating, with generally S. aspect ; a low, broken ridge on S. and W. sides. Soil, generally loamy, of moderate depth, but deep in places. Drainage here and there defective. Has suffered severely from N.E. winds.

CROP.—*Old Wood*. Age, 99 years. 21·003 acres of Scots fir and larch, 5 acres of larch, and 1 acre of beech and ash. Estimated stock, 55 trees, each 25 cubic feet, to the acre. Some of the old trees are damaged by the rope of the traction-engine. There are patches of dense brackens, but numerous young seedlings appear wherever there is light enough.—*Young Wood*. Age, 17 years. Mixture of Scots fir, larch and spruce, with a few silver firs and Douglas firs. There are small blanks throughout, and a good many trees are damaged by browsing. The larch are badly diseased. There is a dense growth of whins in places. Roe-deer and rabbits have done considerable damage.—*Unstocked Ground*. A great deal of broom, whins and brackens over almost the whole area. There is some natural young growth near the old wood.

TREATMENT.—*Old Wood*. The larch, which is for the most part “royed,” should be cut out ; under-plant the patch of Scots fir to the E. of the young wood with shade-bearers.—*Young Wood*. Cut out diseased larches and damaged trees, and fill up with Douglas fir.—*Unstocked Ground*. Most of this will be occupied by experimental plots ; the ground not thus required will be stocked with Scots fir, except in the hollows, where spruce will

be raised. The drains should be looked to. Establish a permanent shelter-belt on the N.E. side.

No. 41.—DAIL GHEAL BELT.

Old Hardwoods, 7·840 Acres.

CONDITIONS OF LOCALITY.—Elevation, 80 feet; practically level ground. Soil, deep sandy loam.

CROP.—About 7 acres are under oak and beech, 60 years old, which have become naturally undersown with beech up to 15 years old. The remainder of the ground is occupied by Scots fir and larch, 80 years old. Estimated stock for the whole, 100 trees, each of 10 cubic feet, to the acre.

TREATMENT.—Complete the under-stock by planting beech.

No. 42.—NEWTON RIVER BELTS.

<i>Old Hardwoods</i> ,	13·371 Acres.
<i>Young Conifers</i> ,	·991 „
<i>Young Hardwoods</i> ,	3·957 „
	<hr/>
<i>Total</i> ,	<u>18·319</u> „

CONDITIONS OF LOCALITY.—Elevation, 10 to 60 feet; slight fall to S. Light, but deep sandy soil. E. winds dangerous.

CROP.—*Old Hardwoods* along the river. Age, 50 years. Ash, elm, oak, alder, willow, larch, Scots fir. Estimated stock, 45 trees, each of $9\frac{1}{2}$ cubic feet, to the acre. Ground exposed by thin crop, and grazed. There is a good deal of coarse grass and some naturally sown ash over most of the area. Along the river-side is a narrow strip of willow and alder, which is cut partly through every second year, and bent over towards the water to protect the fields from erosion.—*Young Conifers* in the corner near the railway. Age, 11 years. Scots fir, larch and Douglas fir all doing well. Below the line are some planes and a few *Nobilis* fir. The planes do not look well.—*Young Hardwoods* and conifers near the sea. Age, 20 years. About an acre under Scots fir, larch and spruce; the remainder under alder and willow. Quality of stock very poor; larch very badly diseased. The plot was thinned nine or ten years ago. Open to grazing.

TREATMENT.—*Old Hardwoods*. Cut out inferior trees, prune up the better ones, and plant oak and ash in the open places, beech under shade. The Scots fir and spruce may be removed from among the young hardwoods, and their places may be taken by alder and willow.

No. 46.—TENDALLON BELTS.

Old Hardwoods, 3·285 Acres.

CONDITIONS OF LOCALITY.—Elevation, 100 to 120 feet; gentle S. slope to the river. Soil, deep light loam. N.E. winds dangerous. Open to grazing.

CROP.—Age, 80 years. Oak, beech, elm. Estimated stock, 40 trees, each of 15 cubic feet, to the acre. Dense broom and whins on the ground.

TREATMENT.—Cut out inferior trees, prune up the remainder, and under-stock with shade-bearers.

Nos. 47, 48, 49.—LOWER PARK AND SKIACK BELTS.

Old Hardwoods :—

No. 47. <i>Skiack Belt</i> ,	9·969 Acres.
„ 48. <i>Lower Park Belt, W.</i> ,	1·792 „
„ 49. <i>Lower Park Belt, E.</i> ,	3·145 „
<i>Total</i> ,	<u>14·906</u> „

CONDITIONS OF LOCALITY.—Elevation, 100 to 310 feet; gentle S. slope. Soil, sandy loam; deep in Skiack, shallow in Lower Park. All open to grazing.

CROP.—Aged 70. *Skiack Belt*. Oak, beech, elm, ash, larch and a few Scots fir. Planted in a belt 30 yards wide as a game-covert, now too thin for the purpose. Estimated stock, 70 trees, each of 17 cubic feet, to the acre. Patches of broom and whins.—*Lower Park Belt, W.* Ash, elm, Scots fir and larch, in a belt 40 to 60 yards wide, planted for shelter; but stock (40 trees, each of 10 cubic feet, to the acre) now too thin to answer the purpose. The timber is of good quality. There are some broom and whins on the ground.—*Lower Park Belt, E.* Elm, oak and beech in a belt 10 to 30 yards wide. Estimated stock, 50 trees, each of 12 cubic feet, to the acre.

TREATMENT.—Cut out inferior trees, and plant oak, ash, elm, sweet-chestnut, spruce or beech, according to the degree of cover.

No. 50.—CULCAIRN BELT.

<i>Old Hardwoods</i> ,	·721 Acres.
<i>Young Hardwoods</i> ,	·500 „
<i>Total</i> ,	<u>1·221</u> „

CONDITIONS OF LOCALITY.—Elevation, 100 to 135 feet. The old wood is on a steep S.W. slope running down to the Blackrock Water. The young wood is on level ground by the river. Soil, light sandy loam; very shallow at top of old wood, deep below. Exposed to S.W. wind. Open to grazing.

CROP.—*Old Wood*. Age, 52 years. A thin crop occupies the slope. Growth slow. Estimated stock, 150 trees, each of 5½ cubic feet, to the acre. There are some good straight poles in the lower part, but most of the trees have “epicormic” branches. There is a strong under-growth of broom and whins.—*Young Wood*. Stock mostly alder coppice, with a few standards 20 years old. There is much rank grass and broom.

TREATMENT.—Clear out such of the oaks as are not likely to improve by standing. Prune off the “epicormic” branches except along the edge of the road, where they may be left to afford increased shelter. Under-plant with beech, clearing away the broom, etc., sufficiently to enable the young plants to grow.

No. 51.—COULAIGS.

<i>Old Hardwoods</i> ,500 Acres.
<i>Unstocked</i> ,	3.942 „
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<i>Total</i> ,	4.442 „
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CONDITIONS OF LOCALITY.—Elevation, 120 feet. Old wood on rise below Evanton village. Unstocked ground on the flat beside the river. Soil, good, deep strong loam. Open to grazing.

CROP.—Beech, ash, elm, larch and oak. Age, 80 years. Estimated stock, 25 trees, each of 25 cubic feet, to the acre. The *Unstocked Ground* carries a few hardwood standards and a fair amount of natural beech seedlings. There is a great deal of broom and whins.

TREATMENT.—Cut out inferior trees, and under-plant with shade-bearers. The unstocked ground may be planted up with oak and beech.

No. 52.—EVANTON WOOD.

<i>Old Conifers</i> ,	44.000 Acres.
<i>Old Hardwoods</i> ,	6.000 „
<i>Young Conifers</i> ,	50.000 „
<i>Unstocked</i> ,	44.038 „
	<hr/>
<i>Total</i> ,	144.038 „
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CONDITIONS OF LOCALITY.—Elevation, 200 to 300 feet; a low ridge runs from the S.E. corner westwards, and strikes through the wood towards the N.W. Soil on the ridge is very shallow, exposing the roots of the trees; on the flatter ground, strong loam of moderate depth, except towards the W. side, where it is shallow, and where the drainage is defective. Has suffered severely from N.E. gales.

CROP.—*Old Conifers*. Scots fir, with small proportion of larch, occupy the ridge. Age, 81 years. Estimated stock, 70 trees, each of 16 cubic feet, to the acre. Timber of fair quality. Some damage by pine beetle and by squirrels. There are some patches of brackens, broom and whins. A portion, closed to grazing for three years, shows very promising natural growth of Scots fir and larch; another portion, closed for one year only, is also filling up with self-sown seedlings. Crop of natural seedlings irregular; better in heather than in grass.—*Old Hardwoods* occupy the centre of the N. portion next the stream. Estimated stock, 80 trees, each of 7 cubic feet, to the acre. Timber of fair quality. A considerable quantity of beech seedlings has sprung up since the closure. Brackens, broom and whins are found in places.—*Young Conifers*. 47 acres of Scots fir and larch with a few spruce, 3 years old, and 3 acres of Douglas fir, 1 year old. A few standards of beech remain. The crop is hindered in places by brackens, broom and whins; it also suffers from weevil, and is

much damaged by rabbits and hares. Otherwise it is doing well. The *Unstocked Ground* carries a few standards of Scots fir, larch and hardwoods, and there is a fair show of self-sown seedlings.

TREATMENT.—The *old stock* may be cut at any time. When regeneration is undertaken, the deficiencies of natural growth may be supplemented by sowing, rather than by planting, on the shallow ground, especially on the ridge. Vacancies in the *young plantation* should be filled up at once, and the young growth must be freed from the dense cover of weeds. Of the *unstocked ground*, about 39 acres will be stocked with Scots fir mixed with a few larch; and the remainder, a strip near the river, will be stocked with oak, beech and ash. Look to the drainage. Establish a permanent shelter-belt on the N.E. side.

No. 53.—DALNAHAUN.

Old Conifers, 14·397 Acres.

CONDITIONS OF LOCALITY.—Elevation, 100 to 200 feet; a steep slope down to the left bank of the Blackrock Water, with some level ground beside the stream. Soil, on slope, shallow and gravelly; deep on low ground, where the drainage is defective in places. Open to grazing.

CROP.—Age, 77 years. Last crop consisted of larch, Scots fir, spruce and some hardwoods; but most of the conifers have been cut out. The larch was well grown, but “royed,” especially in the drier parts. The crop actually left consists mainly of inferior hardwoods, estimated at 60 trees, each of 15½ cubic feet, to the acre. Many of them are seriously damaged by the rope of the traction-engine. There are a few patches of brackens and raspberries; and a good many natural seedlings, especially of beech, in spite of the fact that the area is open to grazing.

TREATMENT.—Fell as soon as possible, leaving only a few of the older trees as ornaments to the Blackrock Gorge, and such of the younger oaks as might improve by standing. Restock with Scots fir on the steep, dry ground; and lower down with spruce, ash and Douglas fir, a few larch being scattered among them.

No. 54.—ASSYNT LOWER BELT.

<i>Old Conifers</i> ,	10·884 Acres.
<i>Young Conifers</i> ,	7·990 „
<i>Total</i> ,	<u>18·874</u> „

CONDITIONS OF LOCALITY.—Elevation, 280 to 310 feet; a gentle S.W. slope, with level ground to S. Soil, fairly deep and fresh sandy loam.

CROP.—*Old Wood*. Age, 77 years. The wood lies below the road leading to Assynt House, and along the N. side of the Blackrock Gorge. Scots fir, larch and spruce, with a few hardwoods. Estimated stock, 60 trees, each of 14 cubic feet, to the acre. The Scots fir and spruce are of rough quality, but there are fine and sound

larch, some of which measure 60 cubic feet. When the crop is felled, selected trees may here be left for ornament. There is a strong growth of whins and raspberry; natural seedlings of ash and alder are showing in places.—*Young Wood*. Age, 11 to 12 years. Scots fir, spruce and larch growing on old cultivation. The growth of the three species is remarkably vigorous—larch 32 feet, Scots fir 25 feet, and spruce 24 feet in height. The larches, even the largest, are being attacked by rabbits, and there are a good many diseased trees among them. The leading shoots of spruce are in places being injured by side shoots of their taller companions. Brambles and raspberries are being killed out by the trees.

TREATMENT.—*The Young Wood*. Cut out diseased larch. Free the heads of the spruce. Keep down the rabbits. Clear out the drains.

No. 55. — BALLAVOULIN.

Old Conifers, 2·181 Acres.

CONDITIONS OF LOCALITY.—Elevation, 300 to 320 feet; gentle S. slope. Soil, shallow light loam. Open to grazing.

CROP.—Age, 51 years. Scots fir and larch, with some oak and beech. Estimated stock, 100 trees, each of 8 cubic feet, to the acre. The Scots firs are damaged by squirrels. There are some patches of whins. About half an acre of ground (detached to S.) is stocked principally with larch.

No. 56.—ASSYNT UPPER BELT.

<i>Old Conifers</i> ,	5·902 Acres.
<i>Young Conifers</i> ,	1·297 „
<i>Young Hardwoods</i> ,	1·500 „
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<i>Total</i> ,	<u>8·699</u> „

CONDITIONS OF LOCALITY.—Elevation, 400 to 420 feet. The *Old Wood* occupies a low ridge running nearly N. and S., with shallow soil and fairly steep slopes. The belt of *Young Conifers* is near Assynt House, on level ground, formerly cultivated. The *Young Hardwoods* are on a belt detached to the N.E. The slope faces E., and is steep, but the soil is good and deep.

CROP.—*Old Wood*. Age, 77 years. Scots fir, larch and spruce, with a few hardwoods. Estimated stock, 75 trees, each of 12 cubic feet, to the acre. Squirrels have done some damage, and the timber is of rough quality. There are some patches of whins and broom.—*Young Conifers*, 3 to 9 years old. Scots fir, larch, Douglas fir, *Nobilis*, beech, sycamore, ash. A plantation raised as shelter to Assynt House. There is a good deal of rank grass, and rabbits do considerable damage.—*Young Hardwoods*. Age, 5 years. Horse-chestnut, beech, ash, elm and lime, with a group of Douglas fir in the centre—doing well.

TREATMENT.—The old wood cannot be entirely removed until the belt near the house has grown up sufficiently to afford shelter.

No. 57.—ASSYNT WEST BELT.

Young Conifers, 4·835 Acres.

CONDITIONS OF LOCALITY.—Elevation, 360 to 400 feet ; gentle S. slope. Soil, shallow, sandy loam, with hard, stony subsoil.

CROP.—Age, 11 years. In N. part pure larch ; side branches green ; grass growing below. A large proportion, even of the largest trees, gnawed by rabbits, and disease very prevalent. In the centre, Scots fir with a few larch ; cover denser than in the above, and grass dying in the thicker places. The larch is well above the Scots fir. In the lower part, pure Scots fir and pure spruce in groups, all doing well. There is a good deal of self-sown birch, which is beginning to injure the leading shoots of the spruce. There are dense patches of whins in places.

TREATMENT.—Cut out diseased larch from the upper or N. portion. Lop birch in lower part where injuring the spruce, but do not cut out all the birch at present. Kill down the rabbits.

No. 58.—BLACKROCK BRAE.

Old Conifers, 23·933 Acres.

CONDITIONS OF LOCALITY.—Elevation, 400 to 420 feet ; occupies a steep N. slope down to the Blackrock Water. Soil, fairly deep and strong loam. Has suffered much from N. winds. Open to grazing.

CROP.—Age, 81 years. Scots fir and larch with a few hardwoods. Fairly dense groups of Scots fir here and there, alternating with extremely thin crops. Estimated stock, 60 trees, each of 17 cubic feet, to the acre. The larch is all "royed." There are some dense patches of brackens, and a few seedlings of self-sown birch.

TREATMENT.—Larch should be cut out at once, and the whole area should be cleared and restocked with Scots fir as soon as possible.

No. 59.—BLACKROCK WOOD.

Old Conifers, 41·206 Acres.

CONDITIONS OF LOCALITY.—Elevation, 420 to 450 feet ; gentle S. slope. Fair depth of light, sandy loam, but shallow in places. Has suffered from wind at N.E. corner, and is also exposed on W. side. Open to grazing.

CROP.—Age, 92 years. Scots fir with a few larch. Estimated stock, 150 trees, each of 15 cubic feet, to the acre. There are some dense patches of brackens, and the wood is open to grazing ; but a few self-sown seedlings of Scots fir and larch are springing up. The trees are attacked by the pine beetle.

TREATMENT.—When the time for felling arrives, close to grazing, and regenerate naturally with Scots fir and a small proportion of larch. Establish permanent shelter-belts on the W. and N.E. sides.

No. 60.—BLACKROCK CORNER.

Young Conifers, 1·500 Acres.

CONDITIONS OF LOCALITY.—Elevation, 480 to 500 feet; old cultivation, sloping gently to the S. Light and shallow soil.

CROP.—Age, 11 years. Scots fir and larch with a few spruce, growing well; larch generally well above the Scots fir. Larch, even the largest, much injured by rabbits; this no doubt induces disease, which is already present.

TREATMENT.—Cut out diseased larch and keep down rabbits.

No. 61.—ASSYNT HILL.

<i>Young Conifers,—Larch,</i>	. . .	137·666	<i>Acres.</i>
<i>Scots Fir,</i>	. . .	110·000	„
		<hr/>	
<i>Total,</i>	. . .	247·666	„

CONDITIONS OF LOCALITY.—Elevation, 500 to 1030 feet; steep to gentle S. slope. Soil, good strong loam, of fair depth in lower parts, thin and hard on higher ground. Upper portion much exposed to N. winds.

CROP.—Age, 15 years. The *Larch*, which has been planted in the S.E. portion, up to an altitude of 900 feet, is very much diseased, especially on the W., from which side it appears to be advancing eastwards. The crop has suffered very much from rabbits, hares and roe-deer. In 1898, a thinning was commenced by removing the worst of the diseased trees; and the experiment was tried in 1899 of under-planting portions of the thinned and also of the unthinned crop with silver fir. There is, in places, a very dense growth of whins and brackens among the young trees. The *Scots fir* is, for the most part, doing well; but squirrels have begun to attack the trees in the lower portion, and the crop is stunted from exposure near the top. A belt along the upper margin should be treated as a permanent shelter-belt.

TREATMENT.—The cutting out of diseased larch should be continued, and as the future of silver fir is uncertain, under-stocking, partly by planting and partly by sowing, should be done also with beech, spruce and Douglas fir. Sweet-chestnut might also be tried.

No. 62.—INCHCHOLTAIR.

<i>Old Conifers,—Scots Fir,</i>	. . .	55·396	<i>Acres.</i>
<i>Larch,</i>	. . .	5·000	„
<i>Unstocked,</i>	. . .	40·000	„
		<hr/>	
<i>Total,</i>	. . .	100·396	„

CONDITIONS OF LOCALITY.—Elevation, 490 to 1030 feet; generally rather steep slope to S.W. Soil, sandy, on clay which is almost on the surface on the W. side; higher up, rocky, with more gentle slope. Drainage defective in parts of the old woods. Suffered severely from S.W. winds. Outside the line of wire netting. Open to grazing.

CROP.—Age, 79 years. The 5 acres of larch represent what is left of the larch wood blown down in 1893-94. The stock is estimated at 65 trees, each of $7\frac{1}{2}$ cubic feet, to the acre; they are therefore poor trees. The Scots fir, with which a small proportion of larch is mixed, is estimated to consist of 130 trees, each of 14 cubic feet, to the acre. The Scots firs are, generally speaking, better than the larches; but on the high ground they are stunted, owing to their exposed situation, and they are throughout very seriously damaged by squirrels. Large areas are covered with dense brackens, and the wood is open to grazing; but in spite of this some self-sown seedlings have established themselves. The *Unstocked Ground* is mostly on the W. side. From a considerable area, the larch was blown down in 1893-94; the trees were for the most part “royed”; the clay soil on S. exposure did not suit them. Some debris is scattered over most of the area; and there are patches of brackens and whins; but on the high ground there is a considerable area which was not stocked by the last crop, but which now shows many self-sown seedlings of both Scots fir and larch. In one place the stock appears to be complete.

TREATMENT.—Crop making no progress and should be removed as soon as possible. Natural regeneration should be attempted. The drainage should be looked to. The *Unstocked Ground* should be restocked with Scots fir and a small proportion of larch. Belts of hardwoods should be established on the W. side and down to the burn. The stocking of the high and exposed ground should be completed, as soon as it can be closed, some Austrian, Cembran and Mountain pines being introduced. This will serve to protect the more valuable crop below.

No. 63.—COTTAGE WOOD.

Old Hardwoods, 3·794 Acres.

CONDITIONS OF LOCALITY.—Elevation, 500 feet; the low flat ground between road and stream. Soil, deep sandy loam, very wet in places. Open to grazing.

CROP.—Age, 77 years. A thin crop of oak, ash, elm, beech and other hardwoods, with a few larch and Scots fir; all for the most part past their prime. Estimated stock, 60 trees, each of 12 cubic feet, to the acre.

TREATMENT.—Cut down as soon as possible; keeping and pruning where necessary any oaks or other trees that might improve by standing. Then restock with beech under nurses of birch. Clear out the drains.

No. 64.—BLARVORICH.

<i>Old Conifers,</i>	.	.	.	.	10·000	<i>Acres.</i>
<i>Young Conifers,</i>	.	.	.	.	45·501	„
<i>Unstocked,</i>	.	.	.	.	37·264	„
					<hr/>	
<i>Total,</i>	.	.	.	.	92·765	„

CONDITIONS OF LOCALITY.—Elevation, 650 to 700 feet. The old wood occupies a low ridge on the W. side. The young wood grows

on ground which is fairly level towards the N., but which slopes steeply down to the river on the S. The ridge is hard and stony; but the remainder of the ground has a light sandy soil of fair depth. Drainage defective in places. Exposed to N.E. wind. Outside the line of wire netting. Open to grazing.

CROPS.—*Old Wood*. Age, 116 years. Scots fir of good quality, but growth slow and very small heartwood (5 inches out of 12 to 14 inches diameter). Estimated stock, 100 trees, each of 14 cubic feet, to the acre. A good deal of damage done by squirrels. Suffered severely from N.E. gales after fellings on the E. side. There are some patches of brackens.—*Young Wood*. Age, 3 years; half on ground from which crop was cleared ten years ago, and half on new ground. Doing well on the whole; but damaged to some extent by weevil, especially on and near the site of the last fellings, and by roe-deer, hares, rabbits and blackgame. Dense heather and brackens in places, especially on the slope facing the river.—*Unstocked Ground*. The crop was removed ten years ago. Débris partly covers the whole area, which is grazed by the proprietor. But there is a fair show of natural seedlings in places.

TREATMENT.—Cut down the old wood as soon as possible. Shelter is needed for the ground to the W.; but the ridge affords some protection, and the crop of trees as they stand does not add much. If they are not cut, most of them will be blown down before long. Regenerate naturally. Fill up vacancies in the young wood, and look to the drainage. Restock the bare ground with Scots fir mixed with a few larch. Permanent shelter-belts are required on all sides but the S.

APPENDIX C.

TABLE OF FELTINGS FOR THE OLDER WOODS.

Serial No.	Season in which to be felled	Nos. and Names of Woods.		Annual Felling Areas.		Cubic Feet (3-grith).		No. of Trees.		Average Age.		Principal Species.
				Total.	Acres.	Per Acre.	On Felling Area.	Total.	No.	Total.	In 1899.		When felled.
1	1899-1900	32	Badger Hill,	8-000	2,700	21,600	360	121	121	Scots fir.		
		10	Contullich,	14-000	1,620	22,700	2,520	75	75	Larch.		
		19	Fyrish Lower Belts,	3-310	1,470	4,800	120	90	90	Various hardwoods.		
		21	Fyrish Upper Belts,	875	400	400	30	81	81	Scots fir.		
		15	Toll Belt,	3-557	900	3,200	200	90	90	Oak and beech.		
2	1900-01	30	Choe-na-Coille,	8-000	750	6,100	640	71	72	Larch.		
		62	Incheolhair,	5-000	490	2,400	320	79	80	Larch.		
		31	Meann Chnoc (South),	9-000	2,925	26,300	400	122	123	Scots fir.		
		58	Blackrock Brae,	13-000	1,020	13,300	780	81	82	Scots fir and larch with hardwoods.		
		63	Cottage Wood,	3-794	720	2,700	230	77	78	Oak and beech with conifers.		
3	1901-02	31	Meann Chnoc (North),	10-000	840	8,100	600	122	124	Scots fir.		
		22	Choe Fyrish,	15-000	900	13,500	750	122	124	Scots fir.		
		28	Creag Knadh,	12-000	850	10,200	1,080	117	119	Scots fir.		
		53	Dahidhann,	11-337	930	13,400	860	77	79	Various hardwoods.		
		59	Blackrock Wood,	3-000	2,250	6,700	450	92	91	Scots fir and few larch.		
4	1902-03	62	Incheolhair,	15-000	1,820	27,300	1,950	79	82	Scots fir.		
		64	Blarvorich,	10-000	1,400	14,000	1,000	116	119	Scots fir.		
		30	Choe-na-Coille,	11-000	1,080	11,900	1,320	116	119	Scots fir.		
5	1903-04	32	Badger Hill,	7-000	2,700	18,900	310	121	125	Scots fir.		
		10	Contullich,	14-000	1,620	22,700	2,520	75	79	Larch.		
		47	Skiack Bell,	9-969	1,190	11,900	700	75	74	Oak, beech, elm.		
6	1904-05	30	Choe-na-Coille,	760	5,300	560	560	71	76	Larch.		
		31	Meann Chnoc (South),	12-000	2,925	35,100	540	122	127	Scots fir.		
		58	Blackrock Brae,	10-933	1,020	11,100	650	81	86	Scots fir and larch with hardwoods.		

TABLE OF FELLINGS FOR THE OLDER WOODS—Continued.

Serial No.	Season in which to be felled.	Nos. and Names of Woods.	Annual Felling Areas.		Cubic Feet (3-girth).			No. of Trees.		Average Age.		Principal Species.
			Total.	Acres.	Per Acre.	On Felling Area.	Total.	No.	Total.	In 1899.	When felled.	
7	1905-1906	31 Meann Chnoc (North),	10,000	840	8,400	600	122	128	Scots fir.			
		22 Cnoc Fyrish,	7,000	900	6,300	350	122	128	Scots fir.			
		28 Crag Ruadh,	8,000	3,420	27,400	1,520	122	128	Scots fir.			
		27 Bullockshan,	8,000	850	10,200	1,080	117	123	Scots fir.			
		24 Temple Park,	42,000	425	1,300	130	70	76	Larch and hardwoods.			
		62 Incheoltair,	15,000	1,820	27,300	600	70	76	Scots fir.			
		39 Blackrock Wood,	12,000	2,250	27,000	1,950	79	86	Scots fir and few larch.			
9	1907-08	10 Contullich,	15,000	1,620	24,300	2,700	75	83	Larch.			
		52 Evanton Wood,	15,000	1,120	16,800	1,050	81	89	Scots fir with some larch.			
		46 Tendallon Belt,	6,000	560	3,400	480	81	89	Oak and beech.			
		51 Coulaigs,	3,285	600	2,000	180	80	88	Oak, beech, elm.			
		48 Lower Park Belt (West),	500	500	300	10	70	78	Beech, oak, ash, elm.			
10	1908-09	49 Lower Park Belt (East),	1,792	400	700	70	70	78	Ash, elm, Scots fir, larch.			
		31 Meann Chnoc (South),	3,115	600	1,900	150	49,400	4,590	70	78	Elm, oak, beech.	
		30 Cnoc-na-Coille,	12,000	2,925	35,100	540	122	131	Scots fir.			
		28 Crag Ruadh,	15,000	1,080	16,200	1,800	71	80	Scots fir.			
		11 Black Park,	15,000	2,000	30,000	990	117	127	Scots fir.			
		37 Dail Gheal,	12,000	1,375	16,500	1,500	91	101	Scots fir and larch.			
		62 Incheoltair,	15,000	1,820	27,300	660	99	109	Scots fir and larch.			
		59 Blackrock Wood,	11,206	2,950	25,200	1,950	79	90	Scots fir.			
		6 Cnoc Duachaie (H.),	13,000	1,900	24,700	1,680	92	103	Scots fir and few larch.			
		6 Cnoc Duachaie (IV.),	14,000	825	11,500	2,470	69	81	Scots fir and larch.			
		14	1912-13	52 Evanton Wood,	15,000	1,120	16,800	2,700	69	81	Scots fir and larch.	
30 Cnoc-na-Coille,	15,000			1,120	16,800	1,050	81	93	Scots fir with some larch.			
31 Meann Chnoc (South),	12,000			2,925	35,100	1,800	71	84	Scots fir.			
6 Cnoc Duachaie (I.),	14,000			1,900	26,600	2,660	69	83	Scots fir and larch.			
6 Cnoc Duachaie (III.),	15,000			825	12,400	2,250	69	83	Scots fir and larch.			
15	1913-14	11 Black Park,	7,000	2,000	14,000	700	91	105	Scots fir and larch.			

16	1914-15	10	Contullich (I.),	.	.	15,000	1,620	24,300	2,700	75	90	Scots fir.
		10	Contullich (II.),	.	.	15,000	1,620	24,300	2,700	75	90	Scots fir.
		5	Baddan's Belt,	.	.	19,420	220	4,300	780	60	75	Scots fir and larch.
		3	Leaty Belt,	.	.	1,500	500	700	150	70	85	Larch and Scots fir.
						50,920		53,600	6,350			
17	1915-16	62	Inchcoltair,	.	.	10,396	1,820	18,900	1,350	79	95	Scots fir.
		59	Blackrock Wood,	.	.	15,000	2,250	33,700	2,250	92	108	Scots fir and few larch.
18	1916-17	6	Choic Duchaire (II.),	.	.	14,000	1,900	26,600	2,660	69	86	Scots fir and larch.
		6	Choic Duchaire (IV.),	.	.	15,000	825	12,400	2,250	69	86	Scots fir and larch.
		52	Evanton Wood,	.	.	14,000	1,120	15,700	980	81	98	Scots fir with some larch.
19	1917-18	6	Choic Duchaire (I.),	.	.	13,000	1,900	24,700	2,470	69	87	Scots fir and larch.
		6	Choic Duchaire (III.),	.	.	15,000	825	12,400	2,250	69	87	Scots fir and larch.
		30	Choic-na-Cuille,	.	.	11,228	1,080	12,100	1,340	71	89	Scots fir.
		8	Moulkavie Belt,	.	.	3,000	712	2,100	220	65	83	Scots fir, larch and spruce.
20	1918-19	10	Contullich (I.),	.	.	15,000	1,620	24,300	2,700	75	94	Scots fir.
		10	Contullich (II.),	.	.	14,000	1,620	22,700	2,520	75	94	Scots fir.
		13	Ballachraggan Belt,	.	.	4,410	1,125	5,000	330	81	100	Scots fir with few hardwoods.
			" "	.	.	2,168	240	500	170	81	100	Oak and other hardwoods.
21	1919-20	11	Black Park,	.	.	15,000	2,000	30,000	1,500	91	111	Scots fir and larch.
		37	Dail Gheal,	.	.	15,000	1,375	20,600	830	99	119	Scots fir and larch.
22	1920-21	6	Choic Duchaire (II.),	.	.	13,000	1,900	24,700	2,470	69	90	Scots fir and larch.
		6	Choic Duchaire (IV.),	.	.	15,000	825	12,400	2,250	69	90	Scots fir and larch.
		17	Clash-na-huicac,	.	.	4,630	1,800	8,300	410	76	97	Larch.
		41	Dail Gheal,	.	.	7,840	1,000	7,800	780	99	120	Oak and beech.
23	1921-22	6	Choic Duchaire (I.),	.	.	13,000	1,900	24,700	2,470	69	91	Scots fir and larch.
		6	Choic Duchaire (III.),	.	.	14,786	825	12,200	2,220	69	91	Scots fir and larch.
		54	Assynt Lower Belt,	.	.	10,884	840	9,200	650	77	99	Scots fir and larch.
		56	Assynt Upper Belt,	.	.	5,902	900	5,300	440	77	99	Scots fir, larch, spruce with hardwoods.
24	1922-23	10	Contullich (I.),	.	.	14,000	1,620	22,700	2,520	75	98	Scots fir.
		10	Contullich (II.),	.	.	14,000	1,620	22,700	2,520	75	98	Scots fir.
		50	Culcaim Belt,	.	.	721	820	600	110	52	75	Oak.
		45	Newton River Belts,	.	.	13,371	430	5,800	600	50	73	Ash, elm, oak.
25	1923-24	36	Cross Hills,	.	.	14,802	900	13,300	1,480	47	71	Scots fir and larch.
		55	Ballavoulin,	.	.	2,181	800	1,800	220	51	75	Scots fir and larch with hardwoods.
		29	Caistel Breac,	.	.	15,000	1,500	22,500	1,500	70	94	Scots fir.
		11	Black Park,	.	.	8,000	2,000	16,000	800	91	115	Scots fir and larch.
			Total,	.	.	924,005		1,314,000	105,550			

Average annual felling-area, 87 acres; average number of trees, 4220; average (4-girth) cubic feet, 52,200.

V. *Note on Raith and Novar Working Plans.*

By R. C. MUNRO FERGUSON, M.P.

The second forest Plan which now appears in the Royal Scottish Arboricultural Society's *Transactions*, nearly completes the work originally mapped out for the Raith and Novar woodlands. There remains yet an area of nearly 700 acres in Fife, part of which will be dealt with as plantations of high forest hardwood for profit, and the rest as pleasure grounds, game coverts, or experimental areas. When the memoranda for this third section is completed, then the 5500 acres treated will be divided into—

- (1) 800 acres of pit-wood ;
- (2) 700 acres of policy coverts and hardwoods in Fife ;
- (3) 4000 acres of high forest conifers in Ross-shire.

There are already similar plans in operation elsewhere, whilst others are on hand ; and the advantages of having definite system in forestry, as in agriculture, are so obvious that the methodical treatment of woods may soon come to be tacitly accepted in estate offices. There is sufficient incentive to take remedial measures in view of the ill-planned, ill-looking, and ill-paying woods that occupy so great a proportion of our forest area, of which some notable examples are revealed in the Novar Plan ; consequently many of us have been led to think that, with elementary precautions, much ornamental woodland can be improved, and our ordinary woods made to give a satisfactory return. On the other hand, others assume that their woods are in a sound condition economically and otherwise, and that we have nothing much to learn abroad but have cause rather to distrust new-fangled ideas.

Admitting, for the sake of argument, that the general state of the Scottish timber area is satisfactory, and accepting the fact unreservedly that the best woods possess considerable money value (as the Death and Succession Duties will show), yet this at least is certain, that for some important purposes even the best woodlands are without value as an asset. Take a familiar example which any average landowner can readily grasp, viz., the power to borrow money. It often happens that we seek to induce others to look favourably upon our lands and heritages as a promising field for investment upon heritable security. We make our pilgrimage to the family writer, where we may

obtain a surprising amount of ready money upon a parcel of feus, a respectable sum upon a pit, or farm land, something even on a sporting rental; but, try to pawn woods for a term of years, and the man of business will change the conversation. There is no security for fixed income from woods, and there is no rotation for the timber harvest. Once show, however, an annual return insured and assured, with every reasonable precaution under a fixed plan, and then the woodland, in due course, becomes a real asset, offering larger security on many estates than either its agricultural or sporting rentals. There are other reasons than that of the lack of periodical returns from timber which account for the depreciation of woodlands, whether as a property or as security. Where the management is generally defective, where man cuts, fire burns, water rots, or the wind blows, as each lists; where the squirrel reigns at the head of the tree and the rabbit at the foot, then there is undoubtedly every cause for owner and creditor alike to refrain from attaching any money value to this class of property.

There are, also, hopeful circumstances which encourage us to deal with our woodlands. Our leading foresters, though deficient in technical training, are educated, enterprising, and reliable; our nurserymen are probably as good as any; whilst our time-expired Indian forest officers, when they really grapple with the practical details of British forestry, are well able either to lay down plans or to direct the general management of timber. Again, the work of the Royal Scottish Arboricultural Society, and the advantages offered by the various courses of lectures, as well as the renewed interest in improvement shown by various classes of persons connected with forestry, has tended of late to place the industry upon a surer basis.

A comprehensive Plan, as the highest test of scientific training and professional experience, should obviously be prepared by a recognised authority who is familiar with the procedure of the best Continental forest schools. In what follows, however, the word "Plan" is used in a more general sense, so as to embrace not only those counsels of perfection which may not at once appeal to everybody, but the tentative schemes of fellings and plantings which may be temporarily organised as substitutes. Some of those who will not undertake a regular scheme may nevertheless draft a rotation of plantings and fellings to provide for younger crops being ready as the older ones become exhausted,

or they may keep a Plantation Book to secure the maintenance of coverts and ornamental woodlands so as best to fulfil their purpose.

The value of work such as that under review, as an encouragement to methodical treatment, needs no recommendation. With it before us, we can see that any woods can be planned for definite purpose, either by an expert or by practical and competent estate managers. If a foreign model be adopted, then probably the French is the less rigid, and is more suited to our present needs than the German; but no one model is essential, and a useful scheme may be worked out in an estate office as the result of study and experience, aided by a record or clear appreciation of the objects for which the area to be treated has been grown, and the purpose to which the product is to be applied.

The first draft of any kind of plan is extremely troublesome, but with the aid of a competent forester and some ordnance sheets—checked in some cases by special survey—a first-rate estate staff may take a plan in hand as part of its ordinary work. Yet since the work is new to us all, it will be often expedient, especially where considerable areas are concerned, to call in expert opinion. This has been done in different ways, upon various estates, and with satisfactory results; and it may be confidently recommended as by far the most reliable procedure. A fee may be given for expert advice with regard to the preliminary steps, or to secure supervision for the final draft of a scheme; periodical inspection can be secured by keeping a control book for the examination and the notes of some recognised authority; or an expert may be placed in regular charge of some large woodland area.

One great end which may be attained through scientific control is continuity of policy. Individual control of industry has many advantages over collective control but it lacks continuity, the very essence of successful forest management; and in these islands there is no example of real continuity of forest treatment. One reason for suggesting this safeguard is that it has been found practically impossible to devise any kind of trust or other security for the due fulfilment of a forest plan. This was much to be desired at the initiation of the movement, because it would be too much to expect that until the cash returns are actually banked, systematic forestry would attract

any but those whose trees are their special hobby : whilst if the plans now in operation lapse there will be no object-lessons for posterity. The alternative to the placing of woodlands under trust or family settlement seems therefore to lie in some sort of scientific control which successive proprietors may be disposed to respect. Of course, when woods are once mortgaged, then full security for the maintenance of forest plans will be at once attained, because the chief condition under which the loan would be advanced, and its main security, would be the adherence to an approved Plan providing for a fixed annual revenue. It may be reasonably expected, however, that apart from such forms of compulsion as those touched upon, the common-sense of the new system, new at any rate here, will alone induce forest owners to adopt it.

The cost of initiation in time and money may be considerable, but once a system is adjusted, then the working of woods for whatever purpose, of pleasure or profit, becomes as simple as it was previously troublesome ; the object for which planting has been done becomes assured ; the saving on outlays becomes large, owing to the knowledge of the requirements for successive years. And on the most careful and moderate calculations the gain in returns and the permanent rise in market value of wooded estates, due to the increase of bulk and the improvement in quality of timber scientifically grown, is likely to be the most remarkable and satisfactory result from the use of forest plans.

VI. *Thinnings*.¹ By M. BROILLIARD.

“A thinning consists in lessening the crowded condition of the crowns of the best trees in a canopy, so as to favour their development.” Such was the definition I formulated in 1874, while touring in the high forests of oak in Central France. By great chance I came upon it while looking up a note on the Hardt, and I found it again amongst a few passing remarks noted on the exotics in the Park of Coucheverny, and on the staves and headers of Blois. Have I stated it elsewhere? Whether I have or not, this is the general idea that has guided me in the thousands of operations of the kind which I have had to direct since 1854, and to-day it still satisfies my conception, though, like every definition, it remains incomplete, and is even dangerous. Comparing it with others, starting from the stems to be removed, the idea is seen to be quite different. Let us see the application of it.

Among our forest trees the oak is the one whose proper bringing up is the most difficult, notwithstanding the fact that an oak wood, left entirely to itself, may be sometimes a marvellously fine sight. For an instance one has only to visit the Plantonneé Wood, in the Tronçais district, if it still exists; nevertheless, we cannot look on a lot of oaks two hundred years old, and only 19½ inches in diameter, while another lot of the same age are twice as thick, without inquiring into the mode of treating the latter. They are not so tall, of course. The former, with boles 65 feet long, give about 66 cubic feet of timber each, and are worth £3, 19s. apiece. The latter, with boles only 39 feet long, give 192 cubic feet, and are worth £23, 16s. apiece. The one wood may contain 200 of the smaller trees to every 50 or 60 of the larger ones in the other, but, apart from the money gain, the difference in quantity of material on the ground is not all loss, for many surplus stems will have been taken out in thinnings. There is no need for speculative argument, however; the fact is convincing. Slow-grown, soft-wooded oaks of 19½ inches diameter make poor planks, or, may be, a little wood for cooperage, whereas the trees of greater girth are good for every purpose. Let us thin out our crowded oaks; we shall in that way reap other advantages also.

¹ Reprinted, by permission, from the *Indian Forester*, after conversion of the French into British measures. Cubic contents are expressed in terms of the quarter-girth system of measurement.

A beech wood is constituted naturally, and almost always as a dense crop, in which the stems lengthen and the crowns stretch up to even 165 feet from the ground, and almost always, if the soil is deep, without risk of their future being compromised. But if left to itself, the beech forest, handsome as it is, does not turn over the capital, the value of the timber does not increase in proportion to its size, or anything like it, as happens with oak. Hence there is a general impression that beech high forest is a poor investment. In a general way it is, but if thinned at short intervals it gives a constant supply of abundant produce, even up to as much as half the current increment. These forests, under timid foresters, so to say, are allowed to sleep, while in Denmark, under bolder hands, they realise 55 to 65 cubic feet in thinnings, or almost as much as at the principal fellings. The facts and figures may be found at page 261 of my "Traitement des Bois." Since the beech, after every thinning, spreads out its branches at once, the soil remains practically always covered, the canopy fully complete, and the growth flourishing.

In broad-leaved high forest of mixed species it is another story. The ash takes for its motto, "*excelsior*"; if it cannot get ahead of the rest it languishes and dies. The oak, also, is sore beset among the dense leaves of the beeches, maples, elms, and hornbeam even, its finest branches are killed off, the most promising individuals are ruined. In certain high forests one may see the last of the oaks being strangled by the beeches, struggling by devious ways as thin poles, 80 feet long and a few inches thick, only to eventually die as slender starvelings. Such mixed forest calls aloud for thinnings, and they are not easy. To guard the crowns of the coming oaks from their infancy, when threatened by the froward birches, through their youth to their mature age, when ambitious neighbours still seek their ruin, requires both judgment and execution.

It may happen that the suppressed stems, the lower story, even the under-wood acquires a great importance for keeping the freed crowns in a good state of growth. In the happy days when the forests of Bains en Vosge were in my charge, we used to make thinnings among the oak and beech poles. One fine winter's day, while visiting a thinning being made in the "Quart en Reserve" of Bains itself, I espied a woodman on the edge of the coupe towards the railway carefully cutting back the seed-

lings of beech which were thickly scattered over the scene of the thinning under the poles to be thinned. Perhaps he remembers to this day the compliment he got. Thinnings were only just coming into practice, and the poor man was only giving the coupe the usual "wash and brush up," as though it were a tan-bark coppice, where the operation is known as *ébrousser, débroussailler*.

It is easy to foresee the difficulty of thinnings in forests where the species are mixed in every possible way, but the complexity adds to the interest. I shall always remember my first walk in the Forêt de Haye with MM. Parade and Nanquette, when I took charge of the Nancy-ouest Cantonment, which was about to be given over to the Forest School. Arriving from the Canton Anne Verjus, we proceeded along a compartment which comes to a point at the Cinq Tranchées. On our left a very ill-constituted pole-crop dominated saplings of beech. In the absence of any officer, a brigadier had been thinning out the beech saplings below and cleaning the soil. "What a pretty sight!" said M. Parade, with a sly smile. "Yes," said I, rather warmly, "but the thinning is not made." "Well, make it!" was the reply. So, as soon as the leaves had fallen, there was a cutting in the pole-crop. About 320 cubic feet per acre were taken out, aspens, beeches that were threatening oaks, coppice shoots overtaking beech saplings, and surplus stems of all kinds. Twelve years later M. Boppe thinned out the same coupe, and took out a lot more material, leaving from that time a nice young seedling forest of beech, oak, and hornbeam over those 69 acres, that were formerly a tangled and disorderly mass of *supererogatory* stems. This juridical word was even used on another occasion, a short time after, by the first president of the Cour d'Appel to M. Parade, who was explaining the operation. The magistrate had grasped the idea as one understands the definition of the term *thinning*, which indicates the classes of stems affected. The practical difficulty of discerning *which those stems are*, remains a matter of art and of skill.

With conifers the matter is no easier than it is with the broad-leaved species. Look at a young pine-wood, uniform and crowded, and commencing to sicken in consequence. Every one of the crowns is a long, narrow cone, reaching upwards, and stretching for its life. Which are to come out? How many stems? Will the thinning be repeated, and when? Can it be foretold? It is so difficult to differentiate that one is tempted

to fall back on a mechanical formula, "cut two out of three"; or, perhaps, "clear lines one yard broad, leaving two yards of forest between." Nevertheless, it is possible for a clear-sighted forester, aided by a careful guard, to do much better by lessening the crowding of the best stems without isolating them.

The pine-wood of Cervières, near Briançon, in a level valley bottom, is stocked with mountain pine growing fairly fast. There I began my career. The forest was then a dense pole-crop, the thin stems no more than about $4\frac{3}{4}$ inches in diameter at breast-height, with a short and narrow pyramid of twigs by way of crown at 40 or 50 feet from the ground. They were sick, and seemed that all they could do was to stand upright. I marked a bold thinning, and got a first-class stiff neck over it. I have not seen it since, but two years ago M. Algan, the *garde général* there, sent me a fine photograph showing the trees and men working among them for comparison, together with a description of the crop, showing that stems of 16 inches are not scarce. These stems have therefore put on 11 inches of diameter in forty years to their original size. And still I have heard of another such dense and dark pole-crop at Gandissart, which, at sixty years of age, on a cold slope, is still in that stage. The Briançon people say "they have always been so." But certainly they have not, for they only began life sixty years ago, and must have been growing since, though at an imperceptible rate. They have never been thinned.

The larches, which shoot up more rapidly, protect themselves better from a crowded condition, for the dominant stems go ahead and get the mastery; all the same, uniform-aged crops from a single sowing often suffer considerably. This is seen. In the ordinary fellings for right-holders, or other fellings not fixed by area, it often happened that instead of following the paradoxical idea of some worthy unknown and felling the finest trees, I would particularly select those that were troubling their betters, thus making a true thinning. The right-holders did not always like it, naturally, and one mayor, he of Villars St Pancrace, fell upon me with some heat. There was more waste heat some time later, when a big fire occurred in his village and it had to be rebuilt. Then the right-holders were uncommonly glad that the best trees had been preserved twenty years earlier.

In silver fir woods, though less indispensable, the thinning is still of great service. Besides permitting the disposal of surplus

increment, it induces the sustained development of magnificent trees. The silver fir, though resisting indefinitely the pressure of its neighbours, often finds itself too crowded as it advances in age, and it is a good deal better off for a little thinning out of trees of the same height; but the work must be gradual, for sudden changes of condition are dangerous. This species loves tranquility; it amplifies its foliage but slowly, and never much; it likes coolness and freshness, and suffers from the introduction of sun and wind. Thus, if isolated after being brought up in a canopy, it dies. We cannot alter nature. The silver fir loves a close canopy; let us take good care never to open it out. I, myself, coming from woods of pine and larch, was at first too bold among the silver firs, too much inclined to give them an excess of *air*, as is commonly and wrongly said, instead of *light and space*. There was a compartment "M" of the forest of Grand' Cote, on a poorish soil with scattered boulders. Here I made a rather severe thinning. The felled stems fetched one penny each. Fortunately the poles were quite young, and we preserved the underwood. Feeble benefit on all sides, and a dangerously excessive thinning! After this experience I became more cautious in dealing with silver firs.

Among the spruces it is again different. This species is somewhat cosmopolitan; it can flourish equally well as an isolated tree on a pasture, or in close canopy. Yes, provided it has been brought up to it. In close canopy its roots are as scanty as its wig; if it is isolated late in life, the roots are wrenched about and the tree dries up. Our friends, the Swiss foresters, led on by enthusiasm, are perhaps trying how far they can go. The idea of thinning, *par le haut*, could not originate in spruce forests, and if I have contributed towards spreading it so far, I should, nevertheless, be sorry to see it carried to extremes. The thinning among the tops is indeed useful to spruce, but this species is certainly the one that has least need of it, and can do very well without it. For instance, see the splendid forests of the Ebenwald (*Revue* of 15th August 1898, p. 520), 320 to 360 stems to the acre at 130 years old. There are also instances in France of forests that have never known a thinning. The rate of vegetation per tree is exceedingly slow, but what splendid sawyer's wood! And what a growing stock peacefully slumbering on foot! up to as much as 12,900 cubic feet per acre at 120 years old. At 7½d. the cubic foot the stock is worth £390 per acre,

which corresponds to a mean annual revenue of £3, 5s. per acre. Is that not sufficient? May we not reply, like the young girl did to her priest, "Since those who marry do well, I will resign myself to it; let those do better who can." She omitted to state that she was in a violent hurry to get married. We are in the same situation with regard to the spruces. Who cares to watch a forest quietly growing for 150 or 200 years, without interfering beyond the removal of the dead or dying trees? It is a good thing, nevertheless, in a few unfrequented parts of the mountains, to spread the increment over thousands of stems, producing timber of the finest quality, even fit for sounding boards with rings only $\frac{1}{100}$ inch thick. One is exceedingly glad to have such marvellous produce of long years and nature to sell, but who will consent to let his own woods grow at the rate of 8 inches per century?

Given a pole-crop of fine up-reaching spruces, the question is, What ought to be taken out in order to obtain a little produce and at the same time to improve the growth of the better stems? The answer is less evident, and the need for prudence is greater here than in almost any other forest. An even-aged pole-crop of pure spruce about forty or fifty years old, may contain 800 to 1200 stems per acre. Many of these, being completely suppressed, are no longer an annoyance to their neighbours, but, on the contrary, are a decided gain, inasmuch as they improve the consistence and solid appearance of the crop. There is no good reason for their removal till their leading shoots have dried up, or some fault shows itself. The real struggle in the upper story thus lies among some 500 to 600 crowns. This is too many for us; it would mean less than $\frac{1}{3}$ of an inch annually on the diameter. We can gradually reduce the number by gently freeing the best and most vigorous crowns, but the crop is one united whole, inter-dependent and inter-responsible. Any sudden openings may tear or loosen the roots of one or two, and in consequence endanger the whole lot. This must be avoided. By working gently and frequently, say, every six years, only removing each time one crown out of, say, six in the upper story, twenty-four years will see the number reduced to half. Under average conditions of growth, this is going quite fast enough. As the crop gets older, the *proportion* to remove becomes less; after eighty years old it is small; and in a pure spruce crop, aged one hundred years, there is very little to be done at all in view to its improvement, whether it has been previously thinned or not.

Which stems are to be cut in thinning the pole-crop? Those which are troubling the finest trees are naturally indicated. They are easily recognised, and must be removed gradually, one at a time, long before they are dominated. Thus, the crowns of the stems of the future get the best of the open air above, while their roots are freed from the struggle with those of the trees removed.

M. Guinier (in the *Revue des Eaux et Forêts* for 10th April 1896) has indicated that in a pure spruce crop the trees to come out are those with narrow crowns. "*Etriquées*," from *stricta*, seems to mean "narrow by reason of crowding." But, if all the narrow crowns are removed, there will be great risk of interrupting, impoverishing, and ruining a crop, however complete it may have been. Let us, therefore, say that the more aggressive among the narrow crowns are to be removed. Actually, in dealing with the operation of thinning, what one has most to guard against is excessive zeal. In trying to do too well there is risk of doing very badly; one must know how to take sufficient time over the operation. This is the conclusion come to a few years ago, by a friend and myself, when discussing matters under the young wood of Petite Fravelle, to the west of the *prés de la Messe*, where I had watched over its birth and its rapid growth in the early years. The surplus stems having become numerous, it would have been an interesting task to eliminate a few of those most hurtful to their neighbours, and it appears to me that a forester who once carries out a successful operation in such a case ought not to be diffident of his ability to do the same in any other conifer forest, and take an enjoyable pleasure over it.

Among the silver firs is it not far easier? Those that are suppressed persist on and on for a very long time in the under wood; those that dominate gradually enlarge their heads; the surplus crowns become deformed and condemn themselves. Add a few diseased, injured, or other hopeless stems, and the thinning goes by itself; any subordinate accustomed to conifers could do it. Then the admixture of beech is a great assistance from its adaptability and general utility in aiding to complete the crop. Similarly, matters are simplified if there are silver firs among the spruces; each silver fir will become a mighty patriarch, surrounded by the spruces, which derive from it both support and fresh moisture in the soil. For further study of thinnings in

silver fir, reference may be made to the "Traitement des Bois," where it is fully treated.

Most of our silver fir forests have been treated under the selection method, and contain stems of all ages, mixed up together, which are consecutively reaching maturity. Then they have to be removed, and sometimes their extraction is combined with a true thinning simultaneously. It would be safer to make the thinning two or three years later, when the absence of the large trees would allow a better insight into the requirements of the crop. But to return to our crops of uniform age.

Take Scots pine. In this case the crowded state must be guarded against. The idea is here again easier to grasp than to execute. Still, when the pine tree is of natural origin, it is always more or less irregular, sometimes containing a few broad-leaved specimens, if only the transitory birches, which will shortly execute a natural thinning of themselves. The idea to grasp is that the pine lives in a canopy, open but evenly distributed, quite a different style of thing from isolated trees. This once realised, the forester will free, without isolating, one or both sides of the crown. The operation is far more necessary here than in silver firs, and more remunerative.

The pure beech forest is the birthplace of the systematic thinning, which consequently presents no difficulty there. Free boldly at first, and much more gradually later, or if preferred operate often in youth, and at longer and longer intervals later. Either rule will give good results. Each time a number of thin or aggressive crowns, greater or smaller in proportion to the boldness and date of the previous operations and to the rate of growth, will be cut out. The definitions of the term *thinning*, based on the *number of stems to remove*, arose in these high forests of pure beech, and are not safe to apply elsewhere.

As these crops grow older, an undergrowth of beech springs up, which remains starved and never comes to anything under the cover. Though probably useful, it is of little importance whether this exists or not. If it comes, leave it; if not, do not seek it.

Under the beech high forest of Dayancourt, aged one hundred and eighty years, at Villers Cotterets, amidst a scanty underwood, notwithstanding the elevation of the very lofty crowns, M. Bagneris, who carried a long, iron-shod stick, drove it in up to the top, so light and loose was the soil. How the oak would have equally prospered under such conditions? In similar soil in

the Canton des Epinais, there is an oak called by the young folk the *chêne à l'unité*. It is 39 inches in diameter, with a timber length of 66 feet, and therefore contains 530 cubic feet of first-class timber, worth nearly £40.

A high forest of pure oak (*Robur*) must be properly thinned if it is to come up to expectations. The strangled crowns become very marked. By removing these and a few others that are simply overcrowded or supererogatory, the growth of the better trees is wonderfully improved. These will acquire diameters equal to one-fifteenth or one-twentieth of the timber length, instead of being limited to one-thirtieth, one-fortieth, or even one-fiftieth. This is all profit, both in the present produce of the thinnings and in the future higher value of the timber per foot. One hundred oaks of 31 inches diameter and 49 feet long would give 13,250 cubic feet timber, and be worth an immense sum. Is not this the proper object in view in these high forests?

In course of time an undergrowth usually springs up which is encouraged by the thinnings. Whatever it may be, it will help to keep the soil light, in good condition, porous, moist, and substantial; while it will be all the better should the undergrowth differ in composition, containing instead of oaks, for instance, holly, hazel, hornbeam, beech, etc. But these latter will rise up under the light cover of the oaks until they interfere with the good growth of these latter. Even under cover they seem to have the advantage and to struggle successfully. I have noticed this in several forests, notably in Fontainebleau, south of the Croix Saint Hérem. It is therefore advisable, when the thinning comes due, to cut back at the same time all such strong-growing species like beech, and especially hornbeam. Possibly their roots may damage the oaks as much in the soil as their crowns do in the air. I suggest this point for further inquiry.

This brings us to the study of the mixed high forest of oak and beech. The difficulty of bringing up or even maintaining the oak in this mixture is only too real; but forewarned is forearmed, for we have the means of overcoming it. I have in this place already indicated, in my study of natural regeneration, the way to obtain oak seedlings among the beeches. That question needs no further mention. The regeneration fellings will be hardly finished before there is a mass of saplings in which it is not very difficult to throw back the beech, but it must not be cut back to the ground, but only to the height of 5 or 6 feet. Thin weeding must be

thoroughly done, not only round each oak, but over the whole area. The beech will start afresh quite sufficiently. Ten years ago, M. Viney did this in coupe No. 5 or 6 of the forest of Cîteaux, on the left as you enter by the road leading from Chocelle to St Nicolas. The result to be aimed at is the preservation of oak everywhere, with beech below it, even from the sapling stage.

The little oak poles soon begin to appear as such, the beech springs up between, and it is soon time for the first thinning, which will remove principally beeches round the oaks. This time they are cut down to the ground, and the oaks will spread and complete the canopy. The beech will undoubtedly remain in the coupe. The succeeding thinnings will boldly attack the biggest beeches, because they are the most dangerous, and in this way the oaks will be kept flourishing. Further, any beeches actually *below the oaks*, but reaching up into their chief boughs, can be cut back. In a coppice with standards the oaks are readily preserved and fostered in the struggle with beech, but this is done only by isolating them about every twenty-five years. In high forest we can do better by means of repeated and fearless thinnings.

The pedunculate oak, mixed with beech in certain forests, such as Mormal (Nord), is generally found in moist places associated with most of the local broad-leaved species, softwoods, ash, elm, hornbeam, etc. It may attain colossal dimensions, but too often it is only found scattered here and there. It is, therefore, necessary to secure its regeneration, if not abundantly, at any rate generally. To this end successive regeneration fellings are made, and at the same time the seedlings of shade-giving species among the oaks are cut back. It is a certain way of building up a forest. The following note, taken from M. Clement de Grandprey, a former Inspector-General of Forests, relates facts which illustrate this admirably:—

“The forests on the immediate banks of the Rhine grow on stony, sandy, or fertile mud alluviums. In the first case, Scots pine springs up naturally; in the second, a forest of every possible species. The pedunculate oak does exceedingly well, and even in some cases forms a splendid crop all to itself, notably in the State forest of Drusenheim, the Communal forest of the same name, and 200 acres of the Canton Steinwald, in the Commune of Gambsheim. Below the oaks is an impenetrable thicket of all sorts of species. How could such a crop arise ?

For the old crops who shall answer? But I know very well how the young ones were created. Some of these are faultless, and I have never seen better, unless, perhaps, on the banks of the Adour. When Alsace was still French, all the forests within three miles of the Rhine were subject to the supply of brushwood for fascines, etc., for embankment works. Consequently, the Forest Administration claimed little concern with them, and they were made over to the Ponts et Chaussées. The engineers located the coupes, which were cut by contractors, without the remotest respect for anything. But fortunately there were a few old forest guards who got work there. These men could not bear to see all their instincts and traditions so ill done by, and of their own responsibility they persuaded the workmen to leave the oaks and elms which were found in the thicket. As the fascine-cutting came round every five years, the proceeding was tantamount to an excellent cultural operation, and produced the crops that I so much admired."

The hint was enough for M. de Grandprey. Being appointed to Haguenau, he got hold of the fascine forests there, submitted them to a rotation of five to eight years, and thus continued the good work begun by those grand old guards. Where oak seedlings were wanting, he sowed broadcast, and success was assured.

Returning to our forest of beech and pedunculate oak, the development of the sapling of the latter amongst the suckers and coppice shoots of all sorts has to be followed with care. Thinnings are indispensable among the fast-growing wood. It is now a case of isolating the species with a light cover, such as birch, ash, aspen, bird-cherry, even alder; with their high shelter they will protect the young oaks from the spring frosts, while the species like elm and lime, that would suppress the oaks, have to be cut down. Thus, frequent repetitions of light thinnings will bring up the young oaks as they should go. Thereafter, thinnings at ten or twelve years' interval will be necessary to liberally free the crown. But in soils where the auxiliary species attain a height of 70 and 100 feet, the mere freeing of the crowns will not suffice to give to the oaks all the space they exact. This fine tree loves to develop in girth, and this can only be effected by assuring it ample liberty on all sides. As soon as the oaks have 40 to 50 feet of bole, the best attention should be given towards isolating the crowns of the choicest trees, and maintaining them in this state by successive thinnings. The neighbouring crowns,

kept at a limited distance, will continue to shade the bole, and, as the oak grows and enlarges its crown, these trees will gradually disappear.

The various species, naturally mixed, will be far from possessing the longevity of the oak, and may reproduce again below the oaks an uneven and most useful underwood. Thus managed, a pedunculate oak forest, often interlarded here and there with ash and elm, will do wonders. Such crops are exceptional in France, for lands that are irrigable or siltable are mostly occupied by agriculture or meadows. Even in the low-lying forests, it is frequently only in a few compartments, and especially along water-channels within flood limits, that the genuine forest of pedunculate oak, alder, and ash or elm, the true meadow-land forest, exists. Generally it is worked as a short rotation coppice with standards; this is easy, but in these coppices the oaks are often but thinly scattered, and leave much to be desired on the score of shape and soundness; really valuable trees are scarce. The treatment of the pedunculate oak in high forest by the bold thinnings that are requisite for its luxuriant growth, gives produce of incomparable quality. Look at the oaks, growing among alders, cut every fifteen or twenty years; imagine 20 of them to the acre; fancy them double their present height; calculate their value at 120 or 150 years, when they will girth 10 to 13 feet, and see what it comes to!

The pedunculate oak is found also as high forest, even pure, on poor sand; but what a contrast! In 1869, under the pleasant guidance of M. Le Tellier, it happened that M. Bagneris and self visited the forest of Boulogne, which is contiguous with the park of Chambord, in Sologne. There, in the Canton des Theilletts, we saw a high pole-crop of pure pedunculate, aged one hundred years, very full, but slender, ill-shaped, and only 8 inches in diameter. It reminded me of the "Sleeping Beauty." At Compiègne, too, Canton des Vineux, there is a sorry high forest of pure pedunculate oak, originally planted, whose boles, already garnished with epicorms, make them appear to fear a thinning. The feeble crowns, the soil covered with heath, give no hope of a spontaneous restoration to better things. Had there been a mixture of beech or an undergrowth of hazel, one could have thinned out the oaks and made something of them, though they are always ill-placed on dry sands. Isolating them now would kill them; all that can be done now is to give them the

thinnings and treatment appropriate to *Q. Robur* under similar conditions.

The above seems to me the procedure suitable in thinning our two oaks under various conditions. We shall thus realise the desirable ends set forth seventy-five years ago (*Revue* of 1st December 1898) by MM. Mallot and Le Grix, naval constructors. In many cases it is done already, and though our ships are now built of iron, our oaks are not less in demand, for the price is greater than ever, notwithstanding the general fall in prices.

The reader who has survived up to this point can now understand my views of the way thinnings should be made, *my style*, in short, which I am far from alleging to be *ne plus ultra*; there are too many things we do not know. In any case, he will have seen that a thinning is not a simple operation, and that it varies exceedingly between the spruce growing pure, which can dispense with it, and the meadow-land pedunculate oak, whose crown, by spreading freely, gives to the annual rings ample thickness, strength, and quality. From one point to the next, at each individual tree, so to say, the thinning introduces different conditions. Satisfactory work can only be done by never losing sight of the guiding idea, and by having a close acquaintance with the life and behaviour of each species, pure and mixed, in every possible way. Such skill is only acquired by those who live in and with the forest. It is infinitely easier, safer, and in every way more satisfactory, to show the operation *in situ* in the forest than to explain it on paper. What the eye sees the mind may understand, but mere reading leaves but vague ideas, for no *complete* idea can be given of the *extent* of thinning. On the ground, it is the application of the main idea to individual cases that enlightens. It is the same with pruning fruit-trees; in fact with all questions of art. See it done, then read as much as you like; such is the only safe road to skill. It is, therefore, not without some apprehension of danger that this article is published.

Thinning is not only a delicate operation. However you attack a growing crop, it is dangerous. The blighting of the whole crop, and the degradation of the select stems, has to be guarded against in different measures, according to the soil and species, and these vary infinitely—particularly in mixed forests. Therefore, I have previously stated (*Revue* of 10th June 1896) that there is no definite formula for a thinning, there is no process

or equation by which one can determine the number of stems to remove, or lay down which they are. This has to be done through knowledge of the various species, their temperament, exigencies, faculties, mutual relations, etc. But I think this is enough. I have known men who did not know x from y , forest guards even, who, having grasped the idea, could act on it and do very respectable work indeed in their own forest, their own beats. One of the most remarkable of these was brave old Antoine Gautherot, of Saint Broing, near Gray. He was a woodman who became a guard in a private forest. He had never left the woods of La Vaivre, which surround the ancient abbey of Corneux. In winter he could not tell *Salix alba* from *Salix fragilis*, but how well he knew the oak and the ash, the red elm with its two homonyms *white* and *diffuse* (though he knew not the name of the latter), and the alder, the aspen, the hazel, and the rest. He lived among them, his life was of theirs, he felt their difficulties, and did exactly what was needed. That is no trifle, I assure you.

The operation of thinning thus may be, nay always is, dangerous; the greatest danger is that of interrupting the canopy, and it must be carefully avoided, notwithstanding the temptation to make a nice open crop. After what I have said about pushing the thinning of *Q. pedunculata* to the state of isolation, I hope to escape being called an advocate of complete canopies at all costs; but how necessary the complete canopy is! What good are isolated conifers? Good to be cleared off at once! What future has a high forest of beech if opened so much that several years must pass before the canopy is re-formed. It is the future of a crop well on in regeneration fellings. Even *Q. Robur* itself may be made to suffer, in the soil and in the air, to the extent of imperilling the future of the crop. Complete canopy is the natural state of forests; let us improve upon it only in showing proper regard for it.

Another great danger in thinning lies in the removal of the finest trees, be they silver firs or oaks, larches or beeches, pines or others, under some pretext or other. Crops so treated consist of a languishing residuum of unprofitable, feebly-growing stems, mostly of useless species, with a plentiful sprinkling of blanks which will not fill up. Concoctors of disastrous theories should be handed over to the hangman, and that without appeal, unless to the owners whose forests they have handled. If these latter

are satisfied, so much the better; but for our part, let us keep our complete canopies filled with our best trees.

A third danger is that of a too heavy thinning, making openings in silver fir woods, gutting a high forest of oaks, destroying the due mixture of secondary species, or simply separating the stems too widely. The result is a shock to the constitution of the forests and a crisis in its existence. What our long-lived forest trees really require is a regular and sustained development: the proof is easily seen by comparison of the two- or three-hundred year-old crops that still exist in a few forgotten, out-of-the-way forests.

From another point of view, heavy thinnings, but still made with prudence and frequently repeated, furnish a good deal of produce, which supplements and sustains the regular yield, sometimes makes it possible to await the due period of maturity, and becomes as important a factor in the revenue as it is in the treatment. It is known that a beech forest, according to soil, may give thinnings amounting to half as much, or even quite as much, as the principal produce. But the quantity can never be determined beforehand, since it depends on the ideas of the operator. In case of competition for the produce, a case of usufruct for instance, the question arises, "Who shall be judge between the parties? Who shall see that the owner cuts enough? Who shall see that the right-holders do not get too much?" Who can decide such a technical question but a skilled, professional forester, called in specially and sworn to the task. The rules and limits by which he will be bound may vary within wide limits from one place to the next, here 500 to 600 cubic feet may come out of half an acre, there nothing at all. Thinnings are becoming more and more matters of daily practice, and though they are at present ignored by the Civil Code, the day is not far distant when the owner of the bare land will be forced to surrender their produce to the usufruct beneficiary or the holder of the ground rent (emphyteutic tenure); it is the opening of a new state of things, which the twentieth century can only emphasise and confirm.

Lastly, the value of small material is falling to nothing, and that of all classes of firewood is similarly affected, whilst every kind of timber is more and more sought after. The deduction is self-evident. The future is for High Forests, complete high forests; standards over coppice with long rotation; plantations of conifers, all kinds of timber trees. The future is, therefore, also for thinnings.

Some owners wish to know how many stems per acre they can keep on foot at given ages in a regular crop. I have already said that there is no formula. It is easy to show the absurdity of expecting one. An oak pole-crop, aged 30 years, may comprise 1600 to 2000 stems per acre, but only about 400 really forming the main crop. On cutting out the feeble and useless, there remain 400 stems suitably spaced. Ten years later, at the age of 40, half may be cut, say 200; at 50, cut a third of the remainder; at 60, one-fourth, and so on at equal intervals, one-fifth, one-sixth, one-seventh, one-eighth. Then, at the age of 100, there will remain $400 \times \frac{1}{8} = 50$ dominant oaks. Continuing as before, there remain

at	120	years	$400 \times \frac{1}{10} = 40$	trees.
	150	„	$400 \times \frac{1}{13} = 31$	„
	180	„	$400 \times \frac{1}{16} = 25$	„

Now, do the same for a spruce forest aged 30 years, containing 1600 stems, all included in the region of practical politics.

At	80	years	old	there	will	be	270.
	100	„	„	„	„	„	202.
	120	„	„	„	„	„	162.
	150	„	„	„	„	„	121.

A silver fir wood, aged 30, may contain 800 principal stems. Treated in the same way, it will, at different ages, contain one-half the number that the spruce has. What sort of result is this? Finally, whatever the species and the number "M" of stems contained at thirty years old in the complete crop, it may be thinned by the formula

$$M \times \frac{1}{2} \times \frac{2}{3} \times \frac{3}{4} \times \dots \times \frac{n-1}{n} = X.$$

Under the definition by which this article begins, the number of stems to be preserved at different ages is, therefore, fixed by the formula

$$X = \frac{1}{n} M.$$

The progression may be accelerated, or diminished, according to the soil, by making intervals of six or eight, twelve or fourteen years. The hyperbolic curve may be constructed, directrices and asymptotes marked out, and so on. What a treat for a mathematician, turned forester by mistake.

VII. *On the Influence of Different Degrees of Thinning on the Growth of Beech.* By A. C. FORBES, Wood Manager, Bowood, Calne.

In the May and July (1899) numbers of the *Zeitschrift für Forst und Jagdwesen*, edited by Dr Danckelmann of Eberswalde, Professor Schwappach published the results of a series of observations on the growth of beech woods under different methods of thinning, as carried out on numerous experimental plots set apart for the purpose. The observations were made under the auspices of the Association of Forestry Research Institutions; and although the beech is not considered as a timber tree of the first importance in Scotland, Professor Schwappach's article is of sufficient interest and importance to forestry in general, and the practice of thinning in particular, to justify the salient points contained in it being brought to the notice of members of the Royal Scottish Arboricultural Society.

The observations were divided into two divisions, one being devoted to the question of *thinning* proper, as understood in German forestry practice, and the other being confined to what is known as "light-felling." Thinning is usually divided into three degrees—weak, moderate, and strong,—all of which are confined to dead, dying, suppressed, and partly suppressed trees. Anything beyond this which touches the dominant stems goes under the name of main-crop thinning. These four degrees of thinning are characterised in the following paragraphs by *a*, *b*, *c*, and *d*, corresponding to weak, moderate, strong, and main-crop thinning respectively.

By "light-felling" is meant a reduction of the crop by the removal of all badly-shaped, injured, or broad-crowned trees in the first place, and a thinning out of the least promising of the remainder in the second, until the crowns of the trees are isolated and the leaf canopy broken up. Light-felling removes from one-fifth to one-third of the total crop, and closely resembles the thinning practised in Scots fir and larch woods in this country between the thirtieth and fiftieth year.

In the experiments in question, eleven main-areas were set apart for the thinning observations, containing twenty-nine sub-areas, all of which have been at least ten years under observation, and in some cases as long as twenty-five years.

The numerous and painstaking measurements and data are

given in seven tables, of which Table I. occupies twenty pages, and gives a complete statistical account of every area under notice.

The chief conclusions arrived at from these data are somewhat as follows:—

1. The growth of the *a* thinned areas was from 23 per cent. to 3 per cent. less than that of the moderate or *b* thinned plots, except in one instance, when it reached and slightly exceeded the latter. On the average, it may be stated that the weak thinnings resulted in 10 per cent. less growth than that of the moderate, while strong thinnings showed an increase of from 3 per cent. to 35 per cent. over the latter, the smaller increase taking place, however, only in the youngest wood. On the better localities, at an age of sixty years and upwards, the increase of growth was in proportion to the strength of the thinning.

2. The main-crop thinning was observed on six main-areas, and a special form of thinning carried out. The six areas were arranged in two groups, in one of which the best stems (future stems) were selected at an age of fifty to sixty years, with a view to their equal distribution over the ground. The number of these stems per hectare varied with the condition of the crop and soil, in four plots being respectively 240, 176, 340, and 292. In the other group the thinning was carried out without regard to equal distribution, but all diseased, badly-shaped, forked trees, etc., removed, and the dead wood taken out. The number of main-crop stems is greater with this form than with the other, being 1404 and 1412 per hectare respectively. But while in the previous form of thinning the future stems remain (unless circumstances arise to warrant their removal) until the crop is mature, in the latter form the number of main-crop stems diminishes with each thinning.

Comparing the results of these two forms of thinning, the one last described deserves the preference. The process of natural selection is carried on to a later age with the beech than with the oak, and at an age of fifty or sixty years, the trees most likely to make the best timber cannot be selected with certainty, and in large plantations their selection is too tedious an operation in practice; whereas every wood-cutter understands the taking out of bad stems. Besides this, the sudden exposure of the crowns in the first method renders uncertain the clearing of the stems, as the side branches take longer to kill off in a shade-bearer like the

beech. The quality of the timber must also be considered when thinning. When strong thinnings are made at an early stage, a large quantity of rough timber is produced, while the lighter thinnings, if resulting in less growth at the outset, make up in the long run, so that by the fortieth to the seventieth year the temporary loss is repaid.

Taking the comparative yields of timber and branchwood on the strong and main crop thinnings respectively, it is found that the former works out at 183·8 cubic metres of timber and 335·4 cubic metres of branchwood, while the latter gives 200·7 cubic metres timber and 214·0 cubic metres branchwood. Still more favourable to the main-crop thinning is the number of stems, and their sectional area, compared with the strong and moderate thinnings, the advantage being further heightened when one considers that with the moderate thinning the badly-shaped stems are still present, whereas these have been removed in the main-crop thinning.

Tables are given showing the influence of the three degrees (*a*, *b*, and *c*) of thinning on the different stem classes arranged according to their diameter, from which the following conclusions are arrived at:—(1) By means of heavier thinnings the growth of the remaining stems is increased. (2) This increase is much greater with the transition from the moderate to strong degree than that of the moderate compared with the weak thinning. Sometimes no appreciable difference can be noted between the *a* and *b* degrees. (3) The amount of absolute growth rises from the weaker to the stronger stem classes with all degrees of thinning. (4) The increase of growth is in proportion to the age, and in youth and on poor soils is inconsiderable. The effect of the increase of growth (due to thinning) on individual stems is so important that it counterbalances the decrease occasioned by the reduction in the number of stems. (5) The absolute and relative rise in diameter growth is most important in the weakest, and gradually decreases with the stronger stem classes, the reason for this being that with the latter the conditions are already so favourable to rapid growth, that any increase caused by further thinning can only take place to a limited extent, and also that those trees which would respond most readily to the improved conditions are chiefly removed in the process of repeated thinnings.

On two of the main-areas (Frienwalde) the diameter growth of the weakest stem class with moderate is about the double of that

with light thinning, while the growth on the strongly thinned areas is five or six times that of the latter. On two areas, again, the increase of growth of the stronger stem classes on the *a* and *b* thinned sections showed no important difference, while the growth on the same stem classes on the strongly thinned sections was from 25 per cent. to 100 per cent. higher than that on the former.

The ages of the trees on the various areas referred to above ranged principally from thirty to eighty years; the majority, however, lying between forty-five and sixty years.

LIGHT-FELLING.

The areas devoted to this research were divided into three groups, and treated by the following methods:—

1. Borgreve's method of light-felling.
2. A method adopted by the Research Association.
3. Seebach's system of treating beech high forest.

No. 1 method was only a step in advance of the *d* thinning carried out in the thinning experiments, and was observed in conjunction with a control area (strongly thinned) in Frienwalde. In 1887, 34 per cent. of the stem sectional area was removed, leaving the equivalent of 75 per cent. of the sectional area present on the control plot. The result of this treatment was particularly good, showing within the ten years an increase of 25 per cent. of sectional area and 26 per cent. of volume over the control plot. The removal of the badly-shaped and broad-crowned trees benefited the growth of the middle-class stems greatly, and the growth of adventitious shoots on the stems was but slight; and it is questionable whether the removal of hopelessly suppressed stems is at all prejudicial in this respect.

In order to ascertain the effect of removing predominant stems from their neighbours, observations were directed to four groups, two of which stood on the light-felling sections and the other two on the control area. The trees were tested with the growth-borer, and the growth during the five years preceding the commencement of the experiment taken as the unit. On the control area the growth during the five years following the date of light-felling was 79 per cent. and 77 per cent. respectively of that of the preceding period, while on the light-felling area it rose to 138 per cent. and 238 per cent. of that of the preceding period.

2. *Light-felling Research, arranged by the Research Association.*
—This consisted of a strongly-thinned control area and two sub-

areas for the light-felling experiment. The former was severely thinned in 1887, and the growth made is rather in excess of what it would have been under ordinary conditions. The two light-felling areas were thinned down to 80 per cent. of the control area, but while on Sub-area I. strong stems were removed generally, on Sub-area II. chiefly stems with wide-spreading crowns were taken out. The result of this difference in the treatment was that Sub-area I. showed an increase in the ten years of 9 per cent. and Sub-area II. one of 17 per cent. over the control area, although the growth of the latter was higher than the average.

3. *Research on Seebach's System.*—Seebach's system of light-felling consists in removing, within a period of about ten years, two-thirds of the crop about the seventieth or eightieth year of its age, and encouraging an undergrowth of beech seedlings, either by natural or artificial means. After thirty years or so the leaf canopy again closes up, and the original stock of timber is again present on the ground. The wood is then treated with a view to natural regeneration in the ordinary way, by preliminary seed-fellings, etc.

Several areas were devoted to this research, one of which was set apart by Seebach himself in 1843, and is still under observation. The result of this treatment on the research areas generally is to confirm the assertion that one-third of the sectional area of the wood is sufficient to produce as much absolute growth under this system as the growth made by a wood left in close order, while the advantages claimed for it are earlier realisation of part of the crop, and larger timber at the final felling. It is, however, only suitable for good soils and localities, and is probably less advantageous on the whole than the gradual isolation of the best stems, as described in the former methods.

In the above light-felling experiments the ages of the respective woods varied between seventy-five and one hundred and ten years, that of the area originally set apart by Seebach running up to one hundred and twenty-six years.

GENERAL CONCLUSIONS.

The general conclusions arrived at by Professor Schwappach, so far as the results hitherto obtained are concerned, are as follows:—

1. By an increase of warmth and light, the additional room at the disposal of the roots, and the removal of mechanical obstacles

to crown development, the growth of stem classes, other than the predominant and suppressed, increases with the degree of thinning.

2. At an early age (up to the fiftieth or sixtieth year) the favourable effect of heavy thinning is not so marked, especially on poor localities, as later on. The beech has the capacity for responding to improved conditions of growth up to a late period, so long as it is not actually crippled by crowding.

3. With the ordinary methods of light and moderate thinning, no great increase of growth takes place, and only when stronger thinnings are instituted does this occur, and more especially when the predominant broad-crowned trees are removed to the advantage of middle stem classes.

4. Only with severe thinning is an increase of growth in all stem classes observable. With thinnings confined to the suppressed and half-suppressed trees, the relative increase of growth is most important in the weakest remaining stems. With thinnings which chiefly remove the broad-crowned predominant stems, the conditions are so far altered that the relative increase is much about the same in all stem classes.

5. By the increase of growth on single stems with sharper thinnings, the loss caused by diminution of stems is not only made up, but exceeded, and only sinks with very thin stocking. In early age (up to the sixtieth year) the difference in favour of relatively stronger light-fellings is small, but rises after that even on poor soil, quickly. Only with a light-felling, which exceeds 60 per cent. of the strong thinning, does the increase sink again. From the point of view of increased growth, about 30 to 40 per cent. in excess of the strong thinning should be aimed at.

6. Upon comparing the yields of different methods of thinning woods under sixty years of age, the main-crop thinning gives the best results.

7. A light-felling of 20 per cent. over the strong thinning in woods over sixty years of age gives an increased yield of at least 10 to 15 per cent.

So far as the different methods of thinning are concerned, the weak thinning cannot be considered a cultural measure, as it produces not only less growth than severe thinnings, but, by leaving badly-formed and broad-crowned trees, lowers the quality of the timber produced. At an early age, however, these badly-

shaped trees assist in shading the ground and preventing too branchy a growth in the other trees, and should not be removed too soon, neither should strong thinnings be made at too early a period in the age of the wood. At a later stage, strong thinnings, as defined by the Association or by Kroft, which confine themselves to suppressed and weakly trees, do little towards assisting an increased growth. To effect this, all badly-formed, forked, and broad-crowned trees must be removed from the neighbourhood of better shaped trees, and the growth of the latter encouraged in every way.

Through the moderate system of thinning beech practised in Germany at the present day, thickly-stocked woods are produced, but their yield of timber and money is decreased.

To produce the best results, the following method of thinning appears likely to be successful:—At the first thinning attention should be chiefly directed to the removal of rubbish, beyond which little is required until the thirtieth year on good, or the forty-fifth year on bad, soils, and then the main-crop thinning should begin. About every six years the wood should be gone through and all badly-shaped trees taken out, groups of well-shaped trees isolated, and all dead and dying trees removed.

When this has been done six or seven times, the crowns of the best trees should meet about the seventieth or eightieth year, and the remaining partly dead and partly unnecessary trees may be taken out.

After this, stronger thinnings, bordering on light-fellings, may be begun, and recur every eight or ten years, removing the worst and leaving the best trees. By this means about 1000 feet of timber per acre should be obtained every ten years or so, and although the crop standing at the final felling may be less than is the case with the usual treatment, yet the total yield will exceed that of the latter by 20 per cent.

From the above extract it will be seen that the German system of thinning (which, in the sense that we understand it, is hardly thinning at all) is undergoing a change which will approach more closely the practice prevailing in this country, the chief difference being that close order until the trees have lost their lower side-branches is still insisted upon, and without which clean timber cannot be produced.

VIII. *Letter from E. JÄGMÄSTARE ELIS NILSON, Stockholm, Sweden, regarding his visit to Larch-woods in Scotland.*

STOCKHOLM, 8th December 1899.

My Report on the Larch will be made first about the New Year. As, however, the greater part of it will treat of local Swedish circumstances, and, accordingly, will not, in its entirety, be of any great interest to Scottish readers, I beg instead now to be allowed to concentrate, in the form of a letter, my impressions of the visit I made to the Scotch larch-woods.

As I had the honour of mentioning at our last meeting, I came to Scotland in the hope that the Scotch larch, being acclimatised under northern conditions similar to ours, would, if transmitted to Sweden, there prove to be possessed of more power of resistance than the tree directly imported from southern Europe—a view which I founded on the circumstance, among others, that the Scotch fir is thriving excellently here, and is suffering much less from disease than the German fir, which has proved itself quite unsuitable to our conditions. But these hopes were rather chilled when, on my arrival in Scotland, I learned there was so much anxiety regarding the future existence of the Scotch larch-woods, and in the despondency of the hour I had nearly given the thing up and returned home. But happily I carried out my programme, and availing myself as much as possible of the recommendations and plans very kindly placed at my disposal, I had the opportunity, in many different parts of Scotland, including Dunkeld, to study larch-woods of from 3, 6, 8, 15, 25, and so on even up to 80 and 100 years of age. However, I had, against all expectations, the good, or perhaps bad luck, whichever you may call it, to light almost exclusively upon sound larch-woods. But I have noted down, as a pleasing and important fact, that pretty and quite sound larch-woods *do* exist of all ages, from the very youngest even to those of ripe age. True enough, I have ever and anon seen individual trees affected with the cancer, but those were very few, and I did not see any larch-wood which impressed me as being doomed to a premature death. But I noticed several young or middle-aged fir-woods, which would certainly never be able to grow up to timber-wood. I also observed a great deal of diseased Norway spruce-wood (*A. excelsa*), and in the places where silver fir and Douglas fir were growing in larger numbers, it was

easy to find trees spoiled with the fungus. From this I arrived at the conclusion that no species of the needle-trees that are most important to forestry are free from attacks of fungus of one kind or another; but that the larch, even as a wood, has rather greater qualifications, in spite of the attacks of fungus, for giving a relatively good percentage per acre of material suitable for timber than the fir (*P. silvestris*), and equally great as the spruce (*A. excelsa*), and probably also as the silver fir (*A. pectinata*). If so, and if you take into consideration the timber of the larch, which is technically very superior to that of all other needle-trees, it seems to me that instead of bringing it into discredit, to the advantage of its rivals inferior in value, it would be very much worth while to spare no pains for its preservation. The moist climate, and mild, rainy winters of Scotland are very apt to facilitate the spread and growth of the fungus; and it is therefore of the greatest importance to watch diligently and carefully from the very first, and during the growth, that nothing is left undone which in any possible degree might help to shut out or limit the fungus. What can and must in this respect be done concerning the larch?

Before answering this question, I beg to state that, of course, I am doing so without any pretensions to authority, and only in the interest of the good cause, hoping that something of what I say may prove acceptable, and be beneficial to the culture of the larch.

1. First of all, I shall have to emphasise the importance of using only perfectly good seed—that is to say, seed gathered at the right time from first-class mother-trees as regards soundness and form of growth. Nothing can induce me to accept the view that the quality of the seed is independent of the quality of the mother-tree. It seems quite impossible, for instance, that a tree of which the sap is infected with the poison of the fungus would be able to leave an equally healthy and good offspring as a strong tree uninfected with disease. Is it not more reasonable to believe that in this respect the same conditions prevail as in the animal world, where chronic and even temporary diseases of the blood have a degenerating effect on the offspring? The well-known fact that a diseased tree carries cones much earlier than a sound one does is a special proof that the health and the offspring of the tree are intimately related to each other. Accordingly, gather in cones only from straight-grown, strong, and quite sound trees, and do this as late as possible—that is, just before

the time when the cones spontaneously drop their seed. Take care, also, lest at the kilning the seed be exposed to too strong a heat, and sort the seed carefully by fanning or winnowing, so that only the heavy and sound seed may come to use. A seed with an inferior power of germination brings forth weak plants, which become welcome victims to the fungus, and accordingly promote the introduction of these diseases into the nursery or the field.

2. The nursery ought to be located on vigorous, good forest soil, preferably on some wood-cutting or opening in a beech-wood. You must take care not to top-dress the nursery—whereby a rapid growth is produced, with very small power of resistance in the plant. On transplanting, only vigorous plants ought to be used. All weak or diseased plants should be taken out and thrown away, or, still better—in the case of the cancer—they should be burnt in order to be turned to the profit of the nursery as ashes. I consider the method of bending the root in an angle at the transplanting, instead of letting it keep its natural position, to be scarcely suitable. The special energy that the plant or tree must develop in its efforts to try and restore the order of nature can only be disposed of at the cost of the growth of the plant or tree, and thereby arises a period of weakness, during which the fungus diseases more easily gain a firm footing. Of course all cutting of the root, whether at the replanting or transplanting, involves considerable danger to the plant.

3. The ground for the plantation ought to be chosen with special care, lest a successful result be rendered difficult or even impossible from the very first, through unsuitable ground, etc. That the quality of the soil is a very important factor, was plainly proved on an occasion when two plantations (crops) of about twenty-five years of age were growing side by side, one of which was covered with moss, and in all respects bearing the stamp of discomfort, while the other one left nothing to be desired in respect of a fine growth and a vigorous appearance. On examining the ground, the pining plantation, which formed a belt of comparatively small breadth within the remaining healthy one, proved to be growing in red soil, while the latter grew in black earth. It can scarcely be doubted that the conditions of the crop and of the soil were here constituting effect and cause. Perhaps some iron-spring situated above found its way through the plantation, sterilising the soil; perhaps the soil was too shallow, so that the roots met the rock. I could not, at the

moment, find out the real cause, but I think it is a matter of great interest; and if, therefore, anybody would undertake to investigate it, I beg to mention that these facts were observed at Glenstriven, the obliging owner of which, Mr Berry, who is interested in forestry, would no doubt be glad to have the matter made clear.

Frosty and saggy earth, strong irony soil, barren gravel or sandy ground, as well as shallow soil on rocky ground, ought to be avoided. A good beech-wood ground, with a slope towards the south or west, would perhaps best suit the larch, which needs a deep and good soil, as well as an ample supply of air and sun to the crown.

4. During the period of rapid growth the larch-wood ought to be *carefully conserved*. Thinning must be begun as soon as the trees begin to grow into each other with their (crowns) branches, whence the danger of pressure from the side arises. All diseased trees—but first of all those infected with the fungus—must be removed and destroyed. It is not good to allow the thinnings to remain lying in the wood. I had long vainly looked for the *Peziza* in a wood about eight years old; but when I crossed a shooting-ride cut through the wood, where the felled trees were left lying about, I immediately, upon examination of the felled trees, found the fungus I was looking for. Of course it is *very* bad to break or cut green branches from growing trees.

5. It would be difficult to settle whether the larch ought to be raised in mixed or in pure plantations. For myself, I am inclined to prefer a mixture of larch and beech in which two rows of beech and one row of larch are planted, with a distance of 2 feet between the rows; or, as in the annexed diagram, where the beech is marked with o and the larch

	×	o	o	×	
with × :	o	o	o	o	The mutual distances of the larch
	o	o	o	o	
	×	o	o	×	

trees would in this case amount to 6 feet. Next to this mixed plantation, the unmixed one may be preferred, with a distance of 5 feet between the rows. When the pure larch-wood has attained an age of thirty to forty years, it ought to be underplanted with beech or silver fir. The common spruce (*A. excelsa*) is not so good for this purpose. As experience shows, it is too intolerant, and even very old oak and larch woods that have been

under-planted with spruce have begun to die out after ten to fifteen years. An equal mixture of larch and fir (*P. silvestris*) has no prospect for the future except on condition that the fir be not allowed to put the least pressure from the side on the larch; but the fir thinnings being of much less value than those of the larch, the unmixed larch-wood is, as I have already mentioned, to be preferred. I have no experience as to whether larch and oak will thrive together, but I think it is very probable they would. The oak has been proved to thrive excellently in Sweden, even as an under-plantation in old fir-woods; and it might therefore, with still greater profit, be raised under larch-woods of from forty to seventy years of age. Plantations of larch and oak of the same age—in which case, however, the distance between the rows must be at least 8 feet—may have a prospect of good success.

As to the age at which the larch ought to be planted out from the nursery, I think that plants two years old, once transplanted, have the greatest prospect of being removed without damage. In cases where there is abundant growth of grass, however, older plants ought to be used, and then I should advise plants of three years, twice transplanted, to be taken.

In conclusion, I wish very warmly to recommend the perusal of the publications of Forstrath Krömmelbein in Varel (Oldenburg) regarding the larch (*Zeitschrift für Jagd- und Forstwesen*, edition 1888); even Dr A. Cieslars: *Separatdruck aus dem Centralblatt für das gesammte Forstwesen*, edition 1899, Febr. und März—to be ordered from die Buchhandlung W. Frick in Wien I., Graben 27.

IX. *The Ash* (*Fraxinus excelsior*) and its *Cultivation*.¹ By JOHN NISBET, D.Cec., F.S.I.

Among the trades using ash timber, and more particularly among carriage manufacturers and makers of agricultural implements, considerable inconvenience is being felt from the want of adequate supplies of mature timber of English growth. There is now said to be such a scarcity of marketable ash throughout Britain, that manufacturers have been forced to make inquiries abroad for this class of wood, though none of it comes up to the standard of the home-grown product with regard to the toughness, density of grain, and elasticity which constitute its special technical value.

With such slow-growing crops as timber, it will of course take fully two generations before ash, now planted, will attain its full technical and financial maturity. But, as prices now rule at from £7 to £11 per load of 40 cubic feet of rough planks as turned out by the sawyer, as the demand is constant and practically certain to remain so, and as the prospect in future is far more likely to be in the direction of gradual enhancement of price rather than towards diminution, the present occasion seems a favourable opportunity for bringing under the notice of landowners a *résumé* of the sylvicultural characteristics and requirements of the ash when grown on strictly economic principles, and not chiefly for ornamental purposes. Northampton and Leicester are more particularly suitable for ash-growing, as their produce ranks first in quality and has long obtained the highest market rate.

From its spontaneous distribution throughout Scandinavia, and thence southwards to the shores of the Mediterranean, the ash proves itself to be a tree capable of enduring both the extreme cold of a northern winter and the great summer heat of southern Europe. But, at the same time, it is decidedly sensitive to late frosts in spring throughout low-lying, moist localities, and here even requires nurses to protect it while young. The shoot within the terminal bud is apt to get nipped with frost, while the shoots in the two side-buds opening later are spared. The result of this

¹ Reprinted by permission of the Controller of H.M. Stationery Office, from *The Journal of the Board of Agriculture*.

is that the ash has a much stronger tendency to forked growth than is characteristic of any other of our forest trees. When planted on fresh, breezy uplands, however, its lateness in bursting into leaf usually affords a fair protection against spring frosts. When once clear of the danger from frost it soon shoots up in growth. The energy of growth in height continues lively up to about the fortieth or fiftieth year, and in the following twenty years it develops considerable increment in girth. It often reaches maturity between the age of sixty to eighty years, and after this is attained it is no longer economical to allow trees to stand. When grown in the close canopy of mixed timber crops, and not in any more isolated position, its financial maturity is not infrequently delayed until between the age of eighty to one hundred years.

The leading silvicultural characteristics of the ash are its inherent demand for light and air, often coupled with inability to endure shade, and its heavy requirements in respect of mineral strength and of moisture in the soil. On the whole, it must be considered one of the most exacting of our forest trees. To attain its best development it should, if possible, be planted on a fresh, deep, light, loamy soil. On dry, light sand, or stiff, heavy clay, it not only develops indifferently, but also soon begins to show signs of premature exhaustion of vital energy, through the soil being unable to supply its normal requirements as to mineral food and moisture. Its root-system is both deep and broad, though ash will thrive well on soils, otherwise suitable, which are hardly deep enough to permit the oak to attain its finest development. Fortunately for its cultivation, the ash can often, during the earlier stages of growth, thrive under standards having light canopy and thus protecting it from frost; but later on, and especially as it approaches maturity, it becomes intolerant even of shade from the side tending to interfere with the impulse it then manifests strongly towards lateral extension of its crown of foliage. Owing to its strong demand for light, and its inability to protect the soil adequately against deterioration through the action of sun and wind, ash is unsuited for the formation of pure forests or even for forming large groups or clumps produced either artificially or from suckers and stool-shoots, except, perhaps, where ash-beds are exceptionally profitable through local demand for hop-poles and the like. Even on moist, low-lying situations specially favourable for its growth, it thrives best when grown

singly as isolated trees or else merely in small knots and patches.

No situation is better fitted for growing ash for profit than the sides of moist dells and chines having a good, strong, loamy or clayey soil, through which the moisture from above gradually percolates. This is much better than stagnating subsoil moisture, which is even detrimental unless a full, hot, southern exposure stimulate to evaporation and strong transpiration through the leaves; and even in dells and hollows on the hill-sides the best and largest trees will usually be found in the lowest and most sheltered positions, where the soil is richest.

Hitherto, in Britain, the ash has chiefly been grown as a hedge-row tree. Here it secures complete exposure to light and air, while its toughness ensures it against being thrown or broken by wind. But in such positions it is apt, when advancing in age, to throw out long, superficial roots, which spread into the fields, rob the soil of moisture and of nutrients otherwise available for the agricultural crops, and interfere with the action of the plough. Moreover, in such completely isolated situations there is an excessive tendency to ramification and coronal development. This not only diminishes the total quantity of useful timber produced, but also very materially affects the elasticity upon which the technical value of the bole mainly depends.

If grown upon purely economical principles, the proper position of the ash is that of a subordinate tree in woods consisting of a matrix of other trees of somewhat slower growth, and better able to protect the soil against deterioration. On hill-sides it may well be planted near small water-courses, whilst on good, but rather moist, low ground it can be grown remuneratively along with oak, elm, sycamore, and maple, or even with willows and alder, on land of a wet description. When associated with the oak on fresh soil, where they often greatly improve the growth of the woods, ash, sycamore, etc., should be cut out about the sixtieth to seventieth year, in order that under-planting may take place, unless a sufficiency of stools, stool-shoots, and other underwood obviates the usual necessity for this.

As a standard tree in copse, the ash finds conditions well suited to its essential requirements. Here it develops a much

better bole than in the open, and, with a free crown above the underwood, it soon thickens in girth, without interfering too much with the coppice by overshadowing. Even among the coppice it can throw out vigorous shoots, soon running up into good-sized poles; but the stools are apt to become soon exhausted, when they should be replenished freely. When grown on marshy land among alder coppice, it also forms a good standard, soon developing a valuable bole.

It is, perhaps, when thus grown as a standard over coppice, that ash attains its best development and its highest market value. Hence the remunerativeness of woodlands might be appreciably increased if stout, healthy, well-grown young ash plants were sprinkled judiciously through copse woods wherever the soil seems suitable for the growth of this very valuable tree.

X. *The late Mr Malcolm Dunn, Dalkeith.*

By W. MATTHEWS GILBERT, Edinburgh.

By the death of Mr Malcolm Dunn, Palace Gardens, Dalkeith, which took place suddenly and unexpectedly on the 11th May 1899, the Royal Scottish Arboricultural Society sustained one of the severest losses it has experienced for many years. For the Society, in which he was a member of long standing, and had been a vice-president and councillor, Mr Dunn had a warm regard. He had watched over its growth with anxious solicitude; he loved to spend himself in its service, and it is not too much to say that, more than most men in its membership, he helped to raise it to the high position which it now holds as an educational and social body in the land. By its members generally no one was better known or held in higher esteem, both for his own and his work's sake. The news of his death, sudden and swift as it was, came as a crushing blow to his many friends, and how numerous these were was abundantly testified by the large and representative gathering of arboriculturists, horticulturists, and gentlemen in every walk of life who were present in Dalkeith Cemetery on 13th May, when his remains were laid to rest in the grave.

Malcolm Dunn was born on 14th December 1837, in the parish of Methven, Perthshire, where his father, Alexander Dunn, was a farm grieve. Owing to changes of his father's household, Mr Dunn was educated both at Methven and in the old parish school of Crieff. Of these early days we have no record; but there is little doubt that he was a diligent and apt student, for he loved knowledge and sought it earnestly from his earliest to his latest years.

His school days were over in 1850, when, at the age of thirteen, he became an apprentice gardener at Strathallan Castle, under the late Mr Thomson. He was there for four years. During the next fifteen years he made several changes, always for the better, seeking fresh experience, and pushing to the front in a way which showed how sterling were the qualities he possessed as a man and a horticulturist. In 1856 he was at Spotsboro Hall, Yorkshire; about 1858 or 1860 he was at Trentham Gardens as foreman; subsequently he went to Eardiston Gardens, Tenbury, Worcestershire, to be head gardener. This establishment having been broken up, he next filled a responsible position in Veitch's Chelsea

Nurseries; and about the end of 1864 or early in 1865 he left there to take charge of the gardens at Powerscourt, Co. Wicklow, the seat of Lord Powerscourt. Of his connection with this famous Irish estate he was always justly proud, for during the six years he was there he took a large share in the laying out of the Powerscourt Gardens, which, as is well known, are very much admired by visitors to them.

On the resignation of the late Mr William Thomson, Mr Dunn was appointed chief gardener at Dalkeith Palace, and took up his work there on the 20th June 1871. This is one of the chief prizes of the gardening profession, and with what credit to himself, and zeal for his noble employer's interests, he filled this responsible position need not here be entered upon. He had a pride in his work, and what his hand found to do he did with his might.

But the daily duties of his vocation did not absorb all his untiring energies. He was a good Churchman and a keen politician, and, what is of particular interest in connection with this notice of his career, is the fact that he gave valuable time and labour on behalf of the horticultural, arboricultural, and other kindred societies in Edinburgh with which he was connected.

He became a member of the Royal Caledonian Horticultural Society in 1871, and in the same year he was elected a member of council, and continued so until 1877. He held similar office from 1882 to 1887, and from 1893 until his death. In 1886 Mr Dunn was unanimously awarded the Neill prize, which is bestowed by the council of the Royal Caledonian Horticultural Society every second or third year to "any distinguished Scottish botanist or cultivator." One condition attached to it is, that at least £10 of the amount shall be expended by the recipient on plate or books to bear a suitable inscription. With Mr Dunn's leanings to Pomology, it was not astonishing that he chose the best work, with coloured plates, that could be found on the subject.

In 1885 the council of the Royal Caledonian Horticultural Society resolved to hold a Special Exhibition of and Conference on Apples and Pears in connection with the Society's winter show in the Waverley Market on 25th and 26th November of that year, and this was a great success. Mr Dunn, on that occasion, acted as secretary to the jurors, and afterwards com-

piled a valuable report on the whole subject, which extends to 208 pages.

Pomology was, indeed, one of Mr Dunn's strongest points. He could pick out all the apples in a large collection and name each in turn, and fruit was sent to him from all parts of the country by people who desired to have it properly classified.

A plum congress was held in September 1889, and again Mr Dunn edited a report upon it, extending to 164 pages. These are not of the nature of ephemeral works, but have to gardeners a practical value at the present day.

During all the years he was connected with it, Mr Dunn was a leading man in the councils of the Royal Caledonian Horticultural Society, and the assistance he gave at the time of its spring, summer, and autumn exhibitions was of a liberal and invaluable kind. He was also one of the prime movers in procuring for this ancient Society a new charter, which has launched it afresh on what its friends hope will be a career of new usefulness.

In this connection reference might be made to Mr Dunn's successful treatment of the vine disease (*Phylloxera vastatrix*), which destroyed many of the vineyards in the south of France and other Continental countries, and also proved itself a plague in some of the vineries at home. Mr Dunn succeeded in destroying the insect, which passes the winter season on the roots of the vines, and his specially written paper for the *Practical Gardener*, edited by Mr James Anderson, was a valuable contribution to the literature on this important subject. Notice might also be taken of his "Statistics of the Conifers in the British Islands," which was reprinted from the *Journal of the Royal Horticultural Society*, vol. xiv.—Conifer Conference. It is for all foresters a most useful pamphlet.

Mr Dunn was also a founder and an enthusiastic supporter of the Scottish Horticultural Association, and in the promotion of the educational schemes of that body, and at its annual Chrysanthemum Show, he was ever to the front. He was also a member of the Edinburgh Botanical Society. In connection with this aspect of his career, the Regius Professor of Botany, Professor Bayley Balfour, says:—"Mr Malcolm Dunn's knowledge of the plants of cultivation was remarkable, and he knew them in the best of all ways, by the cultivation of them. At the same time, he had a ready store of book knowledge of their history. There was no one in Scotland to whom one could apply with more

confidence for information about such plants, whether of horticultural or arboricultural value. From his sympathy with science, and his unrivalled practical knowledge, he was a link keeping in touch two aspects of nature study, which, by men wanting his qualities, are sometimes voted as irreconcilable."

His connection with the Royal Scottish Arboricultural Society was also of a long and honourable character. He became a life member in 1867; he was on the council from 1875 to the date of his death, with the exception of one year, 1879; and he was a vice-president from 1883 to 1889, and again in 1899. He was one of the Essay Judges from 1881 to 1884, and again from 1897 to 1899; and he was on the *Transactions* Committee from 1888 to 1899. In all the affairs of the Society he took the deepest interest. He was an active promoter and member of committee of the successful Forestry Exhibition held in Edinburgh in 1884; he was a strenuous advocate of and a liberal subscriber to the movement for the establishment of a lectureship on forestry in the University of Edinburgh; and he was on deputations that sought to have that lectureship converted into a professorship, and an experimental or model forest area acquired by the Government—objects not yet attained. To recent schemes for the education of the working forester and gardener he gave a hearty support, and himself delivered a series of lectures on gardening to the men attending the Botanic Gardens. At the time of the institution of the educational scheme started there by Professor Bayley Balfour, Mr Dunn gave much help in the way of advice, which, from his wide experience, was of the most valuable kind.

Of the Royal Scottish Arboricultural Society, Mr Dunn, it may be said without any figure of speech, was for many years the life and soul, and had great influence with all classes of its members. This, added to his energy and determination, enabled him to carry through almost any scheme of the wisdom of which he had become convinced. Any sketch of Mr Dunn would be incomplete which did not refer to him as the chief organiser and as the leader of the annual excursions of the Arboricultural Society. These excursions came to him as a welcome break in the year's work. His holiday was timed to suit their convenience, he never missed them, and members coming from a distance were always sure of a kindly welcome from him. On such occasions his great know

ledge of plants and flowers and trees came into active play; he was constantly appealed to for the name of some rare flower or conifer, and seldom in vain, for his reading on his favourite subjects was wide and accurate, and his memory marvellously retentive, so that what he once knew seemed never to be forgotten. If anything ever troubled him in connection with these excursions, it was the inability, sometimes, of a section of the members to appreciate to the full the exacting daily programmes he set before them, lasting always from "morn to dewy eve." Himself an untiring walker, he had little sympathy with those who sought to shirk any item in the day's programme, and at such times he was wont to comment on the degeneracy of modern legs. Little failings that way were all, however, leanings to virtue's side, and everything he undertook was with a single eye to the good of the Society.

It may here be appropriately recalled, that at the annual meeting of the Society, held in January 1898, Mr Dunn was by acclamation elected an honorary member. In making the proposition, Professor Somerville 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."

One phase of Mr Dunn's character specially noteworthy, was his unselfishness and his willingness to consider and to help others, especially any young gardener he thought deserving of encouragement. Many men in different parts of the country, now in good positions, speak with gratitude of the kindly interest taken by Mr Dunn in their welfare when such was of great advantage to them. He spared himself no trouble to serve his friends, and even those who were not in that category received his best attention. Letters frequently came to him from all parts of the country—many of them from utter strangers—asking advice and information on horticultural and arboricultural matters, and he often sat far into the night looking up authorities, in order that there might be no mistake about the replies he gave to his numerous correspondents. Being unmarried, his work, his books, and his interest in the Arbori-

cultural and kindred societies took the place to him of wife and child.

The position he held in the Arboricultural Society was quite a unique one, and it is not likely that it can ever be filled in quite the same way again. For all that he did for the Society, for what he was as a friend, for his independence and integrity of character, honesty of purpose, and industry, activity, and energy as a worker, his name, by those who were his contemporaries, will long be held in kindly remembrance.

It only remains to add that shortly after his death, in response to an almost spontaneous expression of opinion, a fund was started to promote a memorial which should in some way be an acknowledgment of his services to arboriculture and horticulture.

XI. *The Annual Excursion in 1899 to Beaufort, Dunrobin, Dornoch, and Skibo.*

The Twenty-second Annual Excursion of the Society took place on Wednesday, 2nd, Thursday, 3rd, and Friday, 4th August 1899, to Beaufort (Inverness-shire), Dunrobin, Dornoch, and Skibo (Sutherlandshire). The President, the Earl of Mansfield, and Mr R. C. Munro Ferguson, M.P., Hon. Secretary, were of the company, which numbered in all over a hundred; and as the weather was of a favourable character, the Excursion was of a very successful nature.

The Station Hotel, Inverness, was the rendezvous, and thither the bulk of the members travelled from Edinburgh on Tuesday afternoon, after the general meeting. Next morning they proceeded to Beauly, where they were met by Lord Lovat and the Hon. Henry Fraser, Mr J. T. Garrioch, factor on the estate, Mr Daniel Dewar, wood manager, and other officials, and at once drove off for Beaufort Castle, which is situated in the midst of a beautiful country, charmingly wooded, and of great agricultural value. Lord Lovat, who had previously given an invitation to the Society to inspect the woodlands, laid the members still further under obligations by most kindly acting as leader for the day.

The grandfather of the present Lord Lovat—the Right Hon. Thomas Alexander Fraser, in whose person the title of baron was again revived—was a most intelligent and enthusiastic arboriculturist. During his long tenure of the estates, 10,000 acres were planted with Scots pine and larch, and by him also the system of natural regeneration, known then chiefly in India and the Continent, was introduced into the woods, and was practised with a success which is still the admiration of practical foresters.

For more than a quarter of a century the Lovat woods have been skilfully managed by Mr D. Dewar, now one of the oldest members of the Society; and it may be noted that during the last thirty-five years there have been some 2500 acres planted, and, with the exception of one wood, not less than 3000 trees have been set out per acre.

In preparing the programme for the day at Lovat, Mr Dewar, in conjunction with Lord Lovat, had in view to make the visit not only a pleasure for the moment, but also instructive and interesting to the members. In particular, he wished to have the

question of close planting and subsequent thinning, which has been occupying the serious attention of the foresters of the country for some time past, discussed in a practical manner. As is well known, opinions on these points have been undergoing considerable modifications in Scotland. Continental ideas on the subject of close planting and late thinning have been gaining ground. In Germany, where wood has for many years been grown on a thoroughly commercial basis, the trees are planted thickly, and allowed to grow as a dense thicket for twenty or twenty-five years before any thinning is commenced. This has the effect of pulling up the trees to a good height, with straight stems, preventing the formation of side branches of any size, and of thereby securing timber of good quality without knots. Hitherto in Britain, where woods are generally planted for protection or for game covers, the system has been to thin early, with the result that trees were grown well suited for railway sleepers or other rough uses, but not so well fitted for constructive purposes.

The woodlands first visited, therefore, by the party were the Cononbank Scots fir plantations. Part of the newer portion, containing about 130 acres, was planted with larch and Scots fir thirteen years ago, in ground which had formerly been rough pasture. The trees were two-year seedlings one year transplanted when set out at distances of from $3\frac{1}{2}$ to 4 feet apart, or at the rate of 3000 trees per acre. Rabbits and hares had nearly killed out the larch, but the Scots firs had thriven well, and were standing from 18 to 20 feet in height, and showing signs of vigorous growth. No thinning had yet been done. The other portion of the new wood, about 140 acres in extent, was planted in a similar manner seventeen years ago, on a light moorland soil. No thinnings had been made, and the trees were also exceedingly well grown.

Lord Lovat, and afterwards Mr Dewar, made short explanatory statements in regard to the plantations, his Lordship remarking that he meant to carry out Continental ideas regarding the management of these woods, and not do anything in the way of thinning for a good many years to come. Most of the members of the party, a good many of whom had been in Germany with the Excursion of 1895, concurred with Lord Lovat's view, Mr Munro Ferguson expressing the prevailing opinion that the woods should be let alone as long as the trees are healthy and able to clear themselves of the lower branches.

We give, by the courtesy of the proprietors of the *North British Agriculturist*, four photographs of the Lovat woods. No. 1 shows a part of Cononbank plantation. It is taken from the edge of one of the roads systematically laid out in all the Beaufort plantations.

No. 1.

No. 2.



No. 3.

No. 4.

An older adjoining portion of the Long Wood was traversed. In it the trees consist of Scots fir, seventy or eighty years old. Larches of the same age had recently been removed; and the firs are to be cut down, so that the whole area may be replanted. In

the home woods, passed in the course of the day, the larches and Scots firs were of stately dimensions and of much commercial value.

In the afternoon the party was entertained to luncheon by Lord Lovat at the high-lying farm of Achnacloich, from which a magnificent view of the surrounding country could be obtained; and thereafter an inspection was made of the plantation bearing the same name, which lies on a sunny slope at an altitude of 600 feet. This wood, 450 acres in extent, was planted thirty-four years ago, by Lord Thomas Lovat. It was explained by Mr Dewar that his Lordship, being of a practical turn of mind, thought that as the wood was such a distance from a railway or a shipping port, little or no revenue might be expected for early thinnings. He therefore resolved to plant thin, and thereby save the expense of labour. At first his Lordship was inclined to plant only 2000 trees to the acre, but it was finally settled that 2500 should be the number. The result was not unsatisfactory, as beyond the initial cost there had been little or no outlay. The wood, it was explained, had suffered greatly from squirrels, which were a pest on this part of the estate.

A short discussion, which was invited, took place regarding the state of the wood. It was generally agreed by the critics that the wood had been too thinly planted, and that its present not over flourishing state was largely due to that fact. Mr James Robertson, Panmure, threw out the suggestion that in any further treatment of the wood a couple of acres should be experimented on in the old British way, and that at the end of ten years it should be contrasted with the rest of the plantation to which German methods are being applied.

Photograph No. 2 is taken in a part of the Achnacloich plantation, where the density is about the average. It gives a fair idea of the appearance of this plantation.

Another point of interest in the afternoon's drive was Balblair Wood, which consists entirely of pine of grand quality. About 60 or 80 acres of it owed its existence entirely to natural regeneration. Old standard trees had been allowed to remain on the ground; and by preparing the land in the direction of the prevailing wind, the seed which fell when the cones opened found a congenial resting-place, took root, and grew. The seedlings, it was said, came up like a crop of grass, and though, owing to the poverty of the soil, the trees, which are of an average height of

30 feet, with clean, straight stems, are not so tall as some others of the same age, they are all very healthy. Twenty-five years ago, when Sir Dietrich Brandis, the late Inspector-General of Forests in India, visited the Lovat estates, he declared that the Balblair Wood was the best example of natural regeneration he had seen in this country. The system, owing to its somewhat haphazard nature, is not one that is now recommended to planters in this country; but it was exceedingly interesting to see on a large scale, as at Balblair, what, under favouring conditions, might be done with it.

Photograph No. 3 was taken from the edge of the drive through the Balblair Wood, and shows some of the younger trees; while No. 4 gives an idea of the appearance of some of the more mature timber in the same wood.

In the course of the day Beaufort Castle was visited, and there, in the open roof of the servants' hall, the party had an opportunity of seeing larch which had been grown on the estate put to use for constructive purposes. The central beam of the beautiful drawing-room is also of larch. The tree which furnished it, though only sixty-four years of age, contained 112 cubic feet of timber. The hall of the castle, built in 1882, is lined with home-grown oak of fine quality, and in the vicinity of the mansion-house several "original" larches, dating from 1738, are to be seen.

Mr David P. Laird, the convener of the Excursion Committee, proposed a vote of thanks to Lord Lovat, and remarked that they had had a most instructive day. He expressed satisfaction that they were to have Lord Lovat as a vice-president, and hoped they would long have his co-operation in forwarding the interests of forestry in Scotland. Lord Lovat, in reply, expressed the pleasure it had given him to see the Royal Scottish Arboricultural Society at Beaufort Castle, and he trusted they might come back again and see the results of the experiments they were now making. Cheers were given for his Lordship and for Mr Dewar.

DUNROBIN CASTLE.

Through the kindness of the Duke of Sutherland, Thursday, 3rd August, was most agreeably spent in inspecting the policies, home plantations, and gardens at Dunrobin Castle. The day was one of pleasure rather than of business, and under the guidance of Mr Donald Maclean, factor, Mr D. Robertson,

forester, and Mr D. Melville, gardener, a delightful forenoon was passed amid the beautiful surroundings of the stately northern home of the Duke and Duchess of Sutherland. One of the trees which attracted much notice was a Menzies fir (*Abies Menziesii*), one of a dozen ornamental trees planted sixty-five years ago, when the late duke was born. It is now between 80 and 90 feet in height, is finely clad, and at 5 feet up girthed 12 feet. It was considered by the company to be one of the handsomest and largest specimens of this variety of conifer in the country.

The Duke entertained the Society to lunch in the Drill Hall—Mr Maclean taking his place in the chair; and in the afternoon the company set out on a long drive, which took them through the Uppatt Woods and along the side of Loch Broro to Gordonbush, the return journey being by the town of Broro to Golspie. At Uppatt the party saw evidence of the great destruction of timber which took place on the Dunrobin estates by the gale of November 1893. By that blow-down not fewer than 150,000 trees, mostly larch and pine, were levelled with the ground, and thereby a great change was made on the face of the landscape. The timber has all been cleared away, but the roots still remain in the Uppatt Wood to tell the tale of the devastation. Another relic of the storm was to be seen in the state of the remaining Scots firs, which are overrun with beetles, which had bred in the fallen timber. How to get rid of them is a nice forestry problem. At Gordonbush the party had a run through the Kilcalmkill Wood, which was planted as far back as 1797 and 1798, and though Sutherlandshire is about the limit of tree growth in Scotland, the Scots firs on this hillside commanded universal admiration.

In the evening the Annual Excursion Dinner of the Society took place in the Drill Hall, Golspie, and was largely attended. The Earl of Mansfield presided, and several local guests were present. Toasts suitable to the occasion were proposed. The health of the Duke of Sutherland was duly honoured, and acknowledgment made to the estate officials for their kindness to the party during the day.

DORNOCH—SKIBO.

The third and last day of the Excursion also largely partook of the nature of a pleasure trip, though in the long drive undertaken

from Golspie to Dornoch, and from the pretty county town to Skibo and Bonar Bridge, there was much to interest both the arboricultural and agricultural members of the party. The road taken was by the Mound, Skibo Glen, and Balvraid Woods to Dornoch, where, having half an hour to spare, the members visited the cathedral and the famous golf links.

The party was entertained to luncheon in the Sutherland Arms by Mr Andrew Carnegie, and in front of that hotel a photographic group was taken, a copy of which has since been sent to each member of the Society attending the Excursion. Subsequently, at Skibo Castle, the company was cordially received by Mr and Mrs Carnegie, and served with tea on the lawn. There was no time, however, to visit the woodlands on the Skibo estate, which, it may be said, extend to about 5000 acres, chiefly of Scots fir and larch, and form a chief adornment of the northern shores of the Dornoch Firth. A photograph of the party, including Mr and Mrs Carnegie and their house party, was taken at the door of the Castle, and before leaving Mr and Mrs Carnegie were cordially thanked for their kindness. The most of the party returned the same evening to Inverness.

After dinner in the Station Hotel, Mr Michie, Her Majesty's forester, Balmoral, took occasion to refer to the death of Mr Dunn, Dalkeith, who had for so many years been the leader of their Excursions, and to say how much they had missed him. Votes of thanks were proposed by Mr Cook, factor, Arniston, to Mr David P. Laird, and to the secretary of the Society, Mr Robert Galloway, whose admirable arrangements for the convenience and comfort of the members and the success of the Excursion were heartily acknowledged. This terminated the official programme of the Excursion.

VISIT TO NOVAR.

Mr Munro Ferguson having given an open invitation to as many of the members as cared to do so to visit him at Novar on Saturday, a round dozen availed themselves of his kindness, and spent a profitable day among the woodlands there. The nurseries were inspected, the old larches and hardwoods at different parts of the estate admired, and the new woods were visited, where, as is well known, interesting experiments are being carried out for the purpose of testing various matters relative to planting,

thinning, and general management of woods on commercial lines.

At luncheon Mr Munro Ferguson threw out the hint that the Society should come on some future occasion and spend a week under canvas at Novar Woods, where there was plenty to see which would interest them.

Mr W. Mackenzie, forester, acted as guide to the party during the day, and his services were much appreciated.

The thanks of the company were proposed to Novar and Lady Helen Ferguson by Mr W. J. Stalker, Balmoral House, Nairn.

REPORTS BY THE HONORARY SCIENTISTS.

1. *Report on the Meteorology of Scotland for the Year ending 30th September 1899.* 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, as formerly, from the observations made twice daily at the sixty-seven stations reporting to the Scottish Meteorological Society. These observations, after being reduced and otherwise corrected by Dr Buchan, are published as an Appendix to the Quarterly Returns of the Registrar-General for Scotland. The monthly and other reports issued by the London Meteorological Office have also been utilised. It may be remarked that comparatively few of the stations are provided with sunshine recorders, so that the remarks on this element of climate are not based on such reliable data, as in the case of temperature and rainfall.

October 1898.—The weather of October was generally fair and dry till the middle of the month, but from the 14th to the 19th very heavy rains were experienced, unsettled weather prevailing until the close of the month. Temperature was exceptionally high in the north from the 2nd to the 6th, rising to $79^{\circ}8$ on the 3rd at Lairg, and to $78^{\circ}7$ at Dumfries. The mean temperature was $50^{\circ}1$, or $3^{\circ}7$ above the average, being the highest yet recorded by the Scottish Meteorological Society for any October. The highest mean temperature was $52^{\circ}0$, at Craigrannoch, Greenock, and Dumfries, and the lowest, $46^{\circ}4$ at Braemar. The general distribution was in close agreement with the normal, the excess being, if anything, a little higher at inland than at coast stations. The mean rainfall was slightly above the average, taking the country as a whole, but, as is usually the case, was distributed in a very irregular manner. The excess was very large at Haddington, Smeaton, and at Broomlands near Kelso. On the other hand, there was a considerable deficit in many districts, especially from Cape Wrath to Islay, where but half the normal quantity fell. Bright sunshine was below the average in

the east, but there was a marked excess in the north-west. The percentage of the possible varied from 43 at Stornoway to 14 at Glasgow.

November 1898.—Very rough and unsettled weather prevailed at the commencement of the month, especially in the west and north-west, but quieter conditions set in after the first few days. Towards the end of the month another spell of stormy weather was experienced, with frequent snowfalls from the 21st to the 29th. The mean temperature was $41^{\circ}\cdot7$, or $1^{\circ}\cdot1$ above the average, being highest, $44^{\circ}\cdot6$, at Airds, and lowest, $37^{\circ}\cdot6$, at Braemar. The excess of temperature was not so well marked in the north as in the south, but, taken generally, was distributed over the country with fair regularity. The high temperature of the month was wholly due to the mild conditions experienced during the first three weeks, as the last ten days were much colder than the normal. The mean rainfall was a third greater than the average, the excess being very general over the country. There was a slight deficit at some places in Shetland, Ross, Inverness, Argyll, Aberdeen, and in Galloway, but, on the other hand, nearly double the average was recorded at Stornoway, Cupar, Thurso, Stobo Castle, and North Esk Reservoir. Bright sunshine was mostly in excess of the average, the percentage of the total possible ranging from 24 at Aberdeen to 7 at Glasgow.

December 1898.—The weather of December was unusually mild, being the warmest recorded by the Scottish Meteorological Society since 1857. Very heavy rain was experienced over large tracts of the country, the fall being quite phenomenal at many places in the north-west, Fort William, for example, recording 23·20 inches, and Glencarron 21·65 inches. There was a rather decided deficit “to the east of a line from Haddo House, passing Perth, Loch Leven, Edinburgh, and Kelso,” the smallest rainfall being registered at Haddington, where but 1·03 inch fell. The mean temperature was $42^{\circ}\cdot6$, or $4^{\circ}\cdot8$ above the average, and varied from $46^{\circ}\cdot2$ at Lochbuie to $38^{\circ}\cdot8$ at Tillypronie. In the Hebrides, Orkney, and Shetland, the excess was but slight, scarcely exceeding a degree, but in inland situations south of the Grampians it was more than $6^{\circ}\cdot0$. Bright sunshine was very generally deficient, ranging from 20 per cent. of the total possible at Aberdeen to 5 per cent. at Fort Augustus.

January 1899.—The weather of January was extremely unsettled, with heavy rains, the precipitation at times taking the form of snow in the more northern districts. The mean tem-

perature was slightly below the average over the country generally, being above the normal in the south, but below the mean to the north of the Forth. The greatest cold was found in the vicinity of the Pentland Firth, where the deficit, as compared with the normal, amounted to two degrees. The highest mean temperature, $40^{\circ}6$, was recorded at Airds, in the county of Argyll, while the lowest, $31^{\circ}9$, was registered at the hill station of Braemar, 1114 feet above sea-level. Rainfall, taking the country as a whole, was 29 per cent. above the average, the distribution over the country being very irregular. The fall in Caithness was more than double the normal, but in the north-west there was a considerable deficiency. Bright sunshine was in fair accordance with the normal, the percentage of the possible ranging from 8 per cent. at Glasgow to 24 per cent. at Aberdeen.

February 1899.—During the first half of the month unsettled weather prevailed, especially in the western districts, where strong winds and heavy rains were reported. After the middle of the month more tranquil conditions were experienced, with hard frost in many localities. The mean temperature was $38^{\circ}5$, being the average, and was highest, $42^{\circ}6$, at Airds, and lowest, $34^{\circ}7$, at Braemar, showing a range of $7^{\circ}9$ in the means over the country. The distribution of the temperature was very unusual, being slightly below the average along the valley of the Caledonian Canal, and in the counties of Forfar, Perth, and Dumbarton. There was an excess in the vicinity of Peterhead, and at a few stations on the west coast. The rainfall was slightly under the average over the country generally. There was an excess in the counties of Forfar, Fife and Perth being greatest, 73 per cent. above the average at Lednathie. Less than a third of the normal fell over large areas, the greatest deficiency being 81 per cent. at Glencarron. Bright sunshine was in excess of the average, the greatest percentage of the possible, 34 per cent., being recorded at Marchmont, and the least, 14 per cent., at Glasgow.

March 1899.—During the first half of the month the weather was on the whole fair and settled, but thereafter inclement conditions set in, with cold northerly winds, severe frost, and heavy falls of snow. The mean temperature was $40^{\circ}2$, being nearly a degree in excess of the average, the highest being $42^{\circ}2$ at Leith, and the lowest, $36^{\circ}5$, at Braemar. Temperature was a little below the average in Shetland, but was very generally above the normal in

all other districts. Very cold weather was experienced during the week ending the 25th, the mean temperature over large areas being about or slightly under the freezing point. The lowest temperature recorded during this cold spell was $3^{\circ}0$ on the 24th at Braemar, and the next lowest, $7^{\circ}2$, at Lednathie. The mean rainfall was a quarter less than the normal, the deficit being most marked in the vicinity of Skye, and in the counties of Caithness, Aberdeen, Ayr, and Wigtown. On the other hand, there was a marked excess at many places on the west from Stornoway to Wigtown. Bright sunshine was in excess of the average, except in the north-west of Scotland, where there was an insignificant deficiency. The extremes were 36 per cent. of the total possible at Aberdeen and Braemar, and 19 per cent. at Fort Augustus.

April 1899.—The weather of April was characterised by frequent and heavy falls of rain, some showers of snow, sleet, and hail, and a few thunderstorms. Mean temperature was $1^{\circ}1$ below the average, the general distribution over the country approximating closely to the normal. The average varied from $45^{\circ}3$ at Paisley to $39^{\circ}3$ at Braemar. Rainfall was everywhere in excess of the average, the mean, taking the country generally, being 81 per cent. above the normal. The quantity collected varied from 11.21 inches at Lochbuie to 1.69 inch at Smeaton. The number of days with rain was conspicuously large, although no heavy falls in twenty-four hours were reported. Bright sunshine amounted to less than the average, and varied from 38 per cent. of the total at Deerness (Orkney Islands) to 23 per cent. at Glasgow.

May 1899.—Except for an unsettled period about the middle of the month, the weather of May was fine, although cold, with a very large excess of easterly and north-easterly winds. The mean temperature was $46^{\circ}3$, or $2^{\circ}7$ less than the average, being highest, $49^{\circ}2$, at Craigrannoch, and lowest, $42^{\circ}6$, at Tillypromie and North Esk Reservoir. The greatest cold was experienced in the eastern parts of the country, but in the west the values did not differ much from the normal. Rainfall was considerably above the average, the month being one of the wettest Mays since 1856. There was a general deficiency in the north-east and north-west of the country, but a great excess was recorded over the southern districts. Bright sunshine varied considerably in different parts of the country, but on the mean departed but little from the average. The greatest percentage of the possible,

44 per cent., was recorded at Stornoway; and the least, 29 per cent., at Fort Augustus.

June 1899.—Very fine and dry weather prevailed in June till about the 17th, when it broke up completely, remaining unsettled and showery till the close of the month. The mean temperature was $57^{\circ}\cdot4$, or $2^{\circ}\cdot6$ above the average, being highest, $60^{\circ}\cdot8$, at Dumfries, and lowest, $52^{\circ}\cdot2$, at Deerness. The month was a warm one in all districts, but the excess was more decided at inland than at coast stations. Rainfall was below the average, except in Galloway, the Outer Hebrides, Orkney, and Shetland, where there was a slight excess. Bright sunshine was mostly above the average in the east, but there was a slight deficiency in the west and north. The percentage ranged from 44 at Glasgow to 28 at Fort Augustus.

July 1899.—The weather of July was very changeable, with heavy falls of rain and frequent thunderstorms. The mean temperature was $59^{\circ}\cdot1$, or $2^{\circ}\cdot0$ above the average, and was highest, $62^{\circ}\cdot5$, at Dundee, and lowest, $55^{\circ}\cdot5$, at Benquhat. The general distribution over the country was in close agreement with the normal, but the average was exceeded in all districts. The warmth was most marked “to the south of a line drawn from Fraserburgh to Islay,” amounting to three degrees at some places, but in the Hebrides temperature was less than a degree above the average. There were considerable local variations in the amount of rainfall, the quantity collected being above the average at many places in the east and south. Less than the normal fell in the Hebrides, Galloway, East Lothian, Inverness, Kincardine, Forfar, and Caithness. Sunshine was slightly deficient, the percentage of the possible duration ranging from 29 at Marchmont to 17 at Fort Augustus and Fort William.

August 1899.—August was a phenomenally warm, dry month, anti-cyclonic weather predominating throughout. The mean temperature was $60^{\circ}\cdot1$, or $3^{\circ}\cdot5$ in excess of the normal, being the highest on record for August since the establishment of the Scottish Meteorological Society in 1855. The mean temperature varied from $63^{\circ}\cdot2$ at Dumfries to $55^{\circ}\cdot2$ at Deerness. The general distribution agreed closely with the normal, but the prevailing easterly winds brought about a much lower temperature on the north-east coast than was experienced on the west. The rainfall was below the average all over the country, many districts having only one-fifth of the normal. Until after the 25th, when

thunderstorms were recorded, hardly any rain fell. Bright sunshine was greatly in excess of the average, the highest percentage being 56 at Stornoway, and the lowest, 24, at Deerness.

September 1899.—The characteristic features of the weather of this month were a rather low mean temperature, heavy rainfall, and a deficiency of sunshine. The mean temperature was $51^{\circ}9$, or $0^{\circ}9$ under the average, Dundee being the warmest station, with a mean of $55^{\circ}1$, and Braemar the coldest, the average being $48^{\circ}1$. The cold was pretty evenly distributed over the country. The mean rainfall was 30 per cent. above the average, and the number of rainy days was singularly large, having been only once exceeded in this month, viz., in 1872. The rainfall was distributed in a very capricious manner, being more than double the average at places in Orkney, Caithness, and the Outer Hebrides, as much as 11.86 inches falling at Lochbuie. The normal was not greatly exceeded at places to the south of the Grampians, there being even a slight deficiency in the counties of Dumfries, Fife, and Kirkcudbright. Bright sunshine was very generally under the average.

Abstract of Meteorological Observations made at Sixty-seven Stations of the Scottish Meteorological Society for the Year ending 30th September 1899, 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 1898,	50.1	+3.7	4.42	+0.37	82	-14
November „	41.7	+1.1	5.05	+1.23	43	-13
December „	42.6	+4.8	6.07	+2.10	31	-14
January 1899,	36.6	-0.5	5.02	+1.12	43	-11
February „	38.5	+0.1	2.69	-0.37	76	+1
March „	40.2	+0.8	3.44	+0.74	107	-11
April „	43.0	-1.1	3.87	+1.73	115	-40
May „	46.3	-2.7	3.29	+1.01	176	-11
June „	57.4	+2.6	1.80	-0.68	188	-20
July „	59.1	+2.0	3.46	+0.29	140	-31
August „	60.1	+3.5	1.34	-2.29	203	+48
September „	51.9	-0.9	4.59	+1.05	109	-19
Year, . . .	47.3	+1.2	45.04	+6.30	1313	-135

2. *Report by* R. STEWART MACDOUGALL, M.A., D.Sc., Professor of Biology, New Veterinary College, Edinburgh, Honorary Consulting Entomologist.

Of the insects sent to me during the past year by members of the Society, only two could be described as great pests, namely, *Hylesinus palliatus* (Gyll.) and *Hylobius abietis* (Linn.).

HYLESINUS PALLIATUS.

If one were to judge by the mention, or rather the absence of mention, of this insect in our literature of forest insects, the decision would be that *palliatus* was of little or no importance to the forester. Even on the Continent, where *palliatus* and its work are well known, the tendency is to minimise the importance of the pest, and to treat it as of only secondary interest. From my observations of this insect, and from what I have seen of its work in the north-east of Scotland, I am convinced that it plays a far more important part as a destroyer in our country than so far has been suspected. I have more than a suspicion, too, that that scourge of our pine woods, *Hylesinus piniperda*, is confused with *H. palliatus*, and that in spite of the differences of the two beetles in appearance and in work, some of our foresters credit *piniperda* not only with its own misdeeds, but those of *palliatus* as well.

Hylesinus palliatus is a small beetle, measuring about an eighth of an inch in length. The head and edges of the wing-covers are brown-black or black, while the upper surface of the thorax and wing-covers is brown-red. If the thorax, which is broader than long, and is markedly narrowed in front, be examined with a lens, a number of punctures will be seen, and also a smooth raised line running down its middle. The wing-covers are traversed by fine longitudinal lines, the spaces between which show a number of little knobs and rows of fine hairs.

The curled yellowish grubs are legless, and have brown heads and biting jaws.

The grubs infest grown conifers like the pine, spruce, larch (from all of which, in Scotland, I have bred the beetles in scores), and silver fir. One reason, I think, why *palliatus* is not considered of first importance, is that the beetle is modest in its demands for a breeding-place, not calling for fresh material. That the beetles breed willingly in trunks that have been felled

for a considerable time is true enough, and in my experiments with *palliatu*s I have found the newly issued imagines making their tunnels and laying their eggs in the very same piece of stem in which they themselves had been bred, although this had been dead for long. At the same time, in another experiment, where I placed *palliatu*s on freshly-felled healthy pine, kindly sent to me for the purpose by Mr Mackenzie of Mortonhall, the beetles bred and gave rise to a new generation.

The adult females set about egg-laying in March, or, in a late spring, in April. Having bored into the bark, the adults make a main gallery, which runs longitudinally. The tunnel, when finished, is from one and half to over two inches long, and is somewhat bent; at its beginning it is shaped like a crutch or a boot. When this tunnel is being made, both the male and the female beetle are to be found in it. Along the sides of the tunnel eggs are laid in little hollowed out pits, and the grubs, when hatched, eat out galleries which at first are at right angles to the mother-tunnel, but later run longitudinally or irregularly, while they often cross one another and interlace. The full-fed grub pupates in a little bed, which may be hollowed out either in the alburnum or in the bark. The ripe beetles eat their way to the outside, their flight-holes showing as if the stem had been riddled with small shot.

There are two generations in the year. In my experiments the April beetles gave rise to a new generation which appeared in the beginning of July. Some of this brood I placed on fresh material from July 14th to July 19th, with the result that new beetles issued towards the end of October. The length of one cycle, that is from one egg-laying till the issue of a new brood, varies according to the weather from less than three months to over three months. Should late autumn or winter, however, overtake *palliatu*s while still in the grub condition, the length of the cycle will be considerably increased, as during the winter months the grubs make little or no progress, but remain in a condition of hibernation.

The best method of fighting against *palliatu*s is to prepare a series of trap stems, beginning in March and continuing up till October. In 1898 I first got the beetles early in April, and every month thereafter up to and including October. The traps which *palliatu*s will make use of to breed in should be examined and destroyed, with the enclosed brood, at intervals, say, of not more than six weeks from the time of preparation. Mr John

Clark, Kelly-Methlick, has warred against *palliatu*s in this way, and with extremely satisfactory result.

HYLOBIUS ABIETIS, L.—THE LARGE PINE WEEVIL.

This beetle, one of the very worst enemies of the forester in Scotland, does its harm in the adult stage, not, as with many other forest pests, during its larval life. The adult weevils attack plantations or nurseries of young conifers, principally spruce and larch and pine, sometimes also feeding off young broad-leaved species which may be mixed with the conifers. The beetle does its worst work on plants of from two to five or six years of age by gnawing patches of bark out of them right into the cambium, so that acres and acres of young plants may be destroyed. The beetle is half an inch long. It is black or deep brown in colour, with yellow scales or hairs on various parts of the body; in the old beetles these scales may have been rubbed off. There is a well-marked proboscis.

I have known *H. abietis* to be confused with *Pissodes pini*, not so much in mode of work, for *P. pini* is most harmful as grub, but in appearance. The two pests may be distinguished thus:—

Hylobius abietis.

Femur of all the six legs with a marked spine or tooth.
Antennæ inserted on the proboscis, near its apex.
Larger.

Pissodes pini.

No spine or tooth on the femur.
Antennæ inserted about the middle of the proboscis.
Smaller.

Hylobius abietis chooses as its favourite place of egg-laying the roots of the stumps of felled conifers. From the eggs, laid singly, hatch yellowish legless grubs, which make long galleries in the cambial region. When full grown, the grubs hollow out a well-marked bed in the wood, and here, covered by a quantity of sawdust and woodchips, they lie, and pass into the pupal condition.

The adult beetles have a long life, extending to two years and more, it may be. The egg-laying of the individual is not confined to a limited period, but may be partly performed in one year, and after the winter's hibernation may be resumed.

The beetles may be found from April onwards. The first eggs of the year are laid by the adults, whose egg-laying, begun in the previous year, had been interrupted by the intervention of winter, and by other beetles which had issued in the previous year, but

too late to have ripened their sexual organs before the winter's hibernation. Later on these will be joined by other beetles, which will issue in the summer. Thus eggs, young larvæ, fuller grown larvæ, pupæ, young beetles and old beetles, may all be got at the same time.

Preventive and Remedial Measures.—Destroy the breeding-places, if possible, by removal of stumps after felling. When it is possible (and often it will not be) to grub up these they can first be left for a time to serve as traps for egg-laying, so that when grubbed up for destruction they will contain the brood.

Sometimes pieces of fresh pine or spruce are laid a little below the surface in marked places. *Hylobius* visits these and uses them for egg-laying.

A clean area may be protected by a steep-sided, narrow trench 10 to 12 inches deep. The beetles tumble into the trench, where they can be destroyed or collected from branches which have been strewed about the trench.

An excellent plan for trapping is to lay here and there, in infested places, pieces of freshly-stripped pine or spruce bark with the under surface downwards. These traps must be regularly visited and the "catch" destroyed; the beetles collect on the under surface. I have caught hundreds of pine weevils thus.

Wherever traps are used, or generally in proceeding against *Hylobius*, it should never be forgotten that it is of the utmost importance to proceed against the pest in its breeding-places, and not wait till the beetles have started to feed on the young plants. Traps here and there among the young growth are of course not without value, but the beetles trapped or collected in such circumstances will have done some harm, and, moreover, will be such as are likely to have already proceeded to reproduction, and to have accomplished some of their egg-laying.

From the life-history of *Hylobius*, seeing that stumps are the favourite breeding-places, and young plants the food of the adults, the forester will appreciate the importance of avoiding, as far as possible, a practice which would mean the having side by side recently felled and newly planted areas.

Among other interesting specimens received, I may mention a number of the galls of *Retinia resinella* from Colonel Bailey; as also, from Mr John D. Crozier, Durris, some spruce cones showing attack by the caterpillars of the tiny moth, *Phycis abietella*.

TRANSACTIONS

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ROBERT GALLOWAY, S.S.C.,
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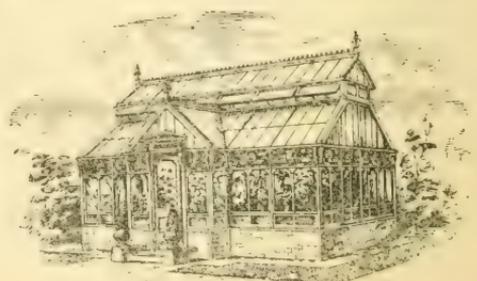
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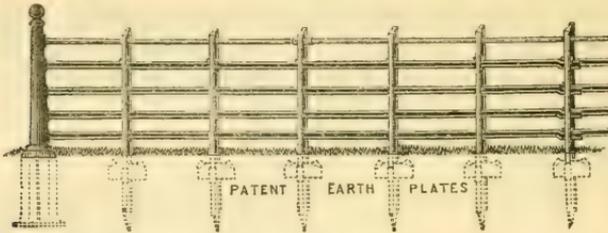
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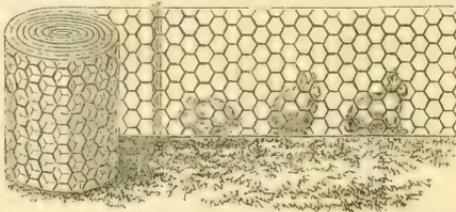
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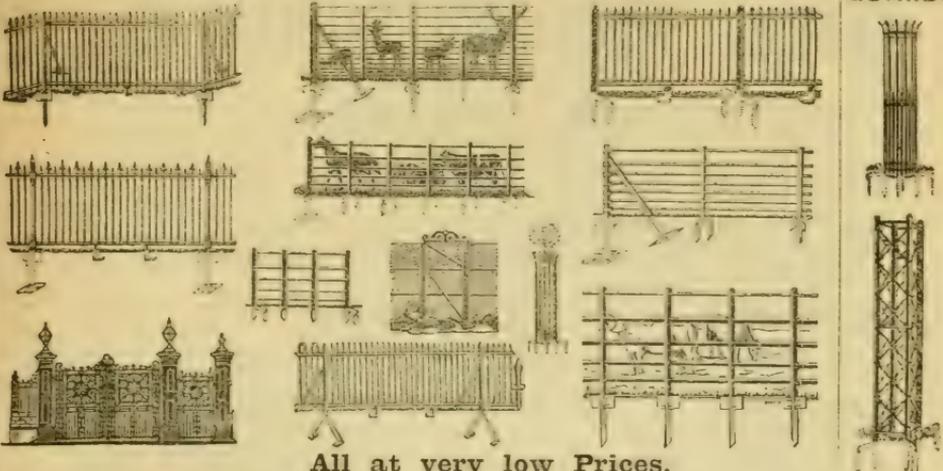
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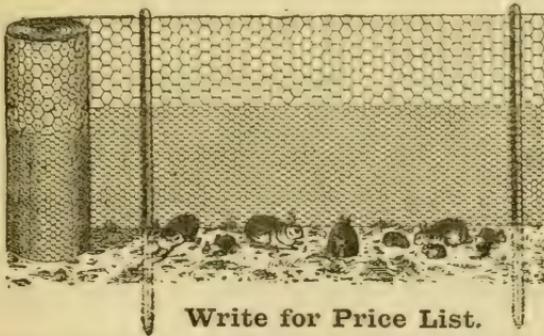
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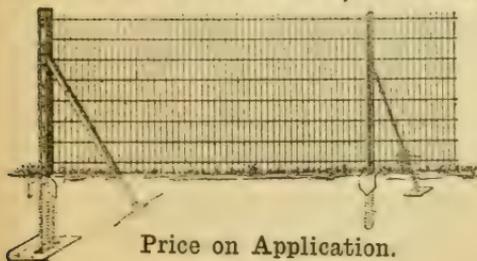
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LIST OF MEMBERS, corrected to December 1900.

PROCEEDINGS OF THE ROYAL SCOTTISH ARBORICULTURAL SOCIETY.

Special Notices to Members.

HONORARY SCIENTISTS.

THE names and addresses of the Society's Honorary Scientists will be found on page 10 of the *Proceedings* appended to this Part.

Members desirous of obtaining scientific information upon subjects connected with Forestry should write direct to the gentleman whom they desire to consult, sending full particulars regarding the subject of their inquiry, accompanied, if possible, by 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 the question. The replies sent to Members by the Honorary Scientists will, if of sufficient interest, be published in the *Transactions* of the Society.

THE READING OF PAPERS.

Members are invited to read short papers on any subject connected with Practical Forestry at the Annual Meeting in January, or at the General Meeting to be held at the time of the Excursion. Members who may desire to do this are requested to intimate the title of their subject, in writing, to the Secretary, not later than 1st January or 1st June 1901, and to state the time they require for reading the paper.

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The Council begs to draw special attention to this Fund, the object of which is to defray the expense of illustrating the Society's *Transactions*.

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The Council wishes it to be known that the Society has an Album of Photographs of Members, and that the Secretary will be glad to receive contributions.

NEW MEMBERS.

The Council has 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 Member 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.

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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:—

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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.

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XII. Every Proposal for Membership shall be made on the FORM provided for the purpose, which must be signed by two Members of the Society as Proposer and Seconder, and delivered to the Secretary to be laid before the next meeting of the Council. The Proposal shall lie on the table till the following meeting of the Council, when it shall be accepted or otherwise dealt with, as the Council may deem best in the interests of the Society. The Proposer and Seconder shall be responsible for payment of the new Member's first Subscription,



THE ROYAL SCOTTISH ARBORICULTURAL SOCIETY AT BARONSCOURT, 9TH AUGUST 1900.

TRANSACTIONS

OF THE

ROYAL SCOTTISH ARBORICULTURAL SOCIETY.

XII. *Address delivered at the Forty-seventh Annual Meeting of the Society, 31st January 1900.* By the Right Hon. the EARL OF MANSFIELD, President of the Society.

There is no doubt that the Annual Excursion of the Society is not the chief end of the Society's endeavours. The word Arboricultural is a word of much power and space, but I have often wished that we could have had a more British sounding word that would have been nearer akin to the word Forestry. However, in the scope of our Society's operations lie all matters appertaining to Forestry in general; and I think it is advisable that each topic which concerns our Scottish Forestry and Foresters generally, should in turn be brought before the members at their annual meeting. I trust, therefore, that I may not be thought to be overstepping the bounds of our special concerns as a Society, ever ready to receive and give instruction, when I mention the topic to which, with your kind permission, I wish to direct your attention to-day. I confess, while the study of all things in Nature is most interesting, the study of mankind, either in groups or as single individuals, is to me infinitely more so; and as in this life the operations carried on to sustain, and even sometimes to improve, what Nature has already prepared or given, have to be performed by men, it is necessary to study the successive stages of educational results and common practice that will be the means of achieving such a performance.

The subject, therefore, of my address to you to-day is "The Practical Training of Foresters." I must apologise to so many here who may say, and say rightly, that they know a great deal more about this matter than I do, and my excuse must be to give an opportunity of ventilating the subject through the medium of our

Transactions and the kindly pages of the press; and to, perchance, elicit the opinions of others, whom I know to be far more at home in the subject than I can possibly be.

To begin with: I venture to state that it is not general at present throughout the country to discriminate between the young man who desires to become a capable and efficient Forester, and the equally necessary and useful youth who is never likely to be, or desires to be, more than an estate labourer. Don't imagine, gentlemen that I am depreciating the latter, but I conceive the Society has a direct interest in the former.

The result of the before-mentioned want of discrimination is that young men get somewhat disheartened, and lose the enthusiasm in their work which is necessary to ultimate success in their profession. In many country districts there is no access to libraries, or even much opportunity of an interchange of opinion with fellow-craftsmen. Thus a young man who has some ambition about him is entirely dependent on the assistance he may obtain from his superiors—the head forester or his foreman—which, I fear, in many cases is not very willingly given, not deliberately, I dare say, but from inattention.

Now, I wish to advocate the system adopted by the gardening profession to hold good equally with foresters. When a young man be engaged, let him be engaged for three years certain, at a yearly increasing wage, with the distinct agreement that he, the apprentice, for so he virtually should be, is to receive a regular course of instruction in the different departments of work carried on on the estate. Let it be understood that, should he not be kept on as a journeyman at the end of his time, his superiors shall use their influence to secure for him a journeyman's situation elsewhere. Let him be entitled to receive a certificate stating that he has undergone an apprenticeship training. For such an apprenticeship training I should recommend that, on a large estate, a lad should be employed, *during his first year*, in the home nursery, so as to make himself familiar with the different varieties of trees—their propagation and general treatment. He would probably thus acquire taste and neatness of work, obedience to orders, general regular habits, and punctuality.

For the second year's work he should be instructed in the formation and protection of plantations and their management, including fencing, hedges' treatment, and rough carpentering, and, perhaps, road-making and bridging.

For the third year he should learn something of the felling and management of timber—the valuing of standing trees—the lotting and valuing of fallen timber—the working and management of saw-mills. I have not mentioned the practical and indispensable knowledge of how to use an axe and a spade, but such undoubtedly would form an early portion of an apprentice's curriculum.

A man could obtain as a journeyman forester, practice in any special duty that had been missed, or could not be acquired on the estate where he had been trained as an apprentice. Should an apprentice elect and be considered fit to remain on as a journeyman in the same service, there can be little doubt that the advantage to young apprentices succeeding him would be not inconsiderable. I would pass on briefly to the existing general system as to how young foresters are lodged. It is the reverse of common to find foresters accommodated in a bothy or lodge, as are most gardeners. They have, as a rule, to find themselves lodgings, where they are isolated, have no one beside them with the same tastes and interests, and besides, are often not very comfortable, and, may be, not extra well fed.

I press the advantages of a lodge for young unmarried foresters on all who may be able to afford them one. Why should they not be lodged as well as gardeners? Self-culture, and the companionship of their fellows on many a long evening, would be the result; and I think such should ever be encouraged by the foreman and head forester, not to speak of the factor and the laird.

Another branch of a forester's training might sometimes be encouraged. On many small estates there is an overseer of the woods, who likewise has charge of the home farm. It often may happen that the occupant of such a post is *only* a farmer or *only* a forester. Among the ranks of young foresters there would be found, I believe, many young men who would be most anxious to acquire some slight knowledge of agriculture. Why should some system of affording them instruction in this subject not be arranged? I think it would be popular with the young men, would not present any great difficulty, and would be of future advantage to the ranks of certain masters and servants throughout the country.

I believe that there is often a considerable difficulty both in obtaining good men for situations and in men finding such for themselves. It has occurred to me that here is an opportunity for

this Society to show another practical reason for its existence. It would give the Society great strength in the land, were it in a position to be looked upon as a Central Registry Office, where foresters are concerned, and more especially such men as are members of it. I should be reluctant to impose heavier duties on our worthy Secretary and the Council generally than they have already, but in this matter great assistance could be obtained from the various local secretaries throughout the country, and, if desirable, a small registration fee could be charged to defray expenses. It would be of benefit to men to possess, as it would be to employers to get men possessing, the *imprimatur* of the Society.

Gentlemen, the object of these few remarks, rather hastily put together, I trust you will accept as an expression of a desire to improve generally the position and standing of Foresters throughout Scotland. There is need, we know, of it being dinned into the public mind that Foresters are men belonging to an independent profession, and not merely cutters of wood and diggers of drains. Where, I ask, should such an attempt be made but before this Society? There may yet come a time when a Forestry Section may perforce be included in all exhibitions, standing by itself and not tacked on to some other department.

But let me say that it largely rests with this Society so to act in all its dealings with this great subject as to enhance the position of Forestry, and Foresters of all descriptions, throughout this kingdom and even elsewhere beyond it.

XIII. *British Forestry and its Future Prospects.*

By JOHN NISBET, D.CEc.

Forestry is a subject which has hitherto in Britain been accustomed to receive at best but intermittent, more or less periodic, and altogether rather spasmodic attention. It is certainly one of the greatest merits of our Society that it has shown itself the only body which has all along known what it wanted, and which has availed itself of every reasonable opportunity in advocating the claims of Forestry to receive much more of national encouragement than it has yet obtained. Ever since the Society's formation, the claims of Arboriculture have been championed by it, as by no other body; and it has during the last twenty years or so taken the foremost part in recognising the importance of Sylviculture, and in helping to diffuse a knowledge of Economic Forestry, or the application of scientific and business principles to the cultivation of woods, treated as crops of timber, and not merely regarded as so many trees growing side by side.

As far back as three centuries ago the demands made on the British oak forests were heavy, for in those days we grew our own supplies of timber for building the ships required for commercial purposes and for constructing the navy, necessary for the protection of our seaports. With miserable communications by land, it can easily be understood that shrinkage in the supply of oak timber within easy reach of the naval and other ship-building yards at an early date caused apprehension to those in authority. Though the cultivation of trees and woodlands took place as early as the reign of Edward IV., four and a half centuries ago, though plantations of trees were made for purposes of utility during the reign of Henry VIII., and though James I. issued instructions on the subject more than once in the shape of statutes in Scotland ordering planting, and of royal proclamations in England ordering the retention of oak standards in copsewoods, yet his successor on the throne, Charles I., contributed largely to the destruction of the natural woodlands through alienating portions of the royal forests by sale and by grant to his favourites and leading courtiers. Then, later on, the effects of the Civil War and of Cromwell's expansive agricultural policy both acted very directly in hastening the further destruction and disappearance of the still remaining forests.

Hence it came that, at the time of the Restoration, Britain

was already threatened by a scarcity of oak timber for supplying the requirements of the naval and mercantile dockyards. The outlook was indeed so serious that, early in the reign of Charles II., John Evelyn, one of the strongest pillars of the newly founded Royal Society of London, and a recognised authority on matters connected with rural economy, was asked to stimulate interest in the subject. Thus originated that charming work, "*Sylva, or a Discourse of Forest Trees*," the great classic of British forestry, which was read to the Society on 15th October 1662, and was the first book printed by its order. So much appreciated was this fine specimen of English literature, that it went through nine editions in one hundred and fifty years, which is probably the record for these days. At that time, Britain was certainly ahead of any Continental country with regard to forestry. Germany, now the home of scientific forestry, had not as yet even dreamed of the possibilities of national wealth lying dormant in her forests, then chiefly used as hunting grounds.

The influence of Evelyn's teaching had the good effect of encouraging the formation of plantations, because the growth of timber urgently required for home consumption was not hampered and discouraged by any rating on woodlands. The strain on the oak forests, however, was not only continued, but even became enhanced as the demands for timber rose, and had to be satisfied at all cost. From 1608 to 1707 the number of loads of timber in the New Forest suitable for naval purposes sank from 197,405 to 19,873 (Percival Lewis, "*Historical Inquiries Concerning Forests and Forest Laws*," 1811, p. 121). The stock of mature timber rose again in 1764, a century after Evelyn's exhortations had stimulated planting, but by 1783 it had fallen lower than ever. To encourage the planting of trees, the Society of Arts in London, between 1775 and 1781, presented twenty-two gold medals and other prizes to landed proprietors in various parts of the country. During the great period of naval warfare about a century ago, the necessities of the Royal dockyards were partially relieved by the importation of teak-wood from Bombay. This was the commencement of the great trade in teak timber with East India, which has developed to such an extent that it now forms one of the staples of Burma, the value of the exports from Rangoon and Moulmein having amounted to £1,590,598 in value during 1897-98. Nowadays, the want of oak for the British navy and mercantile fleet is

absolutely unfelt, because vessels are mainly built of iron or steel, lined with teak-wood.

In other respects, also, improved communication by land and water has throughout the whole of the last century enabled the British Isles to satisfy, at reasonable cost, all their requirements in timber. The streets of London are paved with Australian hardwoods, and it is only the fact of a margin of profit not yet being obtainable for the fine hardwoods which the vast forest wealth of Burma can easily supply on a large scale that has hitherto prevented them from being introduced commercially to the notice of the British timber market. With regard to these particular classes of hardwoods, neither the present nor the future condition of the forests in Britain will exert much influence on the market demand for them; and, as the prices they can command gradually enhance, it is probable that larger supplies, not yet remunerative, will become available than have hitherto been placed upon the British market.

With regard to light timber required for constructive purposes, and consisting mostly of pines and firs, however, the case is very different. Out of total imports of timber and other tree-produce amounting to £25,377,684 in value during 1899, Britain spent about £18,000,000 for coniferous wood alone (in addition to paying for labour on it), which could easily and profitably be grown in different parts of the British Isles. The sources from which these large requirements are supplied are the Baltic countries and Canada. Out of total imports amounting to 10,302,803 loads, the Baltic and Scandinavia supplied us in 1899 with 5,626,863 loads of pine and fir (valued at £12,450,763), or considerably more than one-half; while Canada sent us direct only 1,866,247 loads (valued at £4,752,919), or not much more than one-sixth of the year's imports. And just note how the timber imports have increased both in quantity and in value during the last seven to nine years:—

Class of Timber.	Average Imports for the 3 years, 1890, 1891, and 1892.		Imports for 1899.		Excess of 1899 over average of 7 to 9 years ago.	
	Loads.	£	Loads.	£	Loads.	£
Hewn,	2,333,030	4,806,396	2,667,049	5,327,292	334,019	520,896
Sawn, etc., }	4,750,358	10,550,723	6,635,754	16,201,172	1,885,396	5,650,449
Total,	7,083,388	15,357,119	9,302,803	21,528,464	2,219,415	6,171,345

From these statistics, it appears that the hewn timber has not changed appreciably in value (about £2 per load), but it is notorious that the quality of the pine logs has gone down ; while the sawn timber, etc., has increased in value from £2, 4s. 6d. to £2, 8s. 6d. a load, *an increase of 9 per cent.* And this I hold to be only the commencement of a permanent rise in the price of timber imported.

These two great natural sources of supply of coniferous timber are now, however, being operated upon by economic factors, differing essentially from those which have obtained in the past. Britain still receives the lion's share of the Canadian timber, as well as of the Baltic wood ; but the commercial energy and the rapid industrial development of the United States of America and of Germany, our great commercial rivals, will probably in the immediate future affect the selling prices of the Canadian and the Baltic timber to such an extent as must increase considerably the cost of placing it on the British market. There may not be any absolute scarcity of wood, because one and a quarter million square miles, or 37 per cent. of the total area, of Canada is under forest ; but the enhancement in the local market value of Canadian timber will, of course, render profitable the working of the backwoods, in which lumbering operations have hitherto not been considered likely to be remunerative.

As regards the Baltic supplies, Germany is already competing with Britain for a portion of them ; and there are good reasons for believing that her demands on Norway, Sweden, and Russia for forest produce, in the shape of timber and of wood-pulp, must increase very largely within the next few years. The United States of America, with an annual consumption of wood estimated at over 20,000 million cubic feet, which has been hitherto mainly supplied by the rough exploitation of the forest resources of the country, have by reckless waste, through fires and otherwise, now reduced their natural forest wealth to such a condition, that rational management of the remaining woodlands has become imperative. To supplement their own supplies of forest produce, the United States already have to depend largely on Canada ; and in a few years' time they will be dependent on Canada for their main supplies of wood-pulp, in addition to the timber that will be required in ever increasing quantities as the produce of their own forests diminishes.

The total value of the wood converted into logs, timber, wood-

pulp, and paper in Canada amounts to about £16,000,000 a year. The exports of wood products, chiefly from Quebec and Ontario, amounted in the year ending 30th June 1898 to 27,000,000 dollars in value. Of these, about 15 $\frac{2}{3}$ millions came direct to Britain, while about 9 $\frac{1}{3}$ millions went to the United States.

Unfortunately, no adequate steps have yet been taken by the Canadian Government for the proper conservation and the business-like management of her vast forest resources. But, under any circumstances, the timber she is able to place upon the market in great quantities is soon likely to be driven up in local value by the growing necessities of the United States and the competition of Britain.

Interesting details with regard to the forest industry of Canada will be found in an article on "Canadian Trade with Great Britain," in the *Contemporary Review* for January 1900 (pp. 86, 87); but an article on "Canada and the United States," which appeared in the *Times* of 17th March 1899, describes the position of affairs so well that I venture to quote the following extract from it:—

"Canada possesses in great quantity certain raw materials which are essential to the maintenance of some important American industries. Among these, none are more important than timber. It is a fact that, in the Northern Hemisphere, Canada is rapidly becoming the only country which can afford to export timber. The other countries which possess it in excess of their manufacturing requirements are Russia, Norway, and Sweden. It is a topographical peculiarity of the Russian Empire, that the rivers traversing the principal timber districts flow into the Arctic Ocean. They are, therefore, useless for the purpose of floating out logs to the markets of the world; and, so far, no method of land transport has ever been devised which will carry timber for long distances cheaply enough to bring it into practical competition with water-carried logs. The forests of Russia may for the present be regarded as commercially inaccessible. Norway and Sweden, which do export timber, are hardly able to supply the deficiency of Germany. All other nations requiring timber of the sorts grown in the Northern Hemisphere, must look to Canada for their supply.

"First among these nations will soon rank the United States. It is fully recognised that, owing to the depletion of the forests of the Northern States, the timber supply of the United States

for all ordinary purposes of building and manufacture will not last more than a very limited number of years. The American supply of spruce for pulp-wood will fall far below present requirements in five or six years, and within ten years, assuming the present rate of manufacture to remain unchanged, will be entirely exhausted. This being the case, the United States must evidently, within a very short period, look to outside supplies for the raw material upon which many of her most important industries are based. When it is considered to how many of these a full supply of timber is an essential condition of existence, it will be seen that there is little exaggeration in the statements commonly made by the far-sighted Canadian lumber-man, that the position hitherto held by cotton in the markets of the world is as nothing compared with that which timber is destined within a few years to occupy. The extraordinary development of the single manufacture of wood-pulp, which only a few years ago was practically unknown, and is now used not only for making paper, but for clothing and an immense diversity of other articles, is a sufficient indication of the practically limitless extension of the already widely varied uses of timber. 'Cotton,' it is said on the other side of the Atlantic, 'was once called king; but King Cotton is a lesser potentate than King Timber must soon become.'

When one considers these circumstances, it seems impossible to arrive at any other conclusion than that the days of cheap timber in Britain are now almost at an end, and that the next few years must see a rise in price; and this enhancement will be permanent and progressive. The demands for timber exceed, in the rapidity of their expansion, the power of substitutes to replace them, because new industries develop, requiring wood as their raw material. The greatest example of this is, perhaps, the wood-pulp business in its various branches. So far as home-grown timber is concerned, Britain would be quite unable to supply the existing requirements of the building and other constructive trades, if by any chance the command of the seas was interrupted for a short space of time. Even if the three million acres of woodlands in the British Isles were trebled in extent, were in a fully-stocked condition, and were being managed on purely economic principles, they would only just supply our existing requirements in timber for constructive purposes; while other three million acres might perhaps also be required to provide for normal

expansion of the present demands, and for the growth of wood to meet some of the special requirements of the wood-pulp industry and its various developments.

You may perhaps think that I am rather wasting your time by trying to press, apparently with unnecessary detail, these points on your attention. On various occasions some six or seven years ago—in fact, I may say, on every possible occasion when I was last in England—I tried to draw public attention to the appreciation which must very soon set in, and which has now already begun to make its influence felt with regard to the market value of timber. And many others have been fellow-workers in this same wide field. Until, however, the general public, the landowners, and the State realise the importance of the matter, I do not think we can expect much improvement in the existing condition of Forestry throughout Britain.

The timber-consuming trades and the nation at large may perhaps feel tempted to say, "We have heard this cry of 'Wolf, wolf!' so often in the past, that it really does not alarm us now in the very least degree." Well, just let us examine these different cases. A century ago the failure in the supply of oak was met by the importation of teak-wood from India, and the imports have gone on steadily increasing. Somewhat later on, a timber famine seemed to be imminent. It was bewailed and advised on by Sir Walter Scott in his celebrated articles on Forestry in the *Quarterly Review*; and later on it was warned against by the anonymous author of an excellent treatise on "Planting," published in 1832 by the Society for the Diffusion of Useful Knowledge, a little work really far in advance of the contemporary knowledge of Forestry. But it was averted through the great revolution accomplished by steam communication on land and ocean. Railways and steamships saved Britain from what must otherwise have been the disastrous effects of the clearance of the forests to such an extent that only 3·8 per cent. of the total area remains under woodlands. The causes that are now in operation, however, are such as must inevitably cause a rise in the price of timber, because the requirements in timber of the three greatest purchasers of foreign wood—Britain, Germany, and the United States—can only be adequately met in the future by working fresh tracts which have not hitherto been workable at a profit; and the working of such tracts can only now become remunerative by enhancement in the price of timber. This rise in price

must naturally enhance the local value of home-grown wood, and those landowners will reap the greatest advantages whose timber crops are best suited for the market.

And now, what is the present condition of our three million acres of British woodlands? No better answer can be given to this question than the following quotation from an article on "Woodlands," by Sir Herbert Maxwell, which appeared in the *Nineteenth Century* for July 1891:—

"One chief hindrance to our woodlands being remunerative may be stated at once: we are arboriculturists and sportsmen, not foresters. A large proportion of the land returned as woodland is really pleasure-ground and game-cover. Thousands of landowners follow on a smaller scale the example set by the State on a larger in the New Forest and Windsor Forest."

This is a true indictment, though fortunately there are, at any rate, some among the Scottish woodlands which certainly cannot correctly be included in such a category. But, even in cases where plantations have been formed with the view of growing timber crops for market, faults have often been committed with regard to the choice of kinds of trees for given soils and situations. Plantations have also often been made in such manner that the individual plants do not stand near enough to each other to form a normal density of crop for the given kinds of trees; and when this normal density has perhaps been obtained later on, it has sometimes been deliberately interfered with by well-meant but injudicious thinning, which has only too often permanently damaged the crop and depreciated its ultimate market value as timber. These facts are now well known and generally accepted, and this of itself, I feel sure, marks a distinct advance in knowledge of Forestry throughout Britain within the last six or seven years. But, taking facts as they are, it must be said that the present condition of Forestry in Britain is not satisfactory. The great majority of the wooded estates throughout Britain are managed upon principles in which considerations as to timber are subordinated to sport. Most of the crops are badly stocked. If plantations, they have usually been made at too wide distances; while both plantations and natural woods have generally been thinned so heavily, that excessive branch-development has resulted at the expense of length and cleanness of the stem. Mistakes have often been made in the selection of trees when forming new plantations. Again, large numbers of

timber trees in the woods are rendered almost useless by old age and neglect. Allowed to stand beyond maturity, they gradually deteriorate in value. Thus, while in themselves unprofitable, they prevent the formation of a more vigorous crop of younger wood. Crooked hardwoods and flowered timber for furniture can easily be grown in the hedgerows and in park lands and pastures; but good straight stems, free from branch-knots, can only be grown in the close canopy of much denser woods than are to be found on most British estates. On the whole, it can hardly be denied that the capital represented by the soil and the growing stock of timber are not being managed, except on very few estates, in such a manner as to give the best returns to the owner.

The unsatisfactory condition of our woodlands has, indeed, been openly acknowledged for at least fourteen and a half years, ever since the Select Committee of the House of Commons, appointed in 1885 to consider "whether, by the establishment of a forest school or otherwise, our woodlands could be rendered more remunerative," finally reported, in August 1887, that—

"Whilst on public and national grounds timber cultivation on a more scientific system should be encouraged, landowners might make their woods more remunerative were greater attention paid to the selection of trees suitable to different soils, and to more skilful management after the trees are planted.

"Your Committee recommend the establishment of a Forest Board. They are also satisfied by the evidence that the establishment of forest schools, or at any rate of a course of instruction and examination in Forestry, would be desirable, and they think that the consideration of the best mode of carrying this into effect might be one of the functions entrusted to such a Forest Board."

The uneconomic condition of forests in Britain affects every class of society. Our climate is excellently adapted for the growth of timber, both coniferous and hardwood. If the £18,000,000 spent yearly on the purchase of coniferous timber, which might quite well be grown in our own islands, were retained among us, as it should be, it would prove of incalculable benefit both to the poorer agricultural classes and to the industrial community at large; because Forestry requires the service of much labour at the slack time of the year, when there is little else in the shape of profitable employment in rural

districts. A good example of this was given by Professor Bayley Balfour, when he pointed out to the British Association in 1894, in urging the claims of Forestry to recognition and assistance, that a sixty-one-years-old plantation of 24 acres of pine and larch, cut by Mr Munro Ferguson of Novar, in 1883, yielded a return averaging 9s. per acre per annum, against from 1s. to 2s. yielded by the adjacent grazing land, while the outlay upon labour for the plantation had been at the rate of 31s. per acre per annum. If liberal provisions could be made for enabling land-owners to obtain money on easy terms for such ultimately remunerative investments, no doubt the owners of estates would already have manifested a greater desire than they have yet shown to grow timber upon business principles; and the State itself would derive substantial benefit from profitable utilisation of portions of over sixteen million acres of ground now forming only poor hill pasture, barren moors, and waste land.

The State, however, has done little or nothing as yet for the proper encouragement of Forestry. Even the above meagre recommendations made by the Forestry Committee in 1887 have not been acted on, although it is only fair to say that some assistance has been given to the teaching of this branch of technical education at Edinburgh, Glasgow, and Newcastle, under the Board of Agriculture Act, 1889. The Committee also embodied in their report the opinion that, though "the woodlands belonging to the State are comparatively small," yet "even as regards them, the difference between skilful and unskilled management, would of itself more than repay the cost of a forest school." This charge of neglect led to the appointment of another Select Committee in 1889, to "inquire into the administration of the Department of Woods and Forests and Land Revenues of the Crown." In their final report, in 1890, this Committee were "of opinion that, on the whole, the estates are carefully administered, and that the Commissioners discharge their duties faithfully and efficiently." It is impossible to reconcile this statement with the previous finding of the Forestry Committee of 1887, until it be regarded as a mere study in casuistry. The fact is, the hands of the Commissioners of Woods, and of their Deputy Surveyors, are so tied by Acts of Parliament that they are unable to carry out improvements which they know to be desirable. As was pointed out to the Committee by the Deputy Surveyor of the New Forest, over

40,000 acres of forest land have for years been lying waste there, simply because, under Clauses 5 and 6 of the Act of 1877, no clearing and planting may be done. So far as existing enactments permit of the application of economic principles to the Crown forests, a great step in the right direction has been taken by Mr Stafford Howard, one of the present Commissioners of Woods and Forests, in having a working plan prepared for portions of the Forest of Dean by Mr Hill, a trained forester of varied experience in Europe and India, and in appointing another well trained forester, Mr Popert, to carry out its provisions. And no doubt other portions of the Crown forests will gradually be brought under economic treatment as opportunity offers.

Almost simultaneously herewith various hopeful signs have also been shown of landowners gradually awakening to the fact that their woodlands are not in the state in which they might be, and that immediate steps should be taken to bring them into economic condition, if the present or the future owners are to realise to anything like the full the benefits which the foreshadowed rise in the price of timber indicates as practically certain. Substantial advantages can only be gained if the woods are worked economically and in accordance with carefully prepared working plans, such as have recently been made for the wooded portions of their estates, and approved and adopted by the Duke of Bedford, the Earl of Selborne, Mr Munro Ferguson of Raith and Novar, and others.

The suggestion of a working plan—the idea being a new one in Britain—has not yet found approval. It is not quite understood, and it is therefore suspected as likely to hamper estate management instead of assisting it. The object of a working plan is to carry out, in the best and most economical manner, the wishes and desires of the landowner. Its aim is to effect improvements by making such recommendations as to the treatment of woodlands, or the formation of new crops of timber, as will lead to the soil being utilised to the fullest extent practicable. By judicious arrangement and rotation of the thinnings and falls of timber and of coppice, it will strive to attain, as fully as is feasible, the object in view of the proprietor, and will seek to obtain for him the largest returns which can be continuously harvested from the given soil and situation, in the shape of a regular yield sustained annually.

A working plan may not perhaps at once, or in the immediate future, lead to profitable returns being obtained from woods which have hitherto been unremunerative; nor will an increase in net revenue necessarily be its immediate effect. But, if the recommendations of a good working plan be steadily carried out, the effect must be to gradually increase the capital value of the woods up to a certain economic limit, and thereafter to obtain enhanced revenue in the shape of the maximum sustained yield. Experience in all countries where particular attention has been given to Forestry has shown that it is impossible to obtain the best returns from crops of timber unless managed under working plans; and what is true for France, Germany, and even far-distant Hindostan and Burma, is equally true for Great Britain and Ireland.

In place of providing an immediate source of enhanced income, those who prepare working plans for woodlands in Britain will, unfortunately, often find themselves forced to recommend outlay for stocking blank portions of crops, and to urge delay in thinnings, so that woods may attain the *normal density of crop*, without which they must run to branches, instead of forming clean, long, straight stems.

At the present time, the number of men whose professional services are available for preparing working plans and advising as specialists in Forestry is exceedingly limited, and this must remain the case till State aid is given on a more generous scale than hitherto for instruction in Forestry. Adequate instruction, indeed, both practical and theoretical, I hold to be the first of the two essential changes which must be effected before the future prospects of Forestry in Britain become as bright as they should be. And it is, fortunately, that necessary change which can be effected most easily, cheaply, and speedily. Instruction as to the meaning, objects, and methods of Forestry is alike required by the general public, landowners, agents or factors, foresters, and woodmen. Even the meaning of the word "Forestry" is not generally understood. In 1894, on last returning to India, I arranged with a press-cutting agency for regular supplies of information about Forestry, and the great bulk of the cuttings received were to the effect that, say, the Govan or Partick "Foresters and Oddfellows" had held their usual quarterly meeting, that the funds showed a balance of so much, and that *the Forestry movement was progressing in the district*.

There is only one educational institution in the British Isles where thorough instruction in Forestry can be obtained at present, and that is the Engineering College of Coopers Hill, in Surrey, founded and maintained at the sole expense of the Government of India. Yet the lads trained there for the Indian Forest Service have still to go to the Continent for completion of their studies by practical training in Sylviculture and Forest Management. Unfortunately, however, a three years' curriculum and rather a heavy cost place this well-organised course of instruction entirely beyond the reach of many of those who might wish to study Forestry, and who would be much benefited by doing so. Under these circumstances, it seems only reasonable to expect the State to provide either a National School of Forestry, or else what shall be acknowledged as a thorough and yet a cheap course of instruction in Forestry at some of the universities and agricultural colleges, or rather technical schools, where most of those receive part of their education, who, later on, as agents and factors, are closely connected with the management of landed estates. And it is, perhaps, only by organising something of the same sort at Oxford and Cambridge that the heirs to large landed estates can be introduced to a knowledge that would be of practical use to them. To meet the national requirements, it is just as essential that the instruction for both of these classes should be cheap and easily obtainable, as that it should be thorough; and this can only be hoped for with liberal aid given by the State. Much more should also be done than has hitherto been the case for the instruction of practical men performing the duties of woodreeves and foresters, as this would naturally tend to raise in every way the status of this most deserving class of hard working and poorly paid men. With a more thorough training, these men would probably soon obtain a higher rate of wage than at present. They would not only deserve it, but landowners would find it profitable to employ a better trained class of woodreeves.

The course of lectures in Forestry instituted at Edinburgh University in 1889, commenced by Dr Somerville and now so ably continued by Colonel Bailey, the instruction given by the Professor of Agriculture and Forestry at the Durham College of Science in Newcastle, and the evening classes at the Botanic Garden, Edinburgh,—all three State-aided,—are only initial steps in the proper direction. On the Continent of Europe,

all the important States have either one or more Forestry schools, or have made provision for various chairs of Forestry at their universities. Even Belgium, with a forest area of 1,750,000 acres, or not very much more than the half of that in Britain, though producing the good annual income of £4,000,000, has established its own National School of Forestry. Again, the New York State, to meet its special requirements, and to protect its own State forests, founded a College of Forestry at Cornell University in 1898. Besides giving it an endowment of 10,000 dollars a year, provision was also made for acquiring a demonstration forest of 30,000 acres in the Adirondack Hills.

With regard to instruction, it is of interest to consider the course of the movement, which began with the Forestry Exhibition of 1884, for the foundation of a Chair of Forestry at Edinburgh University. It was disappointing that your then president could only refer to this proposed chair in August 1897 as being in a "one-legged condition." It was originally understood that if the desirability of having such a professional chair could be proved by public subscriptions amounting to £5000, Government would provide other £5000 to complete the necessary endowment. Since then, changes have taken place which necessitate an endowment fund of £15,000 before the University Court can be asked to found a chair. But, up to the end of 1898, only £3016 had been subscribed, including the sums of £500 and £50, which were presented by the partners of a teak timber firm in Rangoon. Now, the present seems to me an opportune time for renewing efforts in this direction; and if only even £5000 could be raised, the Government might possibly be willing to consider the question of completing the endowment. At any rate, it seems well worth trying for.

Many works on Sylviculture have appeared within the last few years; but Forestry can only, like all other arts, be acquired by practical training as well as by theoretical study. This want can, however, easily be supplied without entailing the expense of investment in a large model forest, as was recently proposed in 1898. No doubt the State and other landed proprietors who may have working plans prepared for their woodlands will follow the public-spirited example of Mr Munro Ferguson, and permit their estates to be visited now and again as object-lessons in practical Forestry. It therefore seems to me a far more important thing first of all to provide thoroughly adequate, easily

obtainable, and cheap instruction in Forestry than to try to acquire and work a State model forest in Scotland.

Even with such instruction obtainable, it must be understood by those who may propose to devote themselves to the study of Forestry as a profession, that they will be pioneers in an art new to this country, that they will have to create their own professional opportunities, and that their main chance of obtaining employment will depend on their ability to prove the value of their professional knowledge. And, for some time to come, there will probably be only a very limited number of positions available for foresters with university education, so that only the best equipped and most energetic will be likely to obtain ready employment. But the future prospects of the timber market in Britain are such that there should soon be a real demand for the services of such men.

The second of the essential changes which must take place in order to brighten the future prospects of Forestry in Britain is, that substantial encouragement and assistance should be given by Government to induce landowners to adopt economic Forestry, and to plant the waste areas or the poor pasture lands which unfortunately abound in many parts of the country. It is matter for regret that nothing was done for Forestry in the Highlands when the Congested Districts Act was passed a year or two ago, although the social and economical advantages of an extensive system of planting in many parts of the kingdom, especially on the west side of Ireland and in the Highlands of Scotland, was considered by the Forestry Committee in 1887 to be a subject of great importance, and well worthy of early consideration.

I am afraid that, as a class, landowners regard Forestry at the present moment with indifference, and the causes of this seem fourfold. In the first place, most of them have only a life interest in their estates; and so many calls are made upon them that they have seldom money to spare for planting timber crops for the benefit of their successors. As a long time usually elapses before plantations yield any considerable return on the capital invested in them, Government might perhaps render assistance by enabling advances of money to be obtained at a low rate of interest as one of the first charges on estates by landowners desirous of forming woodlands to be managed economically, and not merely for shelter-woods, as at present. And the same

principle might be extended, so that advances could be made to landowners for having working plans drawn up for their woods and for carrying out such plans, approved, if necessary, by the Board of Agriculture. There are obvious objections to, and practical difficulties in the way of, the State giving such loans direct; but, at anyrate, amendments with some such desirable object in view might be made to the Lands Improvement, the Settled Estates, and the Board of Agriculture Acts. Forestry is in a similar manner assisted with conspicuously successful results in Northern Germany and Denmark; and here again Britain may well learn from foreign methods and their good results.

Then, in the second place, the rating of woodlands seems ungenerous to landowners. In England, timber crops are very often assessed on what is in practice really an assumed value as agricultural or pastoral land, while in Scotland their yearly value is fixed as the rent at which they might in their natural state be reasonably expected to let from year to year as pasture or grazing lands. Reduction of this rating on timber crops would hardly be felt by the Treasury; and this might perhaps be one means of encouraging the formation of conifer plantations on poor soil. In view of the benefits obtainable, the rating might with advantage be entirely removed from woodlands formed or managed in accordance with working plans approved by the Board of Agriculture. This rating was only imposed when the import duty was taken off foreign timber; and thus, instead of being fostered and encouraged, the home growth of timber was handicapped as it had not previously been. In this matter, however, landowners are themselves partly to blame for neglecting their own interests. They must realise, better than any others can, the existing disadvantages connected with growing timber for profit in Britain; and they are certainly in the best position to bring the matter before Parliament in some practical form. Government are not likely to remedy existing drawbacks unless reforms are pressed upon their attention.

A third cause is the result of a legal decision in 1894, by which it was held that railway companies are not liable for damage by fire caused by sparks from their engines, although the owners of traction engines are liable for similar damage. This is a very serious danger in conifer tracts.

The fourth, and, in many cases, the chief cause of the apathy

of landowners towards Forestry is undoubtedly connected with sporting considerations. Those, however, who know the sport afforded by wild boar, stags, roedeer, and smaller game in the great Continental forests, and of good mixed shooting near the edges of the forest, will be well aware that the most scientific Forestry is by no means incompatible with the highest forms of true sport. Thus, for example, well-managed copsewoods give good pheasant-shooting. But economic management of woodlands is certainly incompatible with such a state of affairs as exists in many of the woods, where rabbits are permitted to multiply to such an extent that they cause wholesale destruction to the coppice in copsewoods, rendering natural regeneration all but impossible, killing even large trees by gnawing away their bark, and making the formation of new plantations a practical impossibility without considerable expense being incurred in the erection and maintenance of wire fencing. It is questionable if many landowners have ever calculated in cold blood, and without any sort of prejudice or preference, the true debit and credit of their rabbit account. It would be interesting to know how much their rabbits cost some of them each year in loss of income from, and damage to, woodlands, and in expenditure for wire fencing. If this calculation be made, and the landowners still prefer swarms of rabbits to well-stocked woodlands, then the future prospects of Forestry in many parts of Britain are poor indeed; but otherwise, so far as the future prices obtainable for timber can be forecast, these prospects are now far brighter than they have been for many years in the past.

XIV. *Address delivered at the General Meeting, 7th August 1900.* By ALEXANDER MILNE, Vice-President of the Society.

I am sure that we all regret the absence of our noble President, the Earl of Mansfield, from our meeting to-day. No one is more sorry than I am at his inability to preside on this occasion (on account of my having to fill this chair in his stead). However, we all rejoice that his Lordship is doing duty with his regiment in London, but we must also express the hope that our President may soon return to his extensive and well-wooded estates of Scone and Lynedoch, to direct the planter's spade and pruning-hook instead of the sword and spear of the army. It is no easy matter to take our worthy and honoured President's place on any occasion, but in occupying this chair to-day, I have some consolation in the fact that at this General Meeting of the Society the business is very much of a formal nature,—no lengthened address or discussion is expected, our Annual Meeting in January being the time for lectures and papers on Arboricultural subjects. The principal object of our gathering here (after the transaction of routine business) is for the purpose of proceeding on our Annual Excursion, to the north of Ireland this year, to see and discuss there, object-lessons in practical forestry. I may say that these Excursions, established now for over twenty years, are full of Arboricultural interest and instruction. They afford a valuable opportunity to all the members of meeting collectively once a year, and exchanging views on the different methods of the management of woodlands. Demonstration and discussion are the most approved ways of gaining knowledge, and in the presence of the giants of the forest, which take many years to come to maturity, lessons are inculcated of the deepest concern, both from an æsthetic and industrial point of view.

I will not detain you with many remarks on any special subject of Forestry, as your thoughts are more bent on seeing practical Arboriculture, pointed out in the open-air, rather than by debating theoretical instruction of this nature indoors. With your permission, then, I will only offer a few observations on the past and present work of the Society. To start with, I think that we can congratulate ourselves on our present position. I do not think that the Society was ever in a more flourishing

condition than it is in at present, whether as regards the work which it is accomplishing, or from the state of its finances. Established in 1854 by a few enthusiastic foresters, it has done a great deal of good work in its time. The present membership is about eight hundred, composed of landed proprietors, foresters, gardeners, factors, nurserymen, wood merchants, and allied trades. We have an active and able President in the Earl of Mansfield, one of the best landlords in Scotland or anywhere else. Thus you see that the position of the Society is one of influence and importance from a membership point of view. You are aware that the objects of the Society are to advance the science and practice of Arboriculture, and it has hitherto sought to attain these ends by lectures or the reading of papers, giving prizes for essays on professional subjects, and visiting and inspecting the principal wooded estates at home and abroad. The Society has also in recent years approached the Government of the day, with the view of getting them to found a Forestry Chair at the University of Edinburgh, and also for the purpose of establishing a Model Forest Area. In these projects, we as a Society have not as yet received much encouragement from the State. It is true that Mr Long, President of the Board of Agriculture, received some time ago a deputation of the Society very courteously and sympathetically as regards the objects sought to be attained, but it may be said that there the matter has ended for the present. This leads me to ask the question, Why has the all-important subject stopped there? or has the Society been asking anything unreasonable? I think that I may say, without fear of contradiction, that it is now generally admitted by Forest experts and others, that the State must come sooner or later to the aid of a National Forest System.

The realisation of a National System of Forestry is not one which only concerns the welfare and interests of a few individuals, or even some classes of the population. It has far wider ramifications. The question is one of wide and far-reaching effects. It permeates the whole of society for good.

At the present time, one of the subjects which is most exercising the minds of thinking men is that of the congestion of the population of our large towns and all its attendant evils. Thinking politicians and economists have become alarmed at the rush of the country population to large industrial centres.

The employers of the people in country districts cannot now command that good and honest labour which they formerly possessed. The rural population, which has hitherto been the backbone of the country, is steadily declining. Is it not the wish and work of the philanthropist, that the factory hands and workers in large cities could be transferred to the country, to less populated parts, in order that they may enjoy more fresh air, and thereby gain better health? How can these social and industrial problems be solved for the nation's good? To my mind, the only right and proper solution is the creating of new forests by the State on the waste lands of the country; and then would follow the establishment of works in country districts by private enterprise, for the manufacture of all kinds of forest produce. Thus we see that the subject of afforesting uncultivated lands is not a parochial or local one, but is a work of national importance of the greatest moment. It is computed that there are about eight millions of acres in Scotland of waste lands which could be profitably planted; and there are also similar areas in both England and Ireland which could be brought under the control of the forester for the nation's welfare and prosperity. I saw it stated recently in the public papers, that within a radius of fifty miles of London, there are 700,000 acres of land unaccounted for. What an immense benefit it would be to the teeming population of the capital if those lands could be acquired and planted. Why should the Government of the country allow this wasteful policy to continue? We have been reproached by Continental countries for this neglect, as it is the case that most European states are large owners of woodlands; and they also work them for the benefit of the people, in the same way as we manage the Post Office and Telegraph service. How do we account for the British Government being so neglectful of Forestry, one of the highest interests of our land? It is, perhaps, that not enough of pressure has been brought to bear upon the Executive.

Governments nowadays are very amenable to pressure; they all angle very artfully for votes. It is, therefore, surely high time that such an influential Society as the Royal Scottish Arboricultural should bestir themselves in this direction. It is our bounden duty to educate such a volume of public opinion as will make the Government undertake at once their natural work (so long delayed) of education in the art of Forestry and

the planting of waste lands. If the State had commenced to plant uncultivated lands, there would have been no need of a Crofters Bill, or any other Bill, which violated the sound principles of political economy.

The State, hitherto, has left the planting of trees to private individuals, and many private landowners have done much to enhance the value of their estates, as well as to contribute to the material prosperity of those around them; but you cannot expect private landed proprietors to do the work which unquestionably is the work of the State. In the proper management of woodlands, a continuous system of operations is required, and this is not so easily attainable in a private woodland as it is in a State-controlled forest. The frequent changes among proprietors of woods is not conducive to the best interests of forestry.

Having said this much, let us look for a little to what other countries are doing on some of the points which I have referred to. When a German or French expert on Forestry comes to this country to look over woods, they are invariably loud in their condemnation of our practice. There may be much bad Forestry to condemn in the British Isles, but at the same time there is also much good Forestry, and there are many landed proprietors who deserve our lasting praise for the manner in which they have managed their woods without State aid. But I am sure that no one will deny but that Government instruction and Government model forest areas will do incalculable good to improve and consolidate our forest management. I have asked the question, what are other countries doing on these three points? viz.—(1) Forestry Education; (2) Model Forest Areas; (3) the Planting of Waste Lands. What is being done in Scotland as regards supplying professional education to those who hope in the future to manage woodlands? I may say very little indeed. It is true that a class on this subject is taught in our University, but it is far from being a well-equipped forest training school. This is entirely due to the lack of Government support. What a contrast is here presented to us when we look abroad, and see what our Continental neighbours are doing to train their young men in Forestry. In Germany, for instance, there are many training colleges subsidised by Government, in which is given a highly systematic course of training in all departments of tree-growing.

On the Continent, the State are large owners of forests, and these are utilised for the practical teaching given in the woods. The forests of Germany (as many of us know who visited the German woods five years ago) are very extensive, and it is said that these State forests produce annually a revenue of between 20 and 22½ millions sterling.

Take France also as a country which devotes considerable attention to the cultivation of timber, and what do we find there? France spends annually from the public exchequer a sum of half a million sterling towards Forestry education and upon its woodlands. Compare again the area of land in the British Isles which is devoted to the growing of trees, and we again find ourselves in the background. From statistics, I observe that only 4 per cent. of our lands is under wood cultivation, while Germany can boast of 25 per cent. of its area being under a crop of trees, and France can lay claim to 17 per cent. of its area being so occupied. I have already said that the facilities which exist for Forestry education in this country are practically of no account. I may, perhaps, mention the school at Coopers Hill, where a training is given to those who enter the Indian Forest service, but I believe that the maintenance of this college of instruction is defrayed by the Indian Government. I was pleased to notice a paragraph in the *Scotsman* of 30th July last, calling attention to what Forestry had done for India. With your permission I will read it, as I think it worthy of being reproduced.

“The development of Forestry in British India during less than half a century, is an object-lesson to this country on both its scientific and financial sides. In the days of Alexander the Great, and through the Buddhist period well into the Christian era, the Punjab and Northern and Central India were covered with forests, to the benefit of the people and of the climate. The gradual invasion of nomadic tribes, followed by the devastation wrought by the Mohammedan conquerors, cleared them away, created the great desert tracts from Sind to Rajpootana and Delhi, where the people perish periodically from famine, and reduced the general rainfall of all Northern India. The English East India Company encouraged the destruction of the finest teak forests by granting uncontrolled monopolies to private persons, so that Malabar and South India also were cleared. Lord Dalhousie, having won from the King of Burma the royal

right to the forests of Pegu, placed the present Sir Dietrich Brandis, K.C.S.I., at their head in 1854. From that time a system of scientific and practical forestry has been applied gradually to all India, under that distinguished savant, who lately lectured in the University of Edinburgh, where his old colleague, Colonel Bailey, late R.E., now represents the subject. Dr Schlich, and then Mr Ribbentrop, succeeded Brandis as Inspector-General of Forests. The last, who is about to retire after thirty-three years' service, sums up the remarkable results of the forty-five years' administration of the system introduced by the Marquis of Dalhousie. The Government of India received a gross revenue of 190 lakhs of rupees last year from the forests, and of this, 79 lakhs, or upwards of half a million in gold, was clear gain. Brandis began his work without one expert as assistant. Now the trained Forest establishment is 308 strong, recruited by competition in this country and from skilled natives in India itself. The second Lord Elgin corrected the one mistake of the department, which carried out too stringently the rules for minor produce. Now the forest pastures and brushwood are thrown open to the people to preserve their cattle in time of famine, and the old jealousy between the district and the forest officers has ceased. The survey has covered 24,000 square miles of forests. Working plans have been made for 20,000 square miles, and no fewer than 32,000 square miles are under special protection from forest fires. Of late sylviculture has advanced side by side with arboriculture, and new varieties of merchantable wood have flourished. The physical effects of the extending forests on the climate cannot be financially estimated, but these are none the less real and beneficial. The Scotsman who did most for Indian, and thereafter for Scottish forestry, was the late Dr Cleghorn of Stravithie, Fifeshire."

I think that this article is an additional argument why the British Government should take in hand a National System of Forestry. The crown lands in England are the New Forest in Hampshire, and the Forest of Dean in Gloucestershire. The former the Society visited seven years ago. It contains 100 square miles of land suitable for the growing of timber, and yet it remains comparatively useless. I consider this mismanagement of the New Forest a great blot upon the arboricultural knowledge of the empire. The Forest of Dean, visited

by the Society two years ago, although growing a considerable quantity of oak, also leaves something to be desired. It is stated in the Board of Trade returns that we import annually from abroad 20 millions sterling worth of timber, and it is also affirmed by many authorities that this quantity could quite well be produced at home under good Forest management. We are also told that the foreign supplies of timber are of necessity being much reduced. This being so, it is surely time that the Imperial Parliament were beginning to acquire and plant up the waste lands of the country for the benefit of the people. There can be no doubt but that the rearing of timber will pay, that is to say, if the work is conducted on commercial principles. No private individual could make a better return from woodlands than the Country's Executive, as they can borrow money at a much cheaper rate of interest, and can wait much longer for large and deferred profits.

In pleading for State aid in the matter of Forestry, I could use many more arguments in favour of a Government Board to manage and control woodlands; but suffice it to say that these and similar reasons have been urged before, and although the arguments I have used are not new, they have the higher merit of being true, and we must still keep pegging away until the Society has reached the goal of its ambition, the placing of Forestry education on a national basis.

As I said before, I believe that there is a growing consensus of opinion among the advocates of National Forestry, that the State will ere long take the matter in hand, so that this country may not be behind other countries, and in this way add much to the material prosperity of the empire.

XV. *Douglas Fir on the Durriss Estate.* By ALEXANDER YEATS,
Assistant Forester, Durriss.

Among the many timber-producing trees which are either natural to or have been introduced into this country, Douglas fir—*Pseudotsuga Douglasii* (the Red Fir, or Oregon Pine, of North America)—is worthy of a leading place, owing to its rapid growth, its great dimensions, and the excellence of its timber.

The exposure of this estate is mainly northern, curving round to the east and to the west. In the plantations where Douglas fir is grown, the elevation is from 100 to 600 feet above sea-level.

The soil is a loam, produced in part by the decomposition of granite, which is the only rock of the district. It is of varying depth, but never deep enough to produce oak of the first quality. The subsoil is either a stiff clay pan, lying horizontally, or rotten rock—a subsoil certainly much against Scots pine.

Douglas fir was probably introduced into the Durriss policies about sixty years ago, as standard plants, mixed with oak, beech, spruce, silver fir and others. Unfortunately, no pure plantation of Douglas was formed, nor was the species systematically mixed with others. The object was arboricultural rather than sylvicultural. As regards soil fertility, the tree is not over-exacting; it may be grown on loamy, calcareous, or peaty soil, but, undoubtedly, the best results will be obtained from a deep and fertile sandy loam. The reproductive power is strong, as seed is produced every alternate year on trees of thirty years and upwards which stand well towards the light. The bloom appears in May, and the fruit may be gathered in October. When carefully stored, it would seem to maintain its fertility for a lengthened period, as it may be used after eighteen months without any appreciable diminution of germinating power. Taking into consideration its early reproductive power, and the germinating capacity of the seed, there is every reason to believe that Douglas fir will soon become one of our cheapest seedlings.

The seedlings may remain in the seed-bed for one or two years, the strongest plants of the first year being transplanted into nursery lines 1 foot apart, and 4 inches between the plants. Those which remain in the seed-bed during the second year may be lined out in the same manner. By the end of the third

growing season, the plants will have reached the most suitable size for forming a plantation. The reason why I recommend that mode of treatment in the nursery is, that Douglas fir, although a shade-bearing species, requires an abundance of light to produce growths of the best quality. I find that where light is limited, by plants being crowded closely together, there is a large percentage of them of lanky form, with unripened wood, and an inferior root system. Frequent transplanting produces fibrous roots, which are excellent for supplying moisture, but insufficient fixture is given.

The errors in our present modes of planting, which are either the "notch" or the "pit" system, are readily observed when Douglas fir is planted, as its rate of height-growth, even in its younger stages, soon reaches from 2 to 3 feet annually, and it maintains a dense crown. I have seen a plantation far from firmly established when twenty years old where the "notch" system had been adopted. This I attribute to the bad arrangement of the roots; "as the *root* is bent, so will it grow." Pit-planting is certainly better, as the soil is loosened, and there is an equal distribution of roots round the stem; but even here, all the plants are placed to one depth, with the tap-root turned aside. In pit-planting large plants are generally used, which must be placed at an unnatural depth, to avoid their being wind shaken. To make pit-planting really successful, all plants should be lifted from the nursery lines, with balls of earth attached. I have not seen the block spade in use, though I believe there is much to commend it when the plants are not more than three years old. By having it of triangular shape, staying power would be given with all roots to their natural depth. In loose soil it should answer admirably, while stiff soils might be previously broken up with the pick. This would give an advantage, for I find that on stiff soils, where the planting has been executed with the ordinary spade by "notching," the cuts may be readily seen in times of frost or drought. Pits on stiff soils, or on soils with a pan subsoil, collect water in the rainy season, and this lowers the temperature of the soil, and gives it a spongy looseness.

When a pure plantation of Douglas fir is formed, the planting distance should be between 4 and 5 feet. This would avoid early thinnings, which yield nothing of marketable value, and would maintain an even distribution for a longer period. The first thinning would be about the twenty-fifth year, when the poles

might average 6 inches in diameter at breast height, a useful size, which could be readily marketed. All thinnings must be executed with caution if the ultimate aim is to produce the best quality of timber.

An even-aged mixture of Douglas fir with light-demanders would not, I think, lead to very successful results, as most light-demanders grown in this country are of a slower rate of growth; hence, they would soon become dominated. To obtain the best results in such a mixture, the light-demanding species must be given a start, Douglas fir being introduced at a later period. Here we have an excellent example of this, the Douglas fir having been introduced as an under-crop to larch twenty-five years ago. The management then was not, however, what would be commended now. There had been no careful selection of the larch stems left on the ground, and the Douglas fir was introduced at a too late period. The example is, however, instructive. From the excellent leaf-canopy of the Douglas fir humus is accumulated, which maintains ample moisture to permit the full development of the larch. From this we may infer that it is good forestry, in localities where broad-leaved species cannot be profitably grown, to plant larch where the soil and climate are suitable, and adopting the advice given by an expert, to thin out strongly between the twentieth and thirtieth year, in order to introduce Douglas fir as an under-crop.

This tree seems to enjoy a happy immunity from disease, as no trace of such is to be found on the Durriss estate. But then there is no larch cancer here. To injury by weevils it is somewhat liable, especially when planted after a crop of Scots pine which had been felled the previous season. The damage by game is nothing serious. It has been often observed that Douglas fir will not grow to a useful height, as a timber tree, in exposed situations. When grown as a standard, it does not present the erect outline of *Abies nobilis*; but grown as a pure plantation, or as an under-wood to a light-demanding crop, it will be difficult to find a divided stem. Here may be seen many excellent arboricultural specimens, grown in favoured localities. I will give the dimensions of one in particular, which is 100 feet high, having a diameter at breast height of 3 feet 8 inches, with the crown extending almost to the ground. This tree is nearly sixty years of age. Others there are of forty years' growth, with a height of 75 feet, and a diameter of 2 feet at breast height. These contain on an average

50 cubic feet of timber. Their average spread of branches covers an area of 32 square yards, which gives one hundred and fifty trees, yielding 7500 cubic feet, to the acre. This represents an extremely rapid growth, which is detrimental to the quality of the timber: in this respect the home-grown produce will not bear comparison to the slowly-developed timber imported from America.

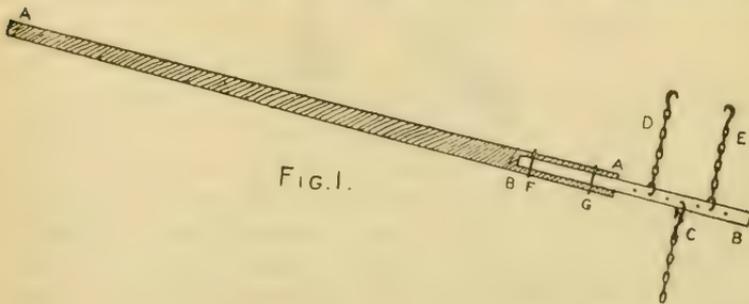
The experience gained in the growing of Douglas fir on this estate, proves that the cultivation of this tree deserves every encouragement.

XVI. *Description and Sketches of Lever Appliance.* By JAMES RODGER, Forester, Morton Hall Estate, Norwich.

This implement is in regular use on this estate, but, to the best of my belief, it is not in general use. Still, it has many qualities to recommend it. It is very simple in construction; it is comparatively inexpensive; it can be moved about and manipulated by four or five men; it can be fixed and applied in places inaccessible to horse or steam power; and, what is of most importance, it is very powerful, being much more so than the best rope-and-pulley tackle, and even approaching the traction-engine in this respect.

For steadying or swinging round leaning trees during the process of felling, for pulling down trees whose tops have fallen into the crowns of neighbouring ones, for pulling up roots, for turning heavy trees over, and such like work, it is simply invaluable, and, in my opinion, it should be included in the equipment of every timber-growing estate.

The "Chain Lever," as it is locally termed, is made up of a stout larch pole, 14 feet long, a bar of iron, 4 feet 6 inches by 3 inches by 1 inch, and a sufficient supply of suitable chains or steel ropes, in lengths of from 10 to 20 feet. By clasps and wedges the iron bar is fixed to the butt end of the pole in such a manner that about two-thirds of its length project beyond the wood, and along the centre of this projecting portion a row of $\frac{5}{8}$ inch holes,



about 6 inches apart, is made; a stout coupling and pin is made and fitted into the centre hole, while two strong chains, 2 feet long, are fitted with a similar coupling and pin at one end and a short pointed hook at the other; these chains are attached by their couplings to holes in the bar, one at each side of the centre coupling, but this may be better understood by looking at the accompanying sketch (Fig. 1).

AA is the pole, BB is the bar of iron, C is the coupling by which the lever is fixed to a tree, stake, or other holdfast; D and E are the pulling chains, and F and G are the clasps by which the iron is fixed to the wood, the butt end of the pole being flattened for their reception.

When a tree or other object is to be moved, a standing tree is selected, or a strong post is fixed into the ground, to act as a holdfast or fulcrum; round this a chain is passed, and the lever is attached by its coupling (C) about 3 feet from the holdfast. From 10 to 20 yards from the object to be hauled is a good distance at which to fix the lever, but a longer distance will answer the

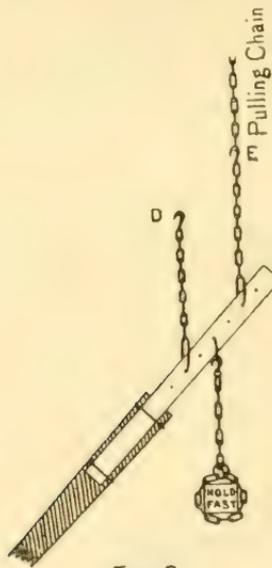


FIG 2.

purpose, provided it is not longer than the supply of ropes and chains will admit of, and a shorter distance may be adopted if sufficient room is left for the working of the lever, which describes a semicircle in its movement. It is, perhaps, needless to mention that it is worked horizontally.

The lever being fixed, the next operation is to lay down a line of chains to the object to be moved, one end being made fast thereto, and the other, after the whole has been pulled as tight as possible by hand, being coupled to the lever (Fig. 2). This being done, everything is ready for pulling.

To accomplish this, one man attends to the hooks, while three

or four others go as near as possible to the free end of the lever, and push it round to the position shown in Fig. 3, when it will be seen that hook E has pulled in the chain a little way, while hook D can be put into another link a little farther up. The lever is then brought back to the position shown in Fig. 2, during which movement hook D pulls in the chain, while hook E is released and put still farther up (Fig. 4). And so the pulling goes on, hand over hand style, every movement showing a hook pulling and a hook being released for a fresh hold; and it is astonishing what weights can be thus moved.

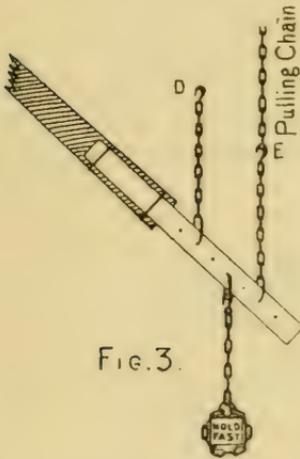


FIG. 3.

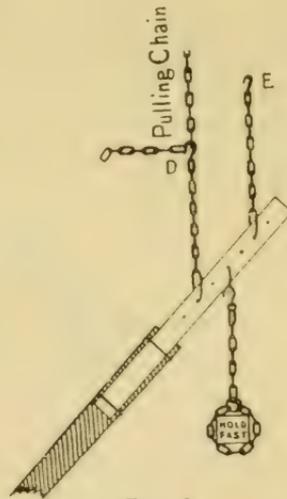


FIG. 4

This estate is bounded on the east by a river about 15 yards wide, and on the west bank there are a number of heavy poplars, growing very close to the edge of the bank, and about 8 feet above the summer-level of the water. These trees are over-ripe, and have the heavy eastward list so common to this species, so much so that a perpendicular line from some of their tops would touch the water about 8 yards from their butts. They average 100 feet in height, and this appliance has been of very great service in bringing them round clear of the water during the process of felling, and also in pulling out of the water a number of them which had been blown down. Last spring I was asked to take down a few of those standing closest to the river and leaning the most; and of thirteen trees selected, twelve were safely landed well on to the meadow without touching the water. The thirteenth

one, through the breaking of a chain, fell into the river at right angles to its course, most of its branches resting on the meadow on the other side. Five men set to work, the tree was cross-cut on the opposite bank close to the water's edge, the lever was attached, and in four hours the main part of the bole was laid high and dry on the spot where it was meant to fall. The log measured 45 feet long by 22 inches $\frac{1}{4}$ -girth, equal to 151 cubic feet.

Five years ago a westerly gale uprooted a good many of these poplars, which all fell into the river, many feet of their tops lying on the opposite meadows. The lever was brought into action, and they were hauled to land at the rate of about one tree per day.

General Remarks.—When it becomes necessary to fix a post into the ground for a holdfast, it is, especially on marshy ground, sometimes a matter of considerable difficulty to make it firm enough to withstand the very great strain brought on it when the lever is at work. A plan I found to work admirably is that shown in

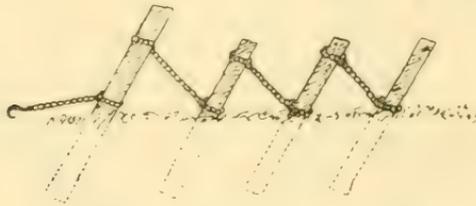


FIG. 5.

the accompanying sketch (Fig. 5). The lever chains may be of any pattern, provided they are strong enough and have got a hook at one end and a ring or big link at the other, so that they may be easily coupled; but it is imperative to have, next the lever, a length of chain with equal sized links, such that the pulling hooks may fit into any of them. The chains we use are made of $\frac{1}{2}$ inch and $\frac{5}{8}$ inch iron, with links about 3 inches long; we have also a wire rope, 25 yards long, which is lighter and more easily hoisted into the top of a tree than the chains. For very heavy pulling I have found it advisable to put coupling C into the second hole from the wood instead of into the central hole, and to put the pulling chains into the first or nearest hole on each side.

I can recommend the lever with the greatest confidence as being an instrument of great power and real practical value in forest work.

XVII. *Working Plan for the Right Honourable the Earl of Selborne's Blackmoor, Bradshott, and Temple Woods in Hampshire.* Prepared by JOHN NISBET, D.Cec., F.S.I.

PART I.—SUMMARY OF FACTS UPON WHICH THE PROPOSED WORKING PLAN IS BASED.

DESCRIPTION OF THE BLACKMOOR, BRADSHOTT, AND TEMPLE WOODS.

Description and Situation of Estate.—The Blackmoor and Bradshott Estates and the Manor of Temple are the property of the Right Honourable the Earl of Selborne, and form part of the Eastern or Petersfield Division of the County of Southampton. They are situated around the sources and to the north-east of the Brockbridge stream, a tributary of the Rother, extending thence east and north-east towards the Crown lands of Wolmer Forest.

Configuration of the Ground.—The woods situated in the western portion of the estates clothe the sides of hills sloping towards the Brockbridge stream and its sources, while those in the central part, and those stretching towards the east, are on level or gently undulating ground. In altitude above sea-level the lands lie mostly between 300 and 500 feet, the lowest portions being in the vicinity of Wolmer Pond (276 feet), and the highest near Temple Farm (534 feet). Except as regards portions of the hill-sides named Temple and Cornbrooks Hangers, the soil is nowhere steep enough to occasion any practical difficulty with regard to sylvicultural operations. Some of the woods in the western portions of the estates are well sheltered, but the great majority of them are rather freely exposed to the action of wind.

Geological Formation.—The estates are situated on the Cre-taceous formation. Towards the western end of the estates the Upper Greensand (Malm) runs in a broad band from north to south. To the east of this a narrower belt of Gault Clay runs also from north to south, while the whole of the eastern portion of the estates consists of the Lower Greensand. The Upper Greensand yields soils of loamy clays and clayey loams of considerable fertility, and the Gault loamy and stiff clays and clayey loams, while the Lower Greensand soils are sands often characterised by great depth, and sometimes apparently possessing a

fair degree of mineral strength. The clays and loams of the Upper Greensand and the Gault yield forest soils well adapted for the growth of the best classes of hardwoods, while the sands of the Lower Greensand are characteristically pine soils, though larch, and sometimes oak, ash, sycamore, and other hardwoods thrive well on the better portions, which are fresh or moist.

Climate.—The annual rainfall averages about 34 or 35 inches, though the last few years have shown some deficiency. During recent years the climate has been drier than formerly, although the area is situated within about 22 miles of the southern sea-coast of England. The summer heat is considerable, and in winter there is often severe cold. Late frosts are rather frequent in spring.

Area of the Woods.—Of the total estate area of about 2000 acres, nearly 400 acres are under forest. But of the latter only 300 $\frac{3}{4}$ acres are actually stocked with timber in the copsewoods and the recent plantations. This area will, however, most likely soon be added to from time to time by the planting up of land going out of arable cultivation.

Boundaries.—Fences of posts and wire-netting are maintained around all plantations till about their tenth year, on account of rabbits. The copses and plantations, after removal of the wire-netting, are kept fenced with posts and wires in order to prevent trespass by cattle. The maintenance of all the fences in proper condition involves a large amount of supervision and repair by the woodmen, and adds in no small measure to the expenditure annually incurred on the timber crops.

Composition and Condition of the Timber Crops.—An enumeration of the various woods and plantations will be found in the Summary and in the Field Book appended to the Report. The copses are irregular in composition both with regard to standard trees and to their distribution, and also as to the underwood and its density. The standards are mostly of oak, varying from 2 to 7 feet in girth, and often with enormous branching crowns, and of ash of somewhat inferior growth, all scattered irregularly over the areas. In some places they stand too thick, while in others standards are wanting. The bulk of the coppice consists of hazel, together with oak, ash, birch, willow, aspen, and in some falls chestnut and a little beech and sycamore.

The copse, growing as they do on rich loamy clays and clayey loams belonging to the Gault and the Upper Greensand, should

produce much finer, more regularly distributed, and more numerous standards of oak and ash than now form the stock, while the coppice underwood should also be of considerably greater density, and should consist to a much larger extent than at present of the more valuable hardwoods, such as oak, ash, sycamore, maple, and chestnut. In past times much fine oak timber went from here for the supply of the naval dockyards.

In the Field Book, forming Appendix B to the Working Plan Report, a detailed description of the various woods will be found. In enumerating these, Roman numerals have been used to define the various customary blocks or sections of the estate, while the different copses and plantations bear their special local names and distinguishing letters in addition to the block number (*e.g.*, IX. c, Temple Hanger).

INJURIES TO WHICH THE CROPS ARE LIABLE.

1. From *Wind*.—Except as regards the Hangers or hill-slopes occupying sheltered positions, the whole area is wind-swept, the heaviest winds coming rain-laden from the south-west. But very little damage has hitherto been done to any of the woods or plantations from wind.
2. From *Snow*.—In some years there are heavy falls of snow, but there is little or no danger of snow-break causing serious damage.
3. From *Fires*.—These are dangerous, and in March especially so, but no serious damage has been done except to the northern portion of Rhododendron Plantation (III. B) in 1881. In March 1886 very serious danger was threatened, and troops were sent from Aldershot to fight against the conflagration spreading from Wolmer Forest, but it was fortunately suppressed before reaching any of the plantations on the estate.
4. *Frosts* in spring are often severe in the valleys, and frequently cause the loss of the top leader of the ash, but on the whole they do not appear to do much damage.
5. *Insects*. Although an occasional dominated pine stem is sometimes found to have been killed by bark beetles (*Bostrichini*), the woods and plantations are otherwise free from the attacks of insect enemies.

6. *Fungus disease* has in rare cases attacked the Scots pine stems, causing them to be partly bent (by *Caeoma pini-torquum*), so that an individual bole here and there is spoiled; but unfortunately the larch canker (*Peziza Willkommii*) has caught hold of many of the larch crops and spoiled some of them so entirely as to necessitate their being cleared (Eveley Field Larches, II. c).
7. *Rabbits* and *Hares* do a great deal of damage, and it would on this account be next to impossible to raise plantations, or to expect trees planted out to succeed, unless protected for several years with wire-netting. Ash, spruce, and larch are especially attacked, but other kinds of trees are also gnawed. The Corsican pine seems, probably on account of its large amount of resin, to be less attacked by them than any of the other kinds of trees. Self-sown seedlings appear less liable to attack from rabbits than transplants. Squirrels also do a certain amount of damage among the larch and Scots pine.

Rate of Growth.—Without making elaborate measurements to determine this quantitatively, which seem uncalled for under the existing conditions of the crops, it may merely be stated that the copsewoods appear to be in vigorous growth. But, owing partly to the excessive branch development of the standards, partly to the species of trees and shrubs forming the underwood, and partly to past want of care in securing proper density of the latter, the productive capacity of the soil is not being utilised at present in the most economic manner. In the conifer plantations on the sandy soils the rate of growth is very satisfactory in some places, but poor in others. This is in part due to comparatively wide planting, and this mistake can only be now rectified to a certain extent by maintaining close canopy when once this has been formed by the pole forests.

Past Management.—Until within about the last five years the standard trees in the copses have not been utilised for about twenty-five or thirty years, nor have they been systematically increased in number by the selection of young stores. Only the coppice was during that time felled in a rotation of about ten to twelve years; and during the last five years occasional standards have at the same time been utilised, young stores being selected to fill their places. This latter operation has, however, been conducted very irregularly. During the last three or four years attention has also been given to

the removal of low branches, not exceeding 3 to 4 inches in diameter, in order to improve the boles of the standard oaks.

Previous to 1895 the coppice wood was sold by auction, the felling being done by the purchaser. In 1895 a large number of standards (oak, ash, and a few beech) was felled and sold by private tender, along with a fall of oaks from the pasture parks. Since 1895 the standards felled (principally oak) have all been used for estate purposes, as also the bulk of the annual falls of coppice; but a few of the latter have been sold by auction, the felling being done by the purchaser. The revenue thus accruing from the woods has been regularly credited to them from the estate.

The only silvicultural operations which have been carried out in the copses, in addition to trimming small lower branches of standards and storing young poles (mostly stool-shoots), have consisted in plashing or layering coppice-shoots to increase the density of the underwood, and in fixing a number of withy sets in the moister localities. On the whole, the plashing has been fairly successful, but not the setting of willows.

The fellings which have been carried out during the last ten years were as follows:—

Year.	Block.		Approximate Area Felled Over.	Approximate Area Felled during the Year.
	Name.	No.		
1888-1889	Temple Hanger (part),	IX. C	6	10
	Cornbrooks Hanger ,,	VIII. C	4	
1889-1890	Temple Hanger (part),	IX. C	5	14
	Snapwood	VIII. A	7	
	Blackmoor Wood ,,	IV. A	2	
1890-1891	Plainbarn Copse (part),	IX. E	3½	11
	Blackmoor Wood ,,	IV. A	5	
	Squiresfield Hanger ,,	VII. A	2½	
1891-1892	Snapwood (part),	VIII. A	6	9
	Claypit Copse ,,	XII. A	3	
1892-1893	Iron Paddock Copse (part),	IX. F	8	19½
	Bradshott Wood ,,	VIII. D	5½	
	Blackmoor Wood ,,	IV. A	6	
1893-1894	Cornbrooks Hanger (part),	VIII. C	1	27
	Temple Hanger ,,	IX. C	5½	
	Sothrington Lane Side,	IX. G	4	
	Snapwood (part),	VIII. A	9	
	Iron Paddock Copse (part),	IX. F	2	
	Lane Hanger,	VII. C	2½	
Blackmoor Wood (part),	IV. A	3		
1894-1895	Iron Paddock Copse (part),	IX. F	7	24¼
	Plainbarn Copse ,,	IX. E	3	
	Snapwood ,,	VIII. A	3	
	Bradshott Wood ,,	VIII. D	1½	
	Blackmoor Wood ,,	IV. A	2	
	Hazel Copse,	IV. B	3	
	Lower Ridges Copse,	IV. C	1½	
	Upper Ridges Copse,	IV. D	¾	
Highfield Copse,	IV. E	2½		
1895-1896	Plainbarn Copse (part),	IX. E	5	10
	Snapwood ,,	VIII. A	5	
1896-1897	Plainbarn Copse (part),	IX. E	4	20½
	Bushy Copse,	VIII. F	5	
	Island Copse,	VIII. G	1½	
	Bradshott Wood (part),	VIII. D	5	
	Homefield Hanger,	VII. B	1	
	Blackmoor Wood (part),	IV. A	4	
1897-1898	Plainbarn Copse (part),	IX. E	5½	12½
	The Alder Bed,	VII. D	2	
	Blackmoor Wood (part),	IV. A	5	
1898-1899	Bradshott Wood (part),	VIII. D	3	10½
	Snapwood ,,	VIII. A	3½	
	Blackmoor Wood ,,	IV. A	4	
Total area felled over in 10 years,				168½

Average Annual Fall = 16½ Acres.

Past Revenue and Expenditure.—The revenue credited to the woods for timber and coppice used on the estate, or coppice sold to purchasers, and the expenditure incurred on woods and plantations, can only be given since 1894-95. These are as follows:—

Year.	Revenue.	Expenditure.	Surplus.	Deficit.
	£	£	£	£
1894-95	498	230	268	...
1895-96	185	427	...	242
1896-97	316	413	...	97
1897-98	208	233	...	25
Total, . . .	1,207	1,303	...	96
Annual average, .	302	326	...	24

The apparent deficits hereby indicated during the last three years include, however, the formation of $23\frac{1}{4}$ acres of new plantations. The cost of these cannot be accurately determined from the estate books, but they may be taken to have been altogether about £8 an acre. Hence this sum of about £186, invested as capital in new plantations, may be deducted from the expenditure above shown, in order to show the true financial position of the copsewoods. The expenditure also includes £118, wages of a permanent staff of woodmen (one foreman and two woodmen).

UTILISATION OF THE PRODUCE.

The *Marketable Products* consist of oak and ash *timber* from the standards in the copses; of *cordwood* for charcoal, used locally for hop-drying; *larch posts* ($2\frac{1}{2}$ inches to 6 inches top diameter) for permanent posts and wire in the hop-gardens; *poles* of all kinds for the hop-gardens; *small coppice-wood* for hurdles, hedging-rods, pea-sticks, and bavins (faggots), as firewood for domestic use, bakehouses, etc.

Oak bark is saleable, and when large oaks are felled they are always barked. The price is now, however, so exceedingly low as to make the barking of oak no longer so profitable as formerly.

Markets.—The purchasers of timber come from the neighbour-

hood of Basingstoke and Guildford, each about twenty miles distant. For timber there is a steady market, and even the smaller produce is always likely to be easily disposed of when not required for estate purposes.

Lines of Export.—The timber is conveyed by road to Liss (4 miles), and thence by rail to Basingstoke or Guildford.

Mode of Extraction and Its Cost.—The standards of the coppice used for estate purposes are felled, barked, and extracted by estate hands, while standards and coppice sold have hitherto been felled, barked, and extracted by the purchaser. The work by estate agency is all done on daily labour; at 2s. 6d. a day.

Felling of timber (also thinning and tending plantations) is done by daily labour, at 2s. 6d. a day.

The felling and barking of oak timber trees is either done by piecework at rate of 30s. to 35s. a ton (which is the common system), or else by daily labour at 14s. a week and 2s. 6d. extra.

Preparing and stacking cordwood and faggots off timber trees ; Felling coppice-wood, stacking the poles and bavins, and making hurdles,	}	are paid for by piecework at local rates, according to the particular class of work.
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Standards and coppice sold to purchasers are felled and extracted by their own employés.

VALUE OF EACH CLASS OF PRODUCE.

Oak fetches 1s. to 2s. per cubic foot, according to its dimensions and quality, everything being saleable as timber, from about 1 foot in mean diameter upwards.

Ash fetches from 1s. to 1s. 6d. a cubic foot, according to size and class, and is marketable as timber from about 6 inches in diameter upwards.

Other hardwoods have not yet been sold from the estate ; but the larch posts, for permanent posts and wire in hop-gardens, are valued (for estate purposes) at from 2s. 6d. to 5s. each (20 feet by 2½ inches to 6 inches top diameter). *Softwoods* have not yet been sold from the estate as timber.

Poles of larch, pine, hardwoods, and softwoods, all mixed as they happen to come, sell for 8s. per 100 poles of 12 feet by 1 inch to 1½ inch. The 14-foot poles, with larger diameter, fetch 10s.

per 100. Between that size and timber dimensions the poles are not sold, but are used for estate purposes.

Cordwood is sold at 8s. to 10s. per stack of 117 cubic feet ($3\frac{1}{4}$ feet by 3 feet by 12 feet).

Coppice is sold by the acre by auction, and fetches from £4 to £5 an acre; whereas formerly it usually sold at from £10 to £15 an acre. It used to bring in a good clear £1 per acre per annum as a return for the use of the soil, leaving the standard timber as additional profit.

Bark now sells at only 40s. per ton. The quantity yielded by the last fall of 10 standard oaks was 1 ton $13\frac{1}{2}$ cwt., the felling and stripping of which cost 105s., while the return from the bark alone was only 67s. In 1895 the price of bark was 67s. 6d. per ton. At present rates, barking is hardly remunerative.

ADMINISTRATIVE AND EXECUTIVE STAFF.

The woods are managed by the estate steward, acting directly under instructions from the Right Honourable the Earl of Selborne. The staff consists of three woodmen, viz., one foreman and two others, who are also partially engaged in other estate work. The pay of these three men, amounting to about £118, 2s. 6d. per annum, is included within the expenditure charged against the woods and plantations. A considerable portion of their time is taken up with the supervision and maintenance of the fences round the woods and other parts of the estate.

Labour Supply.—Woodcutters are obtainable without difficulty for felling, etc., from autumn to spring, at the current rate of 2s. 6d. a day. Planting is also done by daily labour at same rate, as this has been found more advantageous than giving out the work by piece or contract.

PART II.—THE WORKING PLAN PROPOSED FOR FUTURE MANAGEMENT.

The proposals of the Working Plan, though partially determined by the various data collected in Part I., are more particularly based on the crop descriptions detailed in the Field Book (Appendix B). A *Valuation* of the various crops seems unnecessary in their present condition, as it would only increase the expense of preparing the Working Plan, without being of direct practical utility in enabling suggestions to be made for the improvement of the growing crops; hence the present proposals are based entirely on area. The annual falls are either approximately equal in area, or approximately equal in productive capacity.

Objects of Management.—The object in view of the owner is to bring the area under wood into such condition as to growing stock that the copses and plantations may yield the largest possible outturn in timber, in thinnings, and in coppice-wood, while adequate protection is at the same time afforded to the soil in order to ensure the maintenance, and, on the poorer sands, the enhancement, of its productivity. At the same time it is desired to obtain, meanwhile, whatever returns can be made available while the copses are being improved as to the quality and quantity of the crops forming the growing stock, and while the plantations are growing up towards marketable dimensions and maturity.

The Method of Treatment which seems best calculated for the attainment of these objects is (1) *in the case of the copses*, continuation of copse treatment, but with more regular and methodical selection of stores to form standard trees, and improvement as to density and kind of stock in the coppice underwood; and (2) *in the case of the plantations*, allowing them to grow up to maturity as high forest, with underplanting whenever this may become necessary for the protection of the soil.

The total area being only of comparatively small extent, it has not been considered necessary to form separate working circles for the copses and the high forest, as would otherwise have of course suggested itself if large areas were being dealt with.

Periodical Rotation of the Fall.—For the same reason, namely, the comparative smallness of the area under copse, it seems essential that the rotation of the fall of standards and coppice should not exceed twenty years. Even this gives very small areas

(averaging only $8\frac{1}{2}$ acres) to be dealt with each year; but considerations regarding the overwood, the underwood, and the maintenance of the productivity of the soil all militate against the fixation of any lower period of rotation. As, however, the vast majority of the trees now forming the standards have short boles, not capable of being improved so much in financial value as longer, cleaner stems would be by retention, and as their large and widely branching crowns interfere much more than is desirable with the growth of the underwood, it has been arranged that the fall should first of all, before introducing this twenty years' rotation, pass over the whole of the areas under copse during the next ten years (1899-1900 to 1908-1909), and that at the end of this time the fall of one-twentieth of the area each year will then be adopted (1909-1910 to 1928-1929). While this course is prescribed mainly with a view to effecting, as speedily as seems feasible, improvements in the condition both of the standard trees and of the coppice, it is also at the same time intended to bring in revenue till the time when thinnings from the coniferous plantations may be expected to become remunerative and to contribute annually to the income from the woodland portions of the estate.

For the coniferous plantations growing into high forest, it would be premature to prescribe the period of rotation in the meantime. All that can at present be said is that, except for unforeseen accidents, they will (with the exception of II. c and II. d, which should be cleared and utilised at once) probably reach their financial maturity about the age of sixty or seventy years. At the age of about forty to forty-five years, or thirty to forty years if the younger plantations are allowed to grow up in fair canopy, provision will usually have to be made for underwood to protect the soil, a partial clearance of the crop being made for this purpose, after the young trees have culminated in their rate of growth in height. In portions of some of the older plantations (*e.g.*, parts stocked with thirty-year-old larch in Wolmer Plantation, IV. f) this is already requisite, even without any further clearance of stems in addition to those already removed, except such as are badly cankered. Hence, in the case of the coniferous plantations, merely a scheme of thinnings is proposed for the next ten years.

A.—TABULAR STATEMENT OF FELLINGS IN COPSES FOR THE FIRST 10 YEARS (1899-1900 TO 1908-1909), BEING A SHORT PROVISIONAL ROTATION FOR THE SPECIAL IMPROVEMENT OF BOTH THE OVERWOOD AND THE UNDERWOOD.

Year.	Block of Estate.	Compt.	Name of Copse.	Portion for Fall.	Approximate Area of Fall.	Total Fall of the Year.
					Acres.	Acres.
1899-1900	IX. VIII.	C	Temple Hanger, . . .	Whole	16 $\frac{1}{2}$	21 $\frac{1}{2}$
		C	Cornbrooks Hanger, . . .	„	5	
1900-1901	VIII.	A	Snapwood, . . .	E. part	17 $\frac{1}{2}$	17 $\frac{1}{2}$
1901-1902	IV. XI.	A	Blackmoor Wood, (	S.E. and S.W. parts	15	17 $\frac{1}{4}$
		A	Oakhanger Pond, . . .	Whole			2$\frac{1}{4}$
1902-1903	IX.	F	Iron Paddock Copse, . . .	Whole	17	17
1903-1904	VIII.	A	Snapwood, . . .	W. part	16	16
1904-1905	VII. VII. IX. XII. XII.	A	Squiresfield Hanger, . . .	Whole	21 $\frac{1}{2}$	12 $\frac{1}{2}$
		C	Lane Hanger, . . .	„	2 $\frac{1}{2}$	
		G	Sothrington Lane Side, . . .	„	4	
		A	Claypit Copse, . . .	„	3	
		B	Oakwood Row, . . .	„	$\frac{1}{2}$	
1905-1906	IX. VIII.	E	Plainbarn Copse, . . .	N.W. part	10	18
		D	Bradshott Wood, . . .	S. part	8	
1906-1907	IV. IV. IV. IV. VIII. VIII. VII. VII.	B	Hazel Copse, . . .	Whole	3	17 $\frac{1}{4}$
		C	Lower Ridges Copse, . . .	„	1 $\frac{1}{2}$	
		D	Upper Ridges Copse, . . .	„	$\frac{1}{4}$	
		E	Highfield Copse, . . .	„	2 $\frac{1}{2}$	
		F	Bushy Copse, . . .	„	5	
		G	Island Copse, . . .	„	1 $\frac{1}{2}$	
		B	Homefield Hanger, . . .	„	1	
D	The Alder Bed, . . .	„	2			
1907-1908	IX. VIII.	E	Plainbarn Copse, . . .	S.E. part	11	18
		D	Bradshott Wood, . . .	N. part	7	
1908-1909	IV.	A	Blackmoor Wood, . . .	N.W. part	16	16
					Tota Acres,	<u>171</u>

Average Area of Annual Fall, 17 Acres.

B.—TABULAR STATEMENT OF THE REGULAR FELLINGS, WITH NORMAL ROTATION FOR THE FOLLOWING 20 YEARS (1909-1910 TO 1928-1929).

Year.	Block of Estate.	Compt.	Name of Copse.	Portion for Fall.	Approximate Area of Fall.	Total Fall of the Year.
					Acres	Acres.*
1909-1910	IX.	C	Temple Hanger, . . .	N. E. part	6½	6½*
1910-1911	IX.	C	Temple Hanger, . . .	S. W. and N. W. parts	} 10	10
1911-1912	VIII. XI.	C A	Cornbrooks Hanger, . Oakhanger Pond, . . .	Whole ,,			5 2¼	7¼
1912-1913	VIII.	A	Snapwood,	E. part	9	9
1913-1914	VIII.	A	Snapwood,	E. of Centre	8½	8½
1914-1915	IV.	A	Blackmoor Wood, . . .	S. E. part	7½	7½
1915-1916	IV.	A	Blackmoor Wood, . . .	S. W. part	7½	7½
1916-1917	IX.	F	Iron Paddock Copse, . .	N. E. part	8½	8½
1917-1918	IX.	F	Iron Paddock Copse, . .	S. W. part	8½	8½
1918-1919	VIII.	A	Snapwood,	W. of Centre	8	8
1919-1920	VIII.	A	Snapwood,	W. part	8	8
1920-1921	VII. VII. IX.	A C G	Squiresfield Hanger, . Lane Hanger, Sothrington Lane Side,	Whole ,, ,,	2½ 2½ 4	9
1921-1922	IX.	E	Plainbarn Copse, . . .	N. W. part	10	10
1922-1923	VIII. XII. XII.	D A B	Bradshott Wood, . . . Claypit Copse, Oakwood Row,	S. part Whole ,,	8 3 ½	11½
1923-1924	IV. IV. IV. IV. VII.	B C D E B	Hazel Copse, Lower Ridges Copse, . . Upper Ridges Copse, . . Highfield Copse, Homefield Hanger, . . .	Whole ,, ,, ,, ,,	3 1½ ¾ 2½ 1	8¾
1924-1925	VIII. VIII. VII.	F G D	Bushy Copse, Island Copse, The Alder Bed,	Whole ,, ,,	5 1½ 2	8½
1925-1926	IX	E	Plainbarn Copse, . . .	S. E. part	11	11
1926-1927	VIII.	D	Bradshott Wood, . . .	N. part	7	7
1927-1928	IV.	A	Blackmoor Wood, . . .	N. E. part	8	8
1928-1929	IV.	A	Blackmoor Wood, . . .	N. W. part	8	8
				Total Acres, . . .		<u>171</u>

Average Area of Annual Fall, 8½ Acres.

* The lower, sheltered, and more productive portion.

Under ordinary circumstances it would have been advisable to locate the falls so that they follow in sequence from N.E. to S.W., as the heaviest and wettest winds come from the S.W. But as the copses do not form large compact blocks, and as past experience has shown that no great local danger may be apprehended on this account, it seems unnecessary to sacrifice other advantages connected with the present age of the coppice in various compartments merely to obtain additional security from a danger which is not imminent. Where practicable without sacrificing immature crops, the falls have been located so as to run from N.E. to S.W., and felling operations should annually be commenced at the N.E. side of the fall, continuing thence in a S.W. direction till completion. But on hill-sides the fall should also be commenced at the top and continued downwards in order to minimise damage to stools during the process of felling and extracting.

C.—THINNINGS, ETC., IN THE CONIFER PLANTATIONS DURING THE NEXT 10 YEARS (1899-1900 TO 1908-1909).

Year.	Block of Estate.	Compt.	Name of Plantation.	Area.	Treatment Recommended.
1899-1900	II.	C	Eveley Field Larches, .	5	Utilise Larch and replace with Corsican Pine
	II.	D	Eveley Field Larches, .	3	Utilise Larch and replace with Corsican Pine.
	III.	B	Rhododendron Plantation,	9	Sow Corsican Pine on prepared patches.
	VIII.	B	Cornbrooks Plantation, .	7	Fill existing blanks.
	VIII.	E	Bradshott Plantation, .	1	" "
	IX.	A	Rhode Plantation, .	10	Cut out softwoods, and sow blanks with Sycamore on prepared patches.
	IX.	B	Temple Larches, . .	5	Thin out suppressed and badly diseased stems only.
	IX.	D	Temple Hop-Garden Plantation.	2	Fill blanks with Sycamore, Ash, and Chestnut.
1900-1901	I.	A	Eveley Corner, . . .	16	Remove all dead branches and snags by cutting or sawing them off close to the stem; broken or diseased poles to be at same time thinned out.
	I.	B	Eveley Allotment, . .	2	
	I.	C	Eveley Birchwood, . .	2	
	II.	A	Church Plantation, . .	39	
	II.	B	Lemon's Firs,	4	
	III.	A	Vicarage Plantation, .	14	
	IV.	F	Wolmer Plantation, . .	10 $\frac{1}{2}$	
	XI.	B	Sandy Lane Plantation, .	$\frac{1}{2}$	
1901-1902	...	...	All Young Plantations, .	...	Fill blanks and cut out softwoods interfering with growth of main crop.
1902-1903	I.	C	Eveley Birchwood, . .	2	To be strongly thinned and underplanted with Corsican Pine and Spruce.
	IV.	F	Wolmer Plantation, . .	10 $\frac{1}{2}$	To be lightly thinned.
1903-1904	III.	A	Vicarage Plantation, .	14	To be lightly thinned.
	XI.	B	Sandy Lane Plantation, .	$\frac{1}{2}$	" "
1904-1905	II.	A	Church Plantation, . .	39	To be lightly thinned.

C.—THINNINGS, ETC.—*Continued.*

Year.	Block of Estate.	Compt.	Name of Plantation.	Area.	Treatment Recommended.
1905-1906	I.	A	Eveley Corner, . . .	16	To be lightly thinned.
	I.	B	Eveley Allotment, . . .	2	
	II.	B	Lemon's Firs, . . .	4	
	II.	C	Eveley Field Larches, . . .	5	
	II.	D	Eveley Field Larches, . . .	3	
1906-1907	All Young Plantations,	Cut out softwoods interfering with growth of main crop.
1907-1908	III.	A	Vicarage Plantation, . . .	14	To be thinned.
	IV.	F	Wolmer Plantation, . . .	10½	
	XI.	B	Sandy Lane Plantation, . . .	½	
1908-1909	II.	A	Church Plantation, . . .	39	To be thinned.

NOTE.—The light thinnings recommended should only extend, during the next five or six years, to the removal of suppressed, sickly, or badly cankered stems; but at each time of thinning, all snags of dead branches should be cut or sawn off close to the stem. The subsequent thinnings may be carried out much more freely, in some cases even extending to partial clearance and the formation of a new crop as underwood.

PART III.—MODE OF CARRYING OUT THE FELLINGS AND OTHER OPERATIONS RECOMMENDED.

Detailed recommendations have been made in the Field Book as to treatment of the various woods, but it may be convenient to give here a general summary of the operations intended to be carried out:—

(A) *As regards the Standards in the Copses.*—The overwood at present existing is at variance with economic treatment in three respects, namely:—

1. The trees run far too much into branches, instead of forming clean, long boles.
2. The standards are nothing like regularly distributed over the falls.
3. There is no regular gradation of age-classes in the overwood.

These defects can only very gradually be remedied, and it will take at least three periods of rotation (of twenty years each) to bring the copses into the normal condition which the recommendations of the Working Plan, as now framed, aim at ultimately attaining.

Something may, however, at once be done to correct the excessive branch development and to improve the marketable value of the stems by the removal of lower branches not exceeding about three inches in diameter. When this is done, the branches should be clean cut or sawn off close to the trunk—the lower side

being cut into first of all, to prevent tearing of the bark down the stem—and the wound-surfaces should be well coated with tar to prevent wound-rot. Tarring should be repeated subsequently, till the wounds cicatrise completely. But this operation, which has already in some of the copses been carried out to a considerable extent, must be conducted with caution. If proceeded with to any excessive degree, it is very apt to cause a flush of adventitious shoots along the lower portion of the stem, which may lead to stag-headedness and decay of the crown of the tree. Such pruning of branches should be done as soon as possible after the fall of the leaf in autumn, when the trees contain their minimum of sap and moisture. Apart from such partial treatment, there is no remedy for the excessive branch development and dissipation of vital energy in this manner. Standards of this nature can only be felled and utilised as soon as convenient, their places being gradually filled by the retention of young stores of better growth. This measure forms also the only practicable way of removing the second and third objections to the existing condition of the copses; for it enables the young stores to be more or less regularly distributed over each area, in greater or less numbers according to the productivity of the soil; and it ultimately furnishes a regular gradation of standards, each class varying in age by the twenty years which form the period of rotation of the coppice.

Owing to the great irregularity of the present crops, in which old standards are frequent but young stores scarce, the speedy formation of different classes of standards, varying regularly according to age, can only be achieved in course of time. With this end in view, the storing of overwood should be regulated as follows:—

STORING OF OAK STANDARDS IN COPSE, THE ROTATION OF THE FALL BEING ONCE EVERY 20 YEARS.

Age-Class of Standards.	Number of Standards selected to remain.	Age.	Average Individual Growing-space at Commencement of each Rotation.	Total Area overshadowed by the Standards.	
				Just after each Fall.	Just before each Fall.
Young Stores,	40	20	Sq. ft. 25	Sq. ft. 1,000	Sq. ft. 7,000
Double Stores,	20	40	175	3,500	9,000
Young Trees, .	10	60	450	4,500	7,000
Old Trees, . .	5	80	700	3,500	5,000
Total,	75	...	...	12,500	28,000
Proportion of Overshadowing by Standards,				about $\frac{2}{3}$ of area.	nearly $\frac{3}{4}$ of area.

NOTE.—For *ash*, the number of standards may be 50 per cent. in excess of above for oak; and mixtures of oak and ash as overwood should be calculated on these bases.

Considering the good quality of the soil, the above estimated amount of overshadowing towards the close of each period of rotation does not seem such as will prove excessively prejudicial to the coppice underwood; but the overwood is most to be considered, as likely to yield the main portion of the revenue. In addition to the clearance of the coppice, each fall will every twenty years be carried out as follows:—

Removed during each Fall.			Standards left after each Fall.			Remarks.
Class.	Age.	Number.	Class	Age.	Number.	
Coppice, . . .	Years. 20	all	Coppice Stools,	At each fall there will therefore be removed, along with the coppice, <i>all</i> the old trees, <i>an equal number</i> of young trees, <i>twice</i> as many double stores, and <i>four times</i> as many young stores. The <i>average</i> growing space of the standards will be $\frac{43560}{75} = 580$ square feet, and the <i>average</i> distance from stem to stem will be $= \sqrt{580} = 24$ feet.
Young Stores, .	40	20	Young Stores,	20	40	
Double Stores, .	60	10	Double Stores,	40	20	
Young Trees, .	80	5	Young Trees, .	60	10	
Old Trees, .	100	5	Old Trees, .	80	5	
Total,	...	40	Total,	...	75	

The young stems selected as stores should be of seedling growth, if available; and in any case they should be of good, straight development, with a well-shaped, compact crown of foliage. At each fall the inferior stems of each class in the overwood should be cleared away and utilised, leaving the best to attain the larger and more remunerative dimensions. As the future prospects point to advantage in the storing of ash, this tree should, on the whole, receive the preference when selecting the standards, not only on account of a larger number being retainable per acre, but also because, thus treated, it may be expected to attain its full maturity within 60 to 80 years; whereas oak might often require 100 to 120 years, and the latter, involving five classes of standards, seems inadvisable in dealing with the small areas now under treatment. As a general rule, it will perhaps be found advisable to remove all the ash standards at the age of 80 years, and only to allow oak to grow up as old trees to 100 years of age.

Where some of the older standards may have to be removed before the fall of the coppice, they should be lopped of all large branches and of the crown in order to reduce the amount of damage done to the underwood when felling.

(B) *As regards the Coppice Underwood.*—The present condition of the underwood is abnormal in two respects, namely:—

1. In many places there are blanks, or the stock is far from being of normal density;
2. Over most of the area the stock consists of species of trees which are not the most remunerative kinds that can be grown on and in the given soil and situation.

These defects can be much more easily and speedily remedied than the defects in the overwood. By sowing or dibbling in seeds of oak, ash, maple, sycamore, chestnut, beech, and in damp places also hornbeam, on prepared patches in autumn or spring, much can be done to improve the density of the underwood, and to raise up seedlings from which a good class of stores may be selected to form standards. These patches may be made of about four feet square, the earth being hoed or delved up and thoroughly mixed and pulverised before sowing the hardwood seeds. The soil-covering should vary according to the size of the seed, being somewhat over an inch of earth in the case of acorns and chestnuts. Although slower in attaining the object in view, the sowing and dibbling in of seeds of hardwoods has the advantages over planting of being much the cheapest method of improving the crop, and of being far less exposed to danger from rabbits, as local experience has shown. Material assistance can also be effectively rendered by the local system of "plashing" or layering ash and other hardwoods. This method of layering is strongly to be recommended in moist localities prone to heavy growth of weeds which would be likely to choke seedlings. Both of these measures should be carried out to a large extent during the next two or three years, so that, if this can be conveniently done, the whole area under copse (171 acres) may be gone over and improved within a very short period. If this suggestion be carried out, then at the time of the first regular fall of coppice the outer seedlings round all such dibbled patches should be plashed and the inner seedlings allowed to grow up to form the future stores. Most of the copsewoods seem well suited for the growth of ash and sycamore, and these species should be encouraged as largely as may be found practicable. Birch and aspen should be treated as weeds, and cut out wherever they are found interfering with the growth of hazel and hardwoods, and the latter should be freed from interference by hazel wherever the more valuable

species requires assistance in the individual struggle for light and growing-space.

If this can be arranged for, it would, in my opinion, be a very advantageous and a remunerative operation to go over the coppice-woods during the third year after the fall, for the purpose of cleaning them of all weeds (including the softwoods, birch, aspen, willow) interfering with hardwoods, and of thinning out the number of shoots springing from the stools. If this latter operation be not carried out, then the energy of growth often becomes dissipated over about six to ten shoots in place of being concentrated on the more rapid development of from two or three to five or six of the more vigorous stool-shoots.

(c) *As regards the Plantations.*—As these young crops are most of them showing the disadvantages arising from their having been formed at too great distances between the individual plants (up to 6 feet by 6 feet), the best thing to be done for the next few years is to avoid disturbing the canopy now formed, or still in process of formation, and to limit operations to the removal of dead branches and snags, and the cutting out of suppressed or badly diseased poles. Remunerative thinnings may be commenced in about four or five years' time, and continued regularly thereafter at intervals of about five years. Some of the plantations may then be partially cleared and a new crop raised beneath, the best trees being retained as standards to thicken into specially remunerative dimensions.

Where Scots and Corsican pine have been grown together, the latter seems to develop more vigorously and to attain the larger dimensions. It should consequently receive the preference in all future plantations on the sandy pine soils throughout the eastern portion of the estate.

Experiments should be made as early as convenient (see Field Book, Wolmer Plantation, IV. F) with the sowing of Corsican pine on prepared patches. If this operation prove successful, as may reasonably be expected, it will show that young plantations can be raised without wire-fencing against rabbits, and will thus enable operations in this direction to be extended on a larger scale and at much less cost than the plantations which have been formed in the past.

Cost of Planting and Distances between Plants.—Recent plantations have been made at 4 feet by 4 feet, and have cost about £8 an acre, including fencing against rabbits. Although costing more,

plantations at 3 feet by 3 feet seem on the whole preferable, for they form canopy sooner. As at the same time thinnings will prove remunerative earlier, this tends to ultimately equalise the cost of young plantations formed at 3 feet and at 4 feet by the time they reach twelve or fifteen years of age; while there can be no question about the closer planting being much more likely to yield a cleaner and taller class of poles, free from knots and snags affecting the quality of the timber.

New Afforestation in 1899-1900.—As regards the area it is intended to bring under forest this year, I would suggest, in place of planting, the experimental sowing of larch and Corsican pine in ploughed lines 3 feet apart—running parallel, *horizontally*, and not down the hill-side—next spring, in such manner that three lines of larch should alternate with one line of Corsican pine. As broadcast sowing of larch over the whole area requires about 14 or 15 pounds an acre, the amount of seed required for strip-sowing in furrows in this way should not exceed about 7 to 8 pounds per acre, while about 3 to 4 pounds of seed per acre should suffice for the Corsican pine.

Though requiring some weeding, this method of raising a young crop should be considerably cheaper than planting, while it will have the additional advantage of securing a thicker crop. Oak, ash, sycamore, maple, and Douglas fir can also, whenever convenient during the next two or three years, be planted out among the larch and pine in such places and to such extent as may then seem desirable, only the better portions of the soil being thus utilised, while blanks in the poorer parts can be filled up with Corsican pine.

Wind-mantles.—Many of the woods and plantations, and especially the smaller ones, are somewhat exposed to the action of wind along their south-western edges. In all such cases it seems advisable to plant two or three rows of spruce or Corsican pine closely together along the exposed edges, and to allow them to retain their foliage down to the ground, so as to form an efficient wind-mantle.

Forecast of the Conditions of the Crop in 1928-1929.—In the copses the underwood should be of normal density, and consisting to a large extent of hardwoods and other species, according to the local variations of soil and situation; while from the overwood the majority of the old branching trees will have been removed and their places taken by standards of better growth, more regu-

larly distributed over the falls, and tending towards regular gradation in age-classes. These objects cannot possibly be completely attained within the next thirty years; but the various steps recommended will all tend in this direction, and will enable subsequent operations to be carried out regularly to completion and to the attainment of a normal condition of both overwood and underwood.

Many of the conifer plantations will in thirty years' time have reached maturity, which is early attained on the poorer classes of sandy soil, and will be in process of regeneration. But special consideration of the treatment to be accorded to these depends so essentially on their growth during the next ten years (1899-1900 to 1908-1909), that the present Working Plan does not in their case look beyond this short period. At the end of this the plantations should be in normal canopy, and the older crops should be yielding remunerative returns in the way of thinnings.

The formation of Nurseries seems unnecessary for such small areas of woodlands as are here dealt with. For whatever planting is required, it seems preferable to draw the supplies from nursery-men, as hitherto.

Maintenance of Fences, Roads, Rides, etc.—No new works of this nature are necessary. On the contrary, if sowings and dibblings of larch, Corsican pine, and hardwoods prove successful, this will enable considerable reduction of expenditure to be made with regard to the fencing of young plantations.

Financial Results of Proposed Plan of Working.—As the next thirty years are in reality a period of transition for the copse-woods (during which the overwood will be brought from a very irregular towards a normal condition), as the monetary returns therefrom during such period will depend more on the extent to which the existing standards are cleared and utilised than on the yield of coppice, as the value of the thinnings and partial clearance of the older conifer plantations cannot yet be estimated with any approach to accuracy, and as the financial status will probably be greatly influenced by the formation of new plantations and by concrete circumstances connected with their formation (*e.g.*, if sowings prove successful, so that fencing and the more expensive method of planting may become unnecessary), it seems inexpedient to attempt to make any detailed financial forecast. So many specific data would have to be assumed, that the estimate could have no practical value at present.

When once the woods have been brought into normal condition, their average annual outturn should be:—

Kind of Wood.	Area.	Outturn of Produce.		Remarks.
		Per Acre.	Average Total Annually.	
Copse, . . .	Acres. 8½	5 old Oak (or 7-8 old Ash). 5 young Oak (or 7-8 Ash). 10 double Stores of Oak (or 15 Ash). 20 stores of Oak (or 30 of Ash).	42 Oak (or 63 Ash). 42 Oak (or 63 Ash). 85 Oak (or 127 Ash). 170 Oak (or 255 Ash). Bark from 340 Oak aged 40 to 100 years.	It may safely be estimated that the value of Oak and Ash timber 30 years hence will be greater than it is at present, and that the market value of clean, well-grown stems will be considerably higher than the price now obtainable for short-boled, branching trees.
	8½	... ..	8½ acres of coppice under-wood.	
Plantations (now exist- ing),	129¾	Thinnings every 5 years from all plantations from about 15 to 30 or 40 years, and partial clearance from age of 40 to 50 years, followed by gradual removal of the mature trees at about 60 or 70 to 80 or 90 years of age.		

The nearer the copsewoods are brought towards a normal condition—that is to say, after the preliminary rotation of ten years (1899-1900 to 1908-1909), and after the first regular rotation of twenty years (1909-1910 to 1928-1929)—the better should their financial outturn also be. It therefore seems safe to say, and it is all that can safely be said, that if the provisions recommended in this Working Plan be regularly followed, they will result in better material and monetary returns in forest produce, will enhance the capital represented by soil plus growing stock, and, by providing greater density throughout the coppice underwoods and the plantations, will increase and maintain the productivity of the soil.

Control Books.—As it is desirable that extra clerical work should be avoided in the estate office, the existing records of timber, etc., cut and disposed of, should be maintained as nearly as possible in the manner hitherto customary. The only modification, therefore, proposed, is the alteration of the outturn statement in the following form:—

APPENDICES.

APPENDIX A.—SUMMARY OF COPSEWOODS AND OF PLANTATIONS.

(NOTE.—The Block Numbers refer to recognised divisions of the whole estate.)

I.—Copsewoods.

Block of Estate.	Compt.	Name of Copse.	Area.	Coppice.		Standards.	
				Last Fall.	Present Age.	Girth.	Estimated Age.
IV.	A	Blackmoor Wood, .	31	1889, 1890, 1892, 1893, 1894, 1896, 1897, 1898	1, 2, 3, 5, 6, 7, 9, and 10	2 to 6	30-40 to 70-80
	B	Hazel Copse, . . .	3	1894	5	„	up to 70-80
	C	Lower Ridges Copse,	1½	1894	5	„	„
	D	Upper Ridges Copse,	3½	1894	5	„	„
	E	Highfield Copse, .	2½	1894	5	4 to 6	50 to 80
			Total area in Block,	38¾			
VII.	A	Squiresfield Hanger, .	2½	1890	9	3 to 4	30 to 50
	B	Homefield Hanger, .	1	1896	3	„	„
	C	Lane Hanger, . . .	2½	1893	6	„	„
	D	The Alder Bed, . . .	2	1897	2	up to 5	up to 50-60
			Total area of Block,	8			
VIII.	A	Snapwood,	33½	1889, 1891, 1893, 1894, 1895, 1898	1, 4, 5, 6, 8, and 10	...	30 to 40
	C	Cornbrooks Hanger, .	5	1888, 1893	6 and 11	6 to 7	90 to 120
	D	Bradshott Wood, . .	15	1892, 1894, 1896, 1898	1, 3, 5, and 7	up to 4	up to 50-60
	F	Bushy Copse, . . .	5	1896	3	...	35 to 40
	G	Island Copse, . . .	1½	1896	3	...	50 to 60
			Total area in Block,	60			
IX.	C	Temple Hanger, . .	16½	1888, 1889, 1893, 1894	up to 10- 12	...	Oak, 50 to 80 Ash, 40 to 50
	E	Plainbarn Copse, . .	21	1890, 1894, 1895, 1896, 1897	3, 4	3 to 4	50 to 60
	F	Iron Paddock Copse,	17	1892, 1893, 1894	5, 6, 7,	3 to 4	50 to 60
	G	Sothrington Lane Side,	4	1893	6	up to 7 to 8	up to about 120-150
			Total area in Block,	58½			
XI.	A	Oakhanger Pond, . .	2½	...	17, 18	4 to 6	40 to 60
		Total area of Block,	2½				
XII.	A	Claypit Copse, . . .	3	1891	8	up to 2½	20 to 30
	B	Oakwood Row, . . .	½	...	3	up to 6-7	80 to 100
		Total area of Block,	3½				
Total area under Copse,			171	Acres.			

II.—Plantations (consisting mostly of Pine and Larch).

Block of Estate.	Compt.	Name of Plantation.	Area.	Species of Crop.	Age of Plantations.
			Acres.		Years.
I.	A	Eveley Corner,	16	Scots Pine,	25-35
	B	Eveley Allotment,	2	" "	25-35
	C	Eveley Birchwood,	2	Birch, "	32
		Total area in Block,	20		
II.	A	Church Plantation,	39	Scots Pine,	33
	B	Lemon's Firs,	4	Scots Pine, Oak,	29
	C	Eveley Field Larches,	5	Larch,	14
	D	" "	3	Pine and Larch,	12
		Total area in Block,	51		
III.	A	Vicarage Plantation,	14	Scots Pine, Larch,	33
	B	Rhododendron Plantation (Total area 12 acres; under wood, 9 acres only),	9	Scots Pine, Larch, Corsican Pine, Birch,	29; 17-19
		Total area in Block,	23		
IV.	F	Wolmer Plantation,	10 $\frac{1}{4}$	Scots Pine, Larch, Chestnut, Birch,	30
		Total area in Block,	10 $\frac{1}{4}$		
VIII.	B	Cornbrooks Plantation,	7	Larch, Corsican Pine, Douglas Fir, Ash, Sycamore, Oak,	4
	E	Bradshott Plantation,	1	" "	4
		Total area in Block,	8		
IX.	A	Rhode Plantation.	10	Pines, Firs, Larch, Ash, Sycamore,	4
	B	Temple Larches,	5	Larch, Ash, Chestnut,	13
	D	Temple Hop-Garden Planta- tion,	2	Pines, Larch, Ash, Sycamore,	3
		Total area in Block,	17		
XI.	B	Sandy Lane Plantation,	$\frac{1}{2}$	Scots Pine,	29
		Total area in Block,	$\frac{1}{2}$		
Total area under Plantations,*			129 $\frac{3}{4}$	Acres.	

The Gross Total area under Woods is therefore—

Copse,	171	Acres.
Plantations,	129 $\frac{3}{4}$	"
Total,	300 $\frac{3}{4}$	Acres.

* ABSTRACT OF CONIFER WOODS.

	Acres.
Plantations under 5 years of age,	20
" from 5 to 15 years of age,	13
" " 15 to 25 "	4
" " 25 to 35 "	92 $\frac{3}{4}$
Total,	129 $\frac{3}{4}$

APPENDIX B.—FIELD BOOK,

Name of Copse or Plantation.	No. of Estate Block.	Compt.	Area. Acres	Soil and Situation.	Method of Treatment.	Description of Timber Crop.
Eveley Corner,	I.	A	16	A sandy soil on gently sloping ground, but nearly level on the lower portion. Soil poor, and varying in depth, as evidenced by the growth of the crop in height.	High Forest. Not desired to be worked on purely commercial principles.	Healthy Scots pine, varying from 20 to 40 feet in height, self-sown from the adjoining Wolmer woods since the area became private land, under the Wolmer Forest Enclosure Act of 1865. Some birch are to be found in the lower portions.
Eveley Allotment,	I.	B	2	Level to gently sloping sandy soil, apparently of considerable depth in parts, but in other portions wet and marshy in ordinary years. Soil covering consists mostly of heather, bell-heather, and coarse grasses. Under and near the patches of trees the dead foliage has formed good humus.	High Forest. Indefinite, but not to be altered.	Scots pine, self-sown as on I. A. The trees vary from about 20 to 50 feet in height. Where almost forming canopy, the growth is vigorous at the upper corner, having good drainage, but from their isolated position, the trees are badly shaped and branching. The greater portion of the area is unstocked, though, since the enclosure three years ago, young seedling pine are rapidly springing up, self-sown from the neighbouring woods. In the clumps on the higher ground the growth of the trees is as good as can be expected under the circumstances, some of the stems exceeding 30 inches in girth at breast height. On the higher ground at N. W. end, the soil being poor and dry, the growth of the trees is less satisfactory, while the soil covering consists for the most part of heather.
Eveley Birchwood,	I.	C	2	Soil sandy, moist, and slightly marshy in N. E. corner.	Young High Forest.	Pure clump of birch, about 40 to 50 feet in height, and up to over 24 inches in girth. There is a tendency to forked growth, and here and there the canopy is interrupted by small blanks, but on the whole the plantation is doing well.

Containing detailed Descriptions of the various Timber Crops.

Age.	Density and Canopy.	Remarks, and Treatment proposed.
<p>Years. 25 to 35</p>	<p>Incomplete ; only about one-third of the area being stocked.</p>	<p>The crop is self-sown, and the stock is confined only to patches here and there, with open blanks between. The trees are now producing seed abundantly, though the seedlings have no chance of growing up on account of grazing by cattle. Without enclosure, the area cannot become self-sown ; but it is not desired to enclose, as the land is specially required for sporting purposes. The growth of Scots pine is fair wherever the clumps form canopy. They have been recently thinned. There has been a considerable tendency to branching growth, owing to wide growing space for the individual trees ; but this is now correcting itself, so far as possible. Canopy should be carefully maintained in all compact patches, and only suppressed stems thinned out.</p>
<p>25 to 35</p>	<p>Incomplete, even in the patches ; and these only cover about one-half of the area.</p>	<p>About 10 years ago a fire passed over the middle portion of the area, and did considerable damage, so that many of the young trees had afterwards to be cut out. The young growth of the last 3 years is mostly in small family groups, which should grow up well. A few oak seedlings, brought by birds, look as if they were going to establish themselves. As it is not intended to plant up this area, self-sowing is to be allowed to continue : but blanks might advantageously be filled up with Corsican pine and spruce about 4 or 5 years hence, when self-sowing from the neighbouring Wolmer crown forests has proceeded further.</p>
<p>32 (planted 1867).</p>	<p>Complete in parts, broken in others ; very fair on the whole.</p>	<p>Thinned in autumn of 1896 ; but no shoots have sprung from the stools. In the course of the next 3 to 5 years, whenever most convenient, a strong thinning should be made, and simultaneous underplanting (or sowing, experimentally) carried out with Corsican pine and spruce. A few Scots pine are among the stock, and the best of these should be retained at time of thinning and underplanting.</p>

Name of Copse or Plantation.	No. of Estate Block.	Compt.	Area.	Soil and Situation.	Method of Treatment.	Description of Timber Crop.
Church Plantation,	II.	A	Acres 39	A sandy soil, with a fairly good layer of dead leaves and humus, which keeps it fresh. It is nearly level, with undulations here and there.	High Forest.	By far the greater part of the area was planted with Scots pine, irregularly, about 6 ft. by 6 ft., in 1866-67. In consequence of this wide planting, the individual trees have run early into branch formation; but this has already begun to correct itself, through formation of canopy and dying off of the lower branchlets. In the better portions of the crop, the trees are about 30 to 45 feet in height, with a maximum girth of 30 inches, while in the other parts they vary from about 25 to 35 feet in height, and up to 26 inches in maximum girth. Portions of the plantation are overgrown with bracken. The S. portion of the area, S. of the fence and near the churchyard, is intended to be treated arboriculturally, and is omitted from consideration in the Working Plan.
Lemon's Firs,	II.	B	4	On lower portion a sandy soil with a slight admixture of loam, on upper part a pure sandy soil, but all forming a good fresh forest soil, while well protected against sun and wind. The area is a gentle slope facing the S.W.	Young High Forest, with a few standard Scots pine.	Originally, apparently, a crop of Scots pine: this was cleared about 1870, except a few stems here and there with good clean boles, which have been retained to the number of about a dozen altogether, now ranging from about 4½ to over 5 feet in girth at breast height. Beneath these few standard pine, oaks were planted in or about 1870, which now vary from about 18 to 30 feet in height. These now form a more or less broken canopy in parts, while other portions are blanks. Except in the best parts, the soil is completely covered with bracken. The oaks look healthy, but their development is branching, and not good; and it seems questionable that they will ever form good boles, yielding high-class timber.

Age.	Density and Canopy.	Remarks, and Treatment proposed.
<p>Years. 33 (planted during 1866-67).</p>	<p>Normal in parts; light, and even broken, in other parts.</p>	<p>The plants having originally been put out at too great a distance apart, branch development has been greater than is desirable. The plantation is now of itself correcting this defect, and nothing should be done for the next 4 or 5 years to interrupt the canopy in any way. In the meantime, only broken or unhealthy poles should be cut out. All round the edges of the wood, and wherever there are blanks, Corsican pine should be sown or planted.</p> <p>After about 4 or 5 years a thinning out of dominated poles may perhaps become necessary.</p> <p>It is advisable to clean the boles of the dead branchlets by cutting or sawing them off close to the stem; and the sooner this operation can be carried out, the better will be the quality of the timber produced.</p>
<p>29 (Oak planted about 1870).</p>	<p>Fair in parts; other portions forming blanks.</p>	<p>The planting has originally been too wide (about 6 ft. by 6 ft.) in consequence of which the branch development is excessive, in place of growth in height having been stimulated by speedy formation of canopy. The lower branches, up to about 3 inches in diameter, of the young oaks should be removed wherever this can be done without interfering with such canopy as exists; and Corsican pine should be sown experimentally on prepared patches, or else planted in blanks and comparatively open spaces among the oaks.</p> <p>The standard Scots pine look healthy, and can in the meantime be allowed to stand and attain larger dimensions. A belt of two rows of Corsican pine should be planted along the S.W. edge to serve as a wind-mantle.</p> <p>[NOTE.—An outlying area of level sandy soil, of about 1 acre in extent, was planted in February 1899 with Corsican pine at 8 ft. by 8 ft.; but, owing to the drought in summer, nearly all the plants have died. This is to be replanted (so sown in strips, experimentally) early in 1900; if planted, the plants should not be put out at a greater distance than 3 ft. by 3 ft.]</p>

Name of Copse or Plantation.	No. of Estate Block.	Compt.	Area. Acres	Soil and Situation.	Method of Treatment.	Description of Timber Crop.
Eveley Field Larches,	II	c	5	A loamy sand, of better quality than the soils of the neighbouring plantations	Larch poles, intended to form High Forest.	Thrown out of arable cultivation in 1885, the land was planted during that autumn with pure larch, at from 2½ to 3½ feet apart. At first the growth was very good, but in 1890 and 1891 serious attacks of larch canker became noticeable, and heavy thinnings had consequently to be made. The result is that the young poles, now varying from about 12 to 18 feet in height, stand almost completely isolated, and have consequently failed to form canopy.
Eveley Field Larches,	II	d	3	As in II.c, of which this originally formed part.	Young High Forest of pine and larch, of different ages.	Only about one-quarter of area still remains under larch, as originally planted in spring of 1887, on land then thrown out of cultivation. This is of better growth than the crop on II. c, canopy being almost formed in parts. But larch canker is here also general. The height of the poles varies from about 18 up to 25 feet, and girth runs up to 13 or 14 inches. Over about three-quarters of the area the young plants put out were killed by drought in 1887, and the land was left vacant (except a portion used as a nursery) till 1897, when it was planted up with Scots pine and a few spruce, with occasional Weymouth and Corsican pines. This part looks healthy, save here and there, where plants have died from drought and "leaf-shedding" disease.
Vicarage Plantation,	III.	A	11	A sandy soil, similar to that of II. A, of which it forms the higher portion, being	High Forest.	On the level portion the crop is similar to the adjoining II. A, on the other side of the public road. A few larches, survivors of some put out along with the

Age.	Density and Canopy.	Remarks, and Treatment proposed.
<p>Years. 14 (planted autumn 1885).</p>	<p>Incomplete; canopy nowhere normal.</p>	<p>The remnants of the crop are all attacked with canker, and should be felled and utilised as soon as convenient. A few elm, Scots pine, and sweet chestnut were put in during the spring of 1899, but most of them have died off from the drought of the past abnormally dry summer. In the case of the Scots pine, this has apparently induced attacks of the "leaf-shedding" disease as the direct cause of death. Self-sown oak are beginning to make their appearance, and towards the S. part of the plantation birch stool-shoots (from self-sown seedlings very properly removed at last cutting out of cankered larch poles) help to protect the soil. These stool-shoots should be removed when replanting, and during subsequent cleanings.</p> <p>The soil is not a larch soil, but a very good pine soil; and Corsican pine should form the bulk of the new crop. Here and there on the best parts small patches of oak, elm, larch, and Douglas fir might be planted. A wind-mantle of spruce or Corsican pine should be formed by planting two or three rows along the S.W. and N.W. edges, for the protection of the soil against the effects of wind.</p>
<p>12 (planted in spring 1887).</p>	<p>Of larches, incomplete; good in parts, small blanks in others.</p>	<p>The larches look much better than in II. c. They have been thinned lightly, but no clearing was made on account of canker. Most of them are cankered, however; and it seems best to utilise the poles now, and plant up (or sow) as recommended for II. c.</p> <p>The young pine plantation requires nothing except the removal of the dead plants—and <i>burning</i> them to destroy the spores of the fungus disease occasioning "leaf-shedding"—the vacant spaces being filled with Corsican pine. A wind-mantle of two or three rows of spruce or Corsican pine should be planted along the exposed margins on the S. and W. sides. Self-sown birch will need to be cut out from time to time to clean the crop.</p>
<p>33 (planted in winter 1866-67).</p>	<p>Normal in parts, light and broken in other portions.</p>	<p>As in II. A, only the cleaning away of the dead branchlets close to the stems of the pines should be taken in hand at present; and the removal of stems during the next few years should be confined solely to suppressed and unhealthy poles.</p> <p>On the S.E. slope, where the growth of larch is poor, all save</p>

Name of Copse or Plantation.	No. of Estate Block.	Compt.	Area.	Soil and Situation.	Method of Treatment.	Description of Timber Crop.
Vicarage Plantation— <i>Continued.</i>	III.	A	Acres 14	only separated from it by the Blackmoor-Whitehill road. To the E. the soil dips with a gentle slope facing E. S. E., where the soil is poorer and drier than on the higher level ground.	...	pine, are still holding their own, and girth up to 2 feet 6 inches, while the Scots pine range up to 2 feet 10 inches in maximo. As in II. A, the original wide planting (irregularly, about 6 feet by 6 feet) has resulted in excessive branch development, which the formation of canopy is now tending to rectify. On the hot S. E. exposure there are patches of larch and a few chestnut among the pines, but their growth is poor.
Rhododendron Plantation,	III.	B	9	A poor, white sandy soil, belonging to the Lower Greensand; level to undulating. [The total area is 12 acres, of which only 9 acres are wooded.]	High Forest.	Originally this plantation was formed in 1870 of Scots pine and a few larch. In March 1880 the N. E. end was burned through, and was replanted between the autumn of 1880 and 1882 with Scots pine, Corsican pine, and birch, with a few mountain ash along the N. W. edge. The planting all through was 6 feet by 6 feet, and often more; and even in the older parts canopy is not yet formed. In the younger portion the Corsican pine is doing better than the Scots pine; some run up to about 30 feet in height, and girth nearly 24 inches. On the whole the plantation is poor, mainly in consequence of wide planting on a soil of so poor a nature.
Blackmoor Wood.	IV.	A	31	Gault clay, on almost level ground, sloping very gently towards S. E. and S. A rich fertile clay, highly suitable for the growth of oak and other hardwoods. The general growth in height of the oak standards shows the soil to	Copse.	Worked as copse, with a rotation of 10 to 12 years. The standard trees are almost entirely of oak, the coronal development of which is excessive, in consequence of their having been grown for arboricultural effect rather than upon purely commercial principles. A very few ash, beech, birch, and aspen are to be found among the younger standards, but practically all are of oak. The coppice consists mostly of hazel, with ash and a few birch,

Age.	Density and Canopy.	Remarks, and Treatment proposed.
Years. ...	...	<p>the best should be cut out and utilised soon. All blank spaces and breaks in the canopy should be planted (or sown) with Corsican pine. A row of this might also be planted along the edge of the road as a wind-mantle. Thinning will probably be unnecessary for the next 4 to 5 years.</p>
<p>29 (planted 1870), and 17 to 19 (planted 1880 to 1882).</p>	<p>Not yet formed, and in many places large blank spaces.</p>	<p>Nothing can be done to improve this plantation except to try the experiment of sowing Corsican pine freely (as it seems to grow better than anything else here) on prepared patches throughout all the blanks, and as underwood beneath the older pines and larches. If the Corsican pine establishes itself successfully, as there seems reason to anticipate, then the poorer stems can be thinned out from the present crop, and the remaining pine and larch be allowed to grow up along with the Corsican pine as High Forest. When these experimental sowings of Corsican pine are being made, the snags of all dead branches should be removed from the stems now forming the crop.</p>
<p>Coppice, 1 to 10 years. Oak standards vary from about 30-40 to 70-80 years of age. Larch, 12 (planted in February 1887).</p>	<p>Good in parts, but with blanks varying in size in the other portions.</p>	<p>The branching, large-crowned oak standards are a concrete factor which cannot be altered all at once. So far as may be safe, their lower branches have been lopped and the wound-surfaces tarred: and nothing more can be done to them in the immediate future.</p> <p>All blank spaces and thin patches in the coppice should, however, be freely "plashed" or layered, and dibblings should be made with the seeds of hardwoods of all sorts—oak, sycamore, maple, elm, ash, chestnut, beech, etc.—on prepared patches, so as to improve the quality of the underwood, to bring it into normal density, and to provide a plentiful supply of stores when the next fall passes over the copse. Oak, ash, and sycamore should especially be encouraged.</p> <p>As there is no special preference on the part of the owner for the growth of oak, and as ash seems to grow uncommonly well,</p>

Name of Copse or Plantation.	No. of Estate Block.	Compt.	Area.	Soil and Situation.	Method of Treatment.	Description of Timber Crop.
Blackmoor Wood —Continued.	IV.	A	Acres 31	be deep, though here and there, in small patches, low branching crowns point to shallower surface soil. In many parts there is a strong growth of blackberries, and in some of the larger blank spaces there is a heavy growth of bracken, reaching up to 6 feet in height.	...	and aspen, willow, and field maple. On S.S.E. the old pheasantry beat, bordering the parks, was planted early in 1887 with larch and a sprinkling of ash, now being suppressed by the larch. A few standard oaks were allowed to remain when this portion of the park was enclosed and planted. The larch is doing very well, and only a few of the stems seem to be cankered.
Hazel Copse,	IV.	B	3	A clayey loam, formed from the Gault clay; nearly level, with slight depression running down to the S.W.	Copse.	Standards of oak range from 2 to 6 feet in girth. Some are well grown, but others have very branching crowns. The underwood consists mostly of hazel, with birch and willow in the wet hollows.
Lower Ridges Copse,	IV.	C	1½	A loamy clay, on a slope facing W.	Copse.	This is only a narrow belt of woodland, with many oak standards, girthing from 2 to 6 feet, and a few small ash. Along the E. edge there are a few rows of larch, Scots pine, and Corsican pine, planted in 1871. Some of the larch are cankered, but otherwise the growth of all the trees in the belt is good. The coppice consists mostly of hazel and ash, but there are numerous blanks in it.
Upper Ridges Copse,	IV.	D	¼	Loamy clay, as in IV.C, partly level at upper end, thence sloping gently towards the W.	Copse.	Standard oaks of 2 to 6 feet in girth, with a fine group of larch, about 30 years of age, in the N.W. corner. Coppice, chiefly of hazel, with blanks here and there.

Age.	Density and Canopy.	Remarks, and Treatment proposed.
Years. ...		<p>the standards should in future consist for the most part of ash, which can be left in considerably larger numbers per acre than oak standards. During the next three rotations of the underwood, the present oak standards should be utilised, while fresh standards are raised by storing ash and oak — but principally ash—of seedling growth as equally as possible over the area.</p> <p>It is suggested, if funds can be conveniently spared for the purpose, that, early in the third spring after each fall, the coppice should be cleaned of weeds and of the softwoods (birch, aspen, willow) wherever they may be found interfering with the development of hardwoods, and that weakling stool-shoots of the latter should be cut away to promote the more rapid development of the remaining shoots. The present method of “plashing” or layering hazel, ash, etc., should be continued in blanks, but preference should first be given to sowing hardwoods as above recommended.</p> <p>A few Douglas fir might be planted here and there at 4 ft. by 4 ft., or larch at 3 ft. by 3 ft., on larger blanks so as to form small family groups by way of variety; for they should grow rapidly and yield good returns on this class of soil and in admixture with copse.</p>
Standards from about 30-40 to 70-80 years of age. Coppice, 5 years.	Standards rather unequally distributed. Too many stand in some parts, and too few in others.	<p>Should receive similar treatment to what is recommended for IV. A.</p> <p>At first only the most branching of the oak standards should be utilised, while a new supply is being provided by storing oak and ash.</p> <p>The coppice should at next fall be improved by introducing hardwoods, and endeavours should be made to grow ash and sycamore to as large an extent as possible, both along with oak on the drier parts among the hazel, and also on the damper portions now occupied solely by the softwoods.</p>
Standards, 2 to 6 feet in girth, about 30-40 to 70-80 years. Conifers, 28 years. Coppice, 7 years.	Standards crowded in parts, while other parts are blank.	Should receive treatment as recommended for IV. A.
Standards, 30-40 to 70-80 years. Larch, about 30 years. Coppice, 7 years.	Distribution of standards irregular. Density of coppice, poor.	Treatment similar to that recommended for IV. A.

Name of Copse or Plantation.	No. of Estate Block.	Compt.	Area.	Soil and Situation.	Method of Treatment.	Description of Timber Crop.
Highfield Copse,	IV.	E	Acres 2½	A good, deep fresh soil, varying from sand to loamy sand; slopes very gently towards W., at which end the soil is a loamy clay.	Partly copse, partly High Forest.	A mixture of oak, from 4 to 6 feet in girth, originally standards in copse, with sycamore, maple, elm, lime, beech, and other trees, planted between 1868 and 1871. Some of the maple and sycamore now girth up to 3 feet at breast height. The crop now forms full canopy in some places, while in others there are blanks; and in some of these blanks self-sown sycamore are coming up abundantly. Where it still exists, the coppice is mostly of hazel, but patchy, with birch here and there.
Wolmer Plantation,	IV.	F	10¼	Deep sand, belonging to the Lower Greensand, level to undulating.	High Forest.	Crop consists mostly of Scots pine at N. end, planted in lines somewhat irregularly at 4 to 6 feet apart. This portion is now just forming normal canopy, but a growth of bracken covers most of the ground. The growth in height varies from about 30 to 50 feet, and the stems girth up to 2 feet 3 inches in maximo. The S. and W. portions were planted at same time (1869) with larch, chestnut, birch, and a few Corsican pine. Here the larch is doing well on the W. side, where it girths up to 2 feet 3 inches, while some of the chestnut range up to 2 feet 6 inches. On the poorer soil at the S. end there was much more birch planted, which now forms the principal tree, the larch having become so cankered that most of it had to be removed, while the chestnuts were cut out 5 years ago, in the hope that they would grow better by shooting from the stools,—a hope which is not being realised. All parts of the plantation, except the pine, are open, and the soil is covered with bracken for the most part, except on the poorest portion, where birch forms the crop.

Age.	Density and Canopy.	Remarks, and Treatment proposed.
<p>Years. 28 to 31 years (planted 1868 to 1871).</p>	<p>Normal in parts, interrupted in other portions.</p>	<p>Only the most branching of the oaks should be removed, together with limes and other less valuable kinds of trees. Before removing any trees, however, an undergrowth of hardwoods should be provided by sowing seeds freely on prepared patches (sycamore, maple, ash, chestnut, elm); otherwise, there may be danger from weeds. The beeches and other trees along the S.W. edge should be carefully retained as a wind-mantle. With these exceptions, the treatment should be on the general principles recommended for IV. A.</p>
<p>30 (planted 1869).</p>	<p>Almost normal in the portions under pine; open with blanks among larch and birches.</p>	<p>The pines require nothing at all at present, except the removal of dead branches and snags from the stems. They may be thinned 3 or 4 years hence; but only dominated stems should then be removed.</p> <p>Under the larches, on the lighter soil, the seeds of a few hardwoods (sycamore, maple, ash) might be sown on prepared patches, as there is a good deal of light and the soil seems fresh; while on the poorer portions Corsican pine might be sown. If sowings fail in the latter case, then Corsican pine should subsequently be planted, as the present crop of 30-year-old birch will soon become marketable, and should then be cleared to make room for a better crop.</p> <p>[NOTE.—Some Corsican pine sprinkled among the Scots pine are quite outgrowing the latter. Two, at the edge of a green ride, are about 50 feet high, and girth 2 feet 5 inches and 2 feet 9 inches respectively at breast height. Corsican pine tends here to develop a broad branching crown, unless this is checked by the maintenance of close canopy.]</p>

Name of Copse or Plantation.	No. of Estate Block.	Compt.	Area.	Soil and Situation.	Method of Treatment.	Description of Timber Crop.
Snapwood, .	VIII.	A	Acres 33½	Gault clay soil, bordering on the Upper Greensand. Much the same as the soil of IV. A.	Copse.	Similar on the whole to IV. A, but the oak standards are about 30 to 40 years of age, and in some parts the crowns are so low and the branch formation is so excessive, as to make it advisable that the trees should be soon utilised in favour of fresh stores of ash and oak. The coppice is thick, and of excellent growth, but birch and aspen are in many places interfering considerably with the growth of oak and ash.
Cornbrooks Plantation,	VIII.	B	7	A loamy clay soil. Aspect S.W. at upper end, but sloping gently towards S.S.W. A good fertile soil where drainage is good, but stiff, cold, and wet at S.W. end.	Young plantation for High Forest.	Plantation formed of Douglas fir at 16 ft. by 16 ft., Corsican pine at 8 ft. by 8 ft., and filled in with larch at 4 ft. by 4 ft.; consequently larch forms the great bulk of the crop. Blanks were filled in autumn of 1898 with ash and sycamore, the latter being confined mostly to the slope, ash only being put in the cold wet bottom. Except on this latter portion, the crop is doing well. The larch shoots of 1899 measure up to a maximum of 3 feet 2 inches, while those of Corsican pine range up to 2 feet 3 inches. The Douglas firs are still backward in growth. At the upper end a good many ash and oak seedlings and stool-shoots, already on the ground in 1895, are among the crop, and are growing well in advance of the younger portion.
Cornbrooks Hanger,	VIII.	c	5	Loamy clay, from the Upper Greensand, on a slope facing S. and S.W.	Copse.	The old standards are of oak, with a few ash and one or two beech; the younger standards are mainly of ash and oak. The coppice consists mostly of hazel and ash, with birch, field maple, aspen, and a few elms.

Age.	Density and Canopy.	Remarks, and Treatment proposed.
<p>Years. Oak standards, 30 to 40 years. Coppice varies from 4 to 8 years of age.</p>	<p>Normal.</p>	<p>Treatment as recommended for IV. A. If funds are available, it seems desirable to at once cut back birch and aspen, which are interfering with the growth of oak and ash. At next fall all the oak standards with very branching crowns should be utilised, and their places taken by selected ash and oak, and preferably the former, as likely to yield better and earlier monetary returns.</p>
<p>4 years (planted in autumn of 1895).</p>	<p>Canopy not yet formed.</p>	<p>Nothing whatever is at present required, except to fill up some existing blanks. It will be some years before canopy is formed or thinnings become necessary. Cleanings may also be unnecessary; for there are, as yet, no softwoods likely to interfere with the growth of the more valuable species.</p>
<p>Coppice, 6 to 11 years. Oak standards up to 6-7 feet in girth.</p>	<p>Almost normal.</p>	<p>Treatment should be on similar principles to those recommended for IV. A. The standards stored in future should consist only of ash and oak, with an occasional elm; while the growth of hardwoods in the coppice should be encouraged by dibbling seed on prepared patches at each rotation, and by layering freely. Softwoods should always be weeded out wherever they are interfering with more valuable species.</p>

Name of Copse or Plantation.	No. of Estate Block.	Compt.	Area.	Soil and Situation.	Method of Treatment.	Description of Timber Crop.
Bradshott Wood,	VIII.	D	Acres ...	A loamy clay, from the Upper Greensand, on a slope with a S. exposure; moist even on the slope, and wet at the bottom.	Copse.	The bulk of the underwood consists of hazel, willow, ash, and birch, with field maple and alder in the wetter parts. In portions the stock is fairly complete, but in other parts there are blanks, some of which are occupied with bracken. Sets of willow were put out in 1896 to fill blanks in area then felled, but the majority of those have not succeeded in establishing themselves.
Bradshott Plantation,	VIII.	E	1	A loamy clay, on a gentle slope facing N.E.	Young plantation for High Forest.	Similar to VIII. B, with blanks filled in similar manner in 1898. The growth of larch is good at the W. end, which is completely sheltered by copse and high oaks, the shoots of 1899 measuring up to 3 feet 3 inches. Throughout the rest of the plantation the growth is rather poor, especially in the moister portion. The Corsican pine and Douglas fir are not as yet doing well. The ash and sycamore, planted in blanks in autumn of 1898, have done well considering the hot dry summer of 1899. Self-sown seedling oaks are coming up along the S. edge.
Bushy Copse, with Snap Row,	VIII.	F	5	A loamy clay, on gentle slopes with S. aspect.	Copse.	Crop of good growth. The standards are mostly of oak, varying from about 3 feet (Bushy Copse) to 5 feet in girth; well developed in Bushy Copse, but with rather branching crowns in Island Copse. The coppice forms good underwood, stocking the ground fairly well, except in Duck Row, where blanks are numerous. It consists chiefly of ash and hazel, with a good deal of alder and birch.
Island Copse, with Duck Row,	VIII.	G	1½			
Squiresfield Hanger,	VII.	A	2½	Soil, a clayey loam (malin), of average depth. All three Hangers are gentle slopes facing N. and N.E.	Copse.	Crop well grown, with sparse standards of oak and ash from about 3 to 4 feet in girth, of rather branching development. Coppice of hazel, with ash, birch, and alder, and a little chestnut (in A only). Stock of coppice generally good, with but few blanks.
Homefield Hanger,	VII.	B	1			
Lane Hanger,	VII.	C	2½			

Age.	Density and Canopy.	Remarks, and Treatment proposed.
<p>Years. Coppice, 1 to 8 years. Standards of oak and ash up to about 4 feet in girth.</p>	<p>Normal in parts; but stock of coppice incomplete in other parts.</p>	<p>Should be treated according to the general principles suggested for IV. A and other copses. In this moist area, however, the hardwoods will probably have to be increased in number principally by layering, on account of the danger otherwise to be apprehended from the tendency to rank growth of weeds. But sowing of seeds of hardwoods on prepared patches should be tried in addition to plashing, as it would not cost much, and it is only by means of sowing (or planting) that hardwoods can be introduced where they are not already to be found.</p>
<p>4 years (planted 1895-96).</p>	<p>Not yet formed.</p>	<p>Treatment as for VIII. B; but softwoods may perhaps require cutting out in a few years time at N.W. corner, where self-sown birch is already beginning to make its appearance.</p>
<p>Coppice, 5 years. Standards, 35 to 60 years.</p>	<p>Irregular.</p>	<p>Treatment on principles similar to recommendations for IV. A.</p>
<p>Coppice, 4 to 6 years. Standards, 35 to 40 years.</p>	<p>Fairly good, though somewhat irregular.</p>	<p>Treatment on principles recommended for IV. A.</p>

Name of Copse or Plantation.	No. of Estate Block.	Compt.	Area.	Soil and Situation.	Method of Treatment.	Description of Timber Crop.
			Acres			
The Alder Bed,	VII.	D	2	A loamy clay; fertile, but heavy and moist.	Copse.	Standards fairly numerous, chiefly of oak, up to 5 feet in girth, with a few smaller ash. The oak standards have large and branching crowns. The coppice consists mainly of withy and alder, with some ash. It is rather sparse, and with blanks here and there taken up by blackberries and other weeds.
Rhode Plantation.	IX.	A	10	A loamy clay, formed from the decomposition of the Upper Greensand. It forms a good deep soil on the upper portions, but is shallower and inclined to be wet in the low-lying hollows. The area slopes with an E. aspect.	Plantation for High Forest.	<p>Thrown out of arable cultivation in 1895 and 1896. Part of the area was planted in 1895-96 (mostly in spring of 1896) with Douglas fir at 16 ft. by 16 ft., Corsican pine, spruce, and Scots pine at 8 ft. by 8 ft., and larch at 4 ft. by 4 ft. between the other plants. Blanks have since been filled with poplar, ash, and sycamore.</p> <p>In the good portions, the growth is all that can be desired. The larch have made shoots up to 3 feet 6 inches in length during 1899, and the Douglas fir up to 4 feet 3 inches, while the Corsican pine has also done well. The spruce have only just established themselves, but are now beginning to grow energetically.</p> <p>The W. portion of the plantation was formed in 1897 with Corsican pine at 8 ft. by 8 ft., and ash and sycamore alternately at 8 ft. by 8 ft. in between those. Blanks were filled in 1898 with ash and Corsican pine. They are doing as well as can be expected after two such abnormally hot and dry summers in succession.</p>
Temple Larches,	IX.	B	5	A loamy clay soil, having a gentle slope towards N.E. A good,	Young plantation for High Forest.	The greater portion was planted in 1886 with alternate ash and larch at about 2½ to 3 feet apart. The larch now forms the pre-

Age.	Density and Canopy.	Remarks, and Treatment proposed.
<p>Years. Coppice, 2 years. Standards up to 50 to 60 years.</p>	<p>Irregular, and with occasional blanks.</p>	<p>Treatment as for VIII. D, to which this area is adjacent.</p>
<p>4 years (planted 1895-96).</p>	<p>In parts, canopy is already beginning to form. Other portions are still too backward for this.</p>	<p>Nothing should be required for some years, till thinning may be needed, except to cut out softwoods (birch and willow) if they threaten to interfere with the more valuable trees. A few blanks might be sown with sycamore on prepared patches.</p>
<p>2 years (planted in 1897).</p>	<p>...</p>	<p>Nothing required in meantime except filling blanks.</p>
<p>13</p>	<p>Good.</p>	<p>In 1895 some 10,000 larch poles were cut out for hop-poles (fetching £40). The wood is now in good canopy in most places, and even so crowded in parts as to be in want of thinning; but only suppressed stems should be removed, with</p>

Name of Copse or Plantation.	No. of Estate Block.	Compt.	Area.	Soil and Situation.	Method of Treatment.	Description of Timber Crop.
Temple Larches —Continued.	IX.	B	Acres 5	deep, fertile soil, under arable cultivation till 1886.	...	dominating portion of the crop, with a good sprinkling of ash, many of which are holding their own well. The larches are now about 30 feet in height, and girth up to a maximum of 17 inches in the wood and 21 inches at the edge of it. Unfortunately canker has developed on most of the poles. In two portions, at the N.W. and the S.E., a few scattered ash were put out in 1886, while more regular planting with larch, ash, and chestnut took place in 1895. Here the growth of the ash and the chestnut is good; and these will probably form the ultimate crop.
Temple Hanger,	IX.	C	16½	A clayey loam, from the Upper Greensand. The soil is stony and shallow at the top of the Hanger, but deep, fresh, and fertile on the lower part and down in the valley. The Hanger faces S.E., E., N.E., and N.; and the slope is very steep in parts.	Copse.	The standards consist chiefly of oak, with ash, beech, and sycamore. Many of these have very spreading crowns, which take up a large amount of space, besides heavily overshadowing the underwood. The coppice consists chiefly of hazel, with oak, ash, beech, and birch on the top, and with ash, chestnut, willow, and sycamore near the valley and at S. end of the Hanger.
Temple Hop-Garden Plantation,	IX.	D	2	A loamy clay, partly level and partly sloping towards S.E., fringing the S. end of Temple Hanger.	Young plantation for High Forest.	Planted in autumn of 1896 in manner similar to IX. A. The majority of the firs died off, and they have been replaced by ash and sycamore, with a few silver fir in the bottom.
Plainbarn Copse,	IX.	E	21	A loamy clay soil, from the Upper Greensand; gently undulating ground, with an E. and S.E. aspect.	Copse.	Oak standards mostly between 3 and 4 feet in girth, with an underwood of hazel, ash, chestnut, and numerous willows, birch, and alder in the moister parts.
Iron Paddock Copse,	IX.	F	17	Similar to IX. E for the most part; but it also runs out into the Gault clay.	Copse.	As in IX. E; but standards of oak and ash are rather more numerous.

Age.	Density and Canopy.	Remarks, and Treatment proposed.
<p>Years. ...</p> <p>1</p>	<p>...</p> <p>Good in parts.</p>	<p>perhaps a little more assistance given to well-grown ash wherever they are being interfered with.</p> <p>Nothing required in the meantime. A first thinning will have to be made in a few years' time. Here and there blanks might be filled with sycamore.</p>
<p>The oak standards vary from about 50 to 80 years, and ash from about 40 to 50 or 60 years. Coppice ranges up to 10 or 12 years.</p>	<p>Good at base of Hanger; incomplete on the steeper slopes and at the top.</p>	<p>Blanks in the underwood should be filled by layering and dibbling in seeds of sycamore, oak, ash, chestnut, and beech, on similar principles as for IV. A,—preference being here given to sycamore and ash.</p> <p>At next fall the large-crowned oak and beech, and any ash having very branching crowns, should be utilised, and fresh stores of ash and oak (preferably ash) selected to form standards in future.</p> <p>If difficulty is found in stocking suitably the upper portion of the Hanger, it might be best to plant conifers in patches.</p>
<p>3 years.</p>	<p>Not yet nearly formed.</p>	<p>Nothing can be done in the meantime, except to fill up all blanks,—preferably with sycamore, ash, and chestnut.</p>
<p>Oak standards, 50 to 60 years. Coppice, 3 to 4 years.</p>	<p>Irregular.</p>	<p>Treatment on same principle as for IV. A and VIII A.</p>
<p>Standards, 50 to 60 years. Coppice, 7 to 12 years.</p>	<p>Irregular.</p>	<p>As for IX. E.</p>

Name of Copse or Plantation.	No. of Estate Block.	Compt.	Area.	Soil and Situation.	Method of Treatment.	Description of Timber Crop.
Sothrington Lane Side,	IX.	G	Acres 4	Soil as in IX. E.	Copse.	As in IX. E.; but coppice poor, and standards of oak, ash, beech, yew, and chestnut, large and numerous. Some of the oak girth 7 to 8 feet (largest 8 feet), and one large chestnut girths 9 feet 5 inches at breast height.
Oakhanger Pond,	XI.	A	2½	A deep, moist, light sandy loam to sand, surrounding Oakhanger Pond and on islands. Situation sheltered.	Indefinite: arboricultural.	This wood has hitherto remained untouched, except by planting in 1881 and 1882 a few Scots pine, larch, and Corsican pine. The crop consists mostly of old willows and birch, fringing the pond and growing along its edges, and with oak on mounds round the outer edges. These oaks girth from about 4 to 6 feet, but do not form good trees. Many of the willows are large and of fantastic shapes, while the birch are of younger growth, having also been planted on the islands in 1881 and 1882.
Sandy Lane Plantation,	XI.	B	½	A pure white sand, as in III. B.	High Forest.	Scots pine, planted about 1870, which are healthy enough, though their growth has not been rapid.
Claypit Copse,	XII.	A	3	Gault clay, stiff and moist; level, with depressions here and there, formerly used as claypits.	Copse.	Standards of oak with ash, both girthing up to about 2½ feet. They are of fair growth, the crowns not being too branching. The coppice consists mostly of ash and hazel. It is fairly well stocked, except in the old pit-holes.
Oakwood Row,	XII.	B	½	A clay soil, on a gentle slope with S. aspect.	Copse.	Standards of oak up to about 6 to 7 feet in girth, and with large branching crowns, forming big, over-mature timber of inferior marketable quality. Underwood, hazel, with a few oak seedlings sparsely scattered over the area, and with many blanks, chiefly overgrown with blackberries and similar weeds.

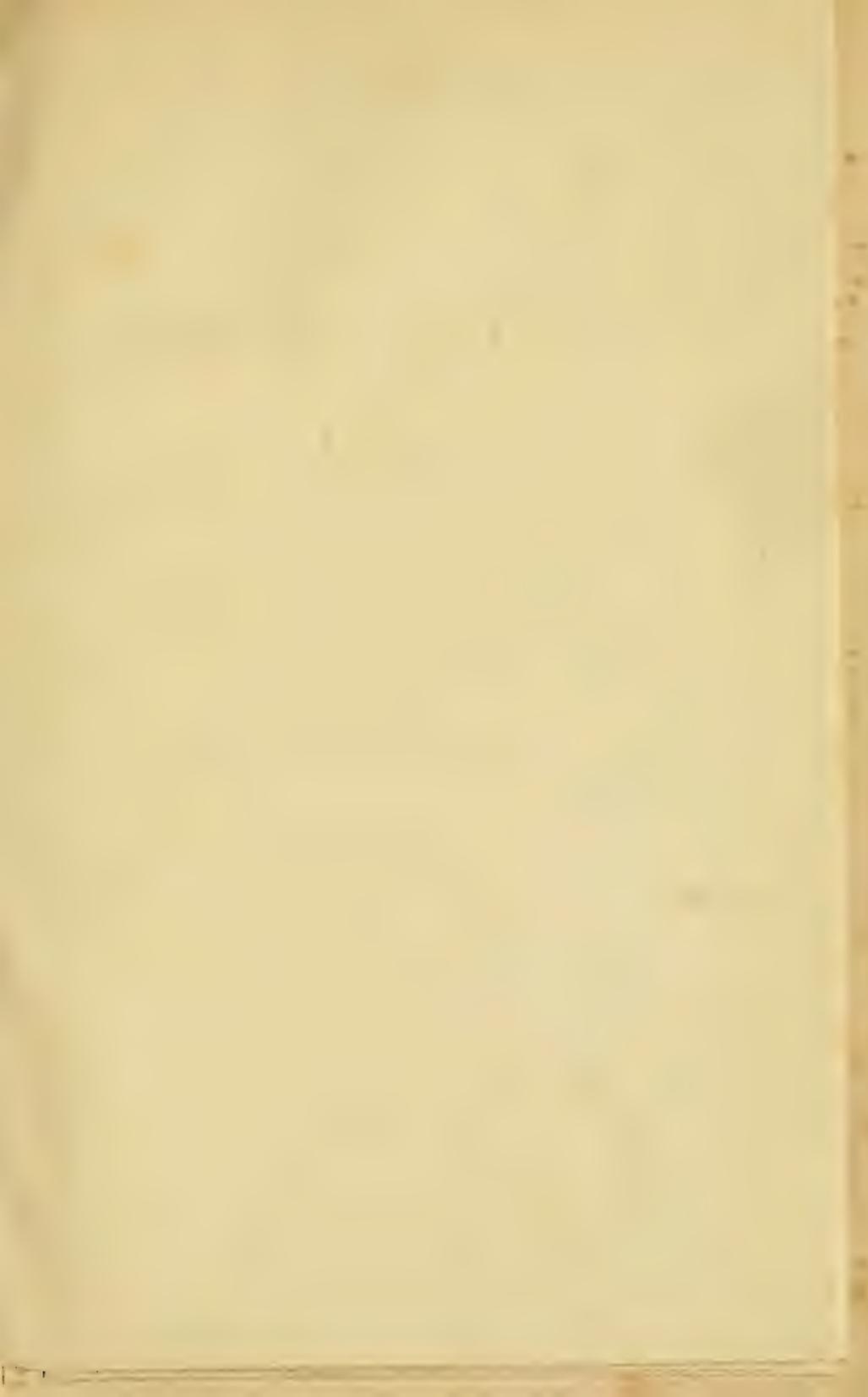
Age.	Density and Canopy.	Remarks, and Treatment proposed.
Years. Standards up to 120 to 150 years. Coppice, 7 years.	Irregular.	As for IX. E.
Various, from 17 years upwards.	Irregular.	As the deep moist soil is prone to heavy growth of blackberries, nettles, balsam, and other large weeds, it seems advisable to sow—even under the shade of the existing crop, and without opening it up in any way—seeds of oak, ash, sycamore, and maple, on large prepared patches of 4 ft. by 4 ft. to 6 ft. by 6 ft. At about the second or third year the young stems all round the edges of these prepared patches can be layered, while those inside are allowed to grow up into seedling poles. The clearance of the present stock of willows, birch, etc., should not be begun till the new stock of hardwood seedlings and plashers is actually assured; otherwise the deep moist soil will be certain to produce a very rank growth of big weeds, likely to choke small seedlings or transplants. Some of the best of the birch trees might in any case be retained to develop into large girth, as they seem likely to form fine stems.
29 years.	Irregular.	Treatment as recommended for III. A.
Coppice, 9 years. Standards, 20 to 30 years.	Irregular.	Treatment similar to that recommended for IV. A, to which area it is adjacent.
Coppice, 3 years Standards, 60 to 80 or 90 years.	Irregular.	Treatment as for IV. A.

APPENDIX C.

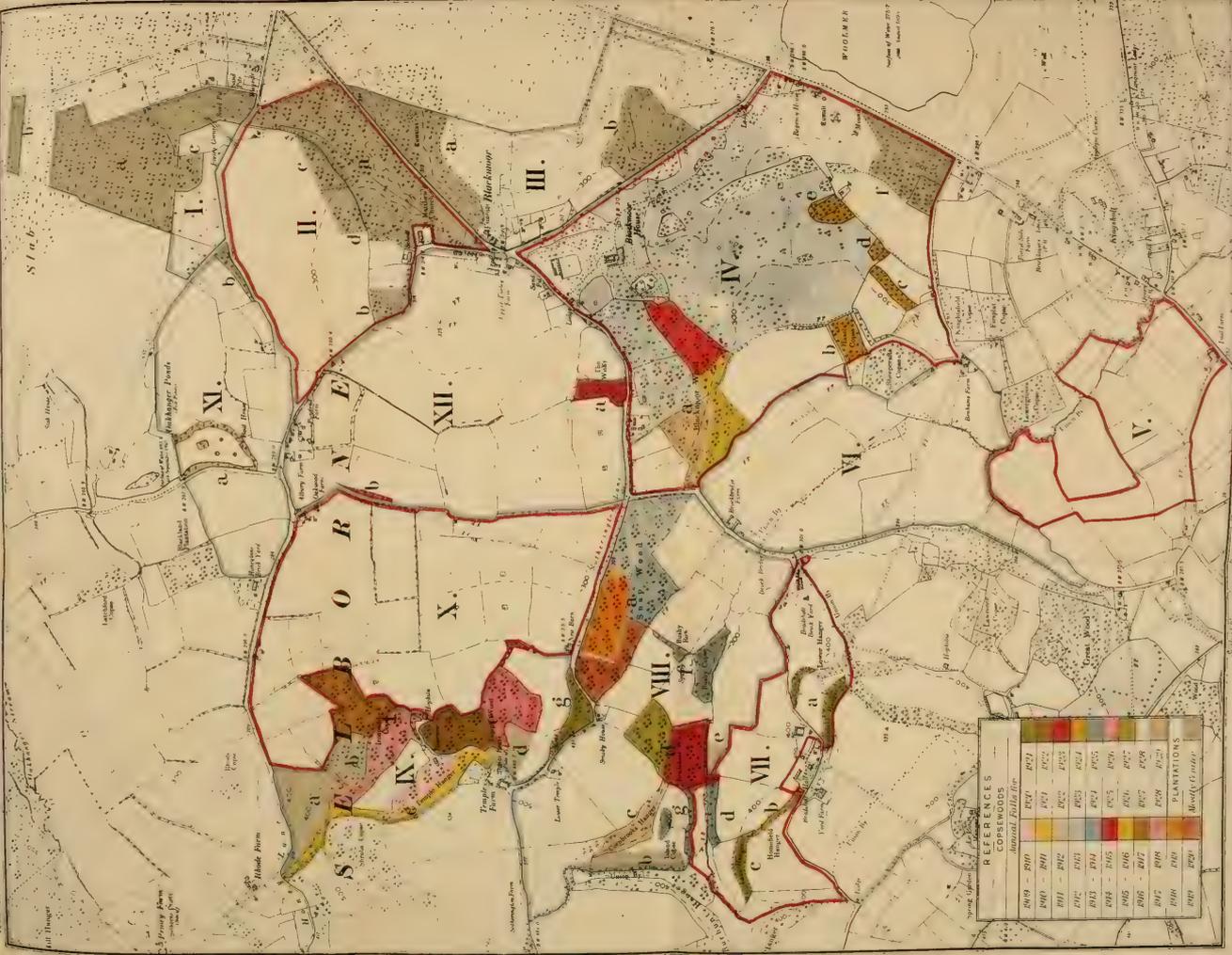
THE MAPS TO ACCOMPANY THE WORKING PLAN,
SHOWING THE ANNUAL FALLS

(1899-1900 to 1908-1909, and 1909-1910 to 1928-1929),

as hereto annexed.







REFERENCES	
COPSEWOODS	
Number	Actual Colour
8019 - 8020	8021 - 8022
8040 - 8041	8023 - 8024
8041 - 8042	8025 - 8026
8042 - 8043	8027 - 8028
8043 - 8044	8029 - 8030
8044 - 8045	8031 - 8032
8045 - 8046	8033 - 8034
8046 - 8047	8035 - 8036
8047 - 8048	8037 - 8038
8048 - 8049	8039 - 8040
8049 - 8050	8041 - 8042
PLANTATIONS	
Borra Forest	

XVIII. *A Visit to Dr Schlich's Forests at Mirwart.*

By Colonel F. BAILEY.

The following notes, made by me during a visit paid in the spring of 1898 to Dr Schlich's estate of Mirwart, in the Belgian Ardennes, may, I hope, interest readers of the *Transactions*. Mirwart lies on the main line of railway running between Brussels and Metz. Much of this hilly region is still under forest, of which 2844 acres belong to the estate. The woods, at an elevation ranging from 900 to 1300 feet above sea-level, occupy a series of undulating hills with rounded tops, which are frequently extended into plateaux. The rock is clay slate. The soil is for the most part a somewhat stiff loam, but clay is found in some places; the soil is shallow, rocky, or stony on southern aspects, but elsewhere it is of good depth. The mean annual rainfall is from 35 to 40 inches.

The growing stock is constituted as follows:—60 acres of oak coppice, which is to undergo conversion into high forest; 100 acres of Scots pine, from fifteen to thirty years old; and the remainder, 2684 acres, carrying crops of beech and oak, generally mixed with a small proportion of hornbeam, sycamore and Norway maple. About 2000 acres of the last-named area have been under-planted with spruce, except in the most choice localities, where either acorns have been dibbled in or one-year-old oak seedlings have been planted to the number of 8000 to the acre.

GRAND CAMPE.

A forest of beech, oak, and other hardwood trees of all ages, the remnant of a forest formerly worked on the "Selection" system. The stock had been very irregular; and though in a few places it was sufficient, the crop was for the most part far too thin, yielding an annual increment of perhaps not more than 15 to 20 cubic feet per acre, instead of 100 cubic feet, as it should have done. It was desired to remedy this state of things, and to obtain a full increment from the soil by under-planting with spruce, to be grown for pit-props. But notwithstanding the general deficiency in the stock, some thinning had to be done in places in order to permit the introduction of the spruce; and a secondary object of this treatment was to realise the value of the trees to be thus taken out.

The general rule followed in thinning was to remove all mature trees, with such as were diseased, injured, or misshapen, and would not improve sufficiently to warrant their being left standing throughout the rotation of the spruce, that is for a period of forty years. In the denser parts, however, which occupied but a small proportion of the area, under-planting was not contemplated; and here fewer trees were taken out, the object being to leave the cover as complete as possible.

After this thinning, the greater part of the area carried a light crop of from 40 to 60 hardwoods to the acre; and these were carefully pruned to a height of about 16 feet from the ground, all branches under 3 inches in diameter being cut off close to the stem; the spruce were then introduced, 2-year-1-year plants being pitted at 4 feet 3 inch intervals (2400 to the acre).

An area of 1700 acres on the estate has now (in 1900) been treated on this principle. The oldest of these spruce plantations, 450 acres in extent, and planted during the season of 1893-94, has already attained a height of 12 feet, and, growing vigorously, presents a remarkably healthy appearance. After the lapse of forty years, the spruce will be cut for pit-props, and the remaining hardwood standards will be dealt with as may then appear expedient.

In order to carry out the fellings of spruce, the forest, which will bear an even-aged under-crop of that species, will be divided into four blocks; and, to avoid risk of damage by insects, through felling in successive years on adjacent compartments, the cuttings will be arranged as follows:—

First Year in Block A,
Second Year in Block B,
Third Year in Block C,
Fourth Year in Block D;

after which they will recommence in Block A, so that there will be a clear interval of four years between two successive cuttings in any block.

Where the young spruce may be interfered with by coppice-shoots, already existing, or springing up as a result of the thinning, they will have to be protected by cutting back the coppice. In similar woods, where the soil was not considered good enough

for spruce, the White (Weymouth) pine has been substituted for it.

FIVE-HUNDRED ACRE FOREST OF HARDWOODS.

Here, though the stock was deficient, and the annual increment much below what it should have been, the crop was far better than that found in Grand Campe, but the proportion of oak was too small. The treatment laid down was to pick out the thinner parts, where the scantiness of the crop was not due to poverty of soil, and to extend them by thinnings, made with a view to the planting of one-year-old oak seedlings to the number of 8000 to the acre, or about 2 feet 4 inches apart. It had originally been intended to introduce the oak by dibbling in acorns at intervals of 12 to 15 inches, but this intention had to be abandoned owing to the depredations committed by mice. After about ten years, when the young oaks have had time to establish themselves, the denser parts of the wood will be regenerated for beech; and the result will be a mixed forest of oak and beech, arranged in groups, the oak being at least ten years older than the beech.

At Mirwart, it is not advisable to leave isolated beech standards, as they are liable to injury, inducing disease, occasioned by the direct impact of the sun's rays on their exposed stems, especially during severe frost. Beech standards also expand their crowns too widely, and grow into trees of small value.

OAK COPPICE ON A SOUTHERN SLOPE.

A worn-out coppice. The open spaces had been planted up with oak seedlings, which were destined to grow into standards, and to yield additional and vigorous stools for coppice. In places where the soil is very poor, Scots pine had been planted between the stools.

RIBELLE ROSE.

A very irregular beech-wood, consisting chiefly of poles with some trees of larger size, and a few oaks; also some naturally sown beech seedlings, in patches up to ten years old.

The treatment was to be as follows, viz.:—

- (a) To widen openings over natural growth of beech, and thus permit its extension.

- (b) Where the cover was light enough, and the natural growth of beech insufficient or absent, to under-plant with spruce.
- (c) To plant larches here and there amongst the natural growth of beech, and amongst the young spruce in the more open parts.
- (d) To defer for a time the regeneration of the denser parts of the crop.

The result of this treatment will be a mixed crop of beech and spruce, arranged in groups, with some larch scattered throughout them.

FANGE D'ESTANG.

Swampy ground, with a thin young coppice of birch, oak, and other species. The ground had been planted up with spruce at 3 feet 3 inch intervals; the plants were looking yellow, and many of them were making but little progress, especially in the wetter places. But on the little bank made by soil thrown out of the ditches, they were doing well. A good plan might have been to make small ditches and ridges at 8 or 10 feet apart, and to plant spruce on the ridges. The intervals between the lines thus formed might have been stocked with birch, which, however, grows spontaneously in places.

A little farther on we entered a thin forest of beech poles under-planted with spruce, a few oaks being seen in the thinner parts.

LA HURE DU CHAPEAU.

A forest situated on an open, sunny, southern slope, the soil being thin, dry, and stony, with a covering of short grass and herbs from 6 to 12 inches high. The ground was to be sown with Scots pine, in accordance with an old local practice, as follows:—

The denser parts of the herbage to be burned off, and the seed to be sown broad-cast without further preparation of the soil. Shallow trenches, from 3 to 4 inches deep, to be then dug with pick and shovel at $6\frac{1}{2}$ feet intervals, the sods and soil being scattered between the trenches. This soil, together with that knocked out of the sods, falling through the herbage, was to afford a light covering to the seed.

The estimated cost of this method of sowing is 10s. for the seed and 32s. for the work, in all £2, 2s. per acre.

FOSSE ORBAN.

Here thinnings of undesirable trees had been made, and a light crop, consisting principally of oak, remained; this was to be under-planted with spruce, the oaks being pruned up to a height of about 16 feet. The shade was for the most part too heavy for a crop of Scots pine, but this tree has since been sown on the more open and drier portions of the area.

SAPINS DE BIOLIN—30 Acres.

A crop of Scots pine, about twenty-four years old, raised by broad-cast sowing.

The *first thinning* had been made at the age of nineteen years, when dead, injured, misshapen, and suppressed trees only were taken. It realised about 4s. an acre net. A *second thinning* had been made at the age of twenty-one years; it was similar in character, and realised about 16s. an acre net. A *third thinning* had been made (at the age of twenty-four years). It resembled the above, but a few additional stems were removed from patches which appeared too dense. It realised £2 an acre net. The crop remaining after the third thinning consisted of about eighteen hundred stems to the acre, or about half the number that had been previously cut out. The height of the dominant trees was 39 feet, their diameter being 5 inches at 4½ feet above the ground. Dead branches had been knocked off up to a height of 8 feet. The ground was covered with moss, unmixed with grass, indicating that the cover was not too open. A *fourth thinning*, similar to the third, has since been made at the age of twenty-seven years, and has realised £4 an acre net. A *fifth thinning* will be made at the age of thirty years. It will be somewhat heavier than those preceding it, in order to allow the remaining trees to expand more rapidly in girth. It is expected to yield £8 an acre net. The crop on the ground after this thinning will be about six hundred trees to the acre.

If it be then decided to clean-fell for pit-wood at the age of forty years, and if it be evident that the desired diameter will be attained at that age, the crop may be left alone; but, if necessary, a *sixth thinning* will be made between the thirty-sixth

and the thirty-eighth years, in order to promote the further development in diameter of the final crop. This crop, together with the produce of the sixth thinning, if made, is expected to realise from £55 to £65, or say £60 an acre net. After it has been removed, the ground will be re-sown with Scots pine.

The financial returns will probably work out somewhat as follows, viz.:—

			£	s.	
First thinning at 19 years,	.	.	0	4	<i>realised.</i>
Second „ 21 „	.	.	0	16	„
Third „ 24 „	.	.	2	0	„
Fourth „ 27 „	.	.	4	0	„
Fifth „ 30 „	.	.	8	0	<i>expected.</i>
Final crop at 40 „	.	.	60	0	„
Total . .			£75	0	an acre net.

This represents a net sale-price equivalent to £1 17s. 6d. per acre per annum.

The produce of the Mirwart Woods is sold either by public auction, by private contract, or by tender, the last being the more usual practice. The crops are all sold standing, the purchaser felling and converting the trees, and removing the timber. Scots pine poles, from twenty to thirty years old, sold as pit-wood, realise about 3½d. per (¼-girth) cubic foot net; at thirty-five to forty years old the net price rises from 4d. to 4½d.; at fifty years old to 5d.; and so on. Old Scots pine fetches a net price of 7d. or 8d.; beech realises from 7d. to 10d.; oak, on an average, 1s. 3d. per (¼-girth) cubic foot net.

If, at about the thirty-fifth year, it should be decided to let the wood stand to produce timber of larger size, instead of cutting at the age of forty years for pit-wood, a thinning will then be made, sufficient to permit the introduction of an under-crop of beech; and further thinnings will subsequently be made, from time to time, to enable the beech to develop. The produce of these thinnings will be sold as pit-wood, and the best of the Scots pine trees will be left as standards until they attain their most profitable dimensions. The final crop will, in the end, probably consist of pure beech.

Had the crop on Sapins de Biolin been composed of spruce instead of Scots pine, the rotation of forty years for pit-wood

might have been adhered to; but the first thinning would probably not have been required until about the twenty-fifth year. Even at that age, the number of dead, dying, and suppressed trees would probably have been small, and it might have been found necessary to remove a portion of the healthy stems in order to afford more growing space for those left upon the ground. Thinnings might have been necessary at short intervals between the twenty-fifth and the thirty-second years, after which a comparatively heavy thinning would have been made, in order to allow the stems of the final crop to put on girth. At the age of forty years, the crop per acre might have been expected to consist of from 800 to 900 trees (as compared with 600 in the case of Scots pine), these trees being about 55 feet high, and having a girth at breast-height of about 18 inches. The volume of such a crop would be about 30 per cent. higher than the crop of Scots pine, and the yield per acre per annum might approach 150 cubic feet. On the stock being removed, it would probably have been renewed by planting spruce at 4 feet intervals.

A HILL-SIDE,

from which a crop of Scots pine, consisting of 600 trees to the acre, and forty years old, had been cut for pit-wood in 1892. The ground had then been planted up with Scots pine, spruce, and White (Weymouth) pine. The treatment contemplated was to utilise all thinnings made up to the age of forty years as pit-wood. The greater part of the Scots pine would be taken out during these thinnings, and the remainder of the crop, mostly spruce and White pine, would be allowed to grow on into high forest. At the end of the rotation, the area might be restocked with spruce by the method of Natural Regeneration.

VALUATION SURVEY.

A matter well worth recording in connection with these forests is the manner in which Dr Schlich made, a few years ago, a rapid valuation survey of them. He spent three days in passing through all the blocks which make up his total area of 2844 acres. Once within the woods, he commenced by marking off upon the ground an area of one-tenth of an acre. On this small plot he estimated the value of every tree; he then walked on, at an even pace, for exactly ten minutes by the watch, when he halted,

marked off a second area of one-tenth of an acre, and likewise estimated the value of every tree upon it. He proceeded in this manner throughout the whole of the three days; and, adopting the measured plots as sample areas, he calculated from them the money value of the stock standing on the various blocks of the forest and on the whole property.

He has since been able to check the correctness of a portion of his work, and the following figures may be taken as fairly representing the degree of accuracy he attained. A block called Les Loches was estimated to carry stock worth £11,960. Having cut and sold timber from this block to the net value of £8400, he carefully measured what was left, and found it worth £3960. These two values added together amount to £12,360, only £400, or $3\frac{1}{2}$ per cent., in excess of his valuation. On the whole, so far as he has data for forming an opinion, Dr Schlich believes that his other estimates will turn out to be from 4 to 5 per cent. below the actual values, and will thus leave a suitable margin to meet unforeseen contingencies. Considering the very irregular nature of the crop, which changed in character every few yards, the results attained by his rapid survey are truly astonishing. They testify in a remarkable manner to his experience and skill in estimating.

XIX. *Forest Operations in County Galway, Ireland.*

The following remarks are taken from a Report by Dr SCHLICH, written in 1895, but not hitherto published.

1. PAST OPERATIONS AT KNOCKBOY.

The Knockboy estate consists of a block of land 914 acres in extent, of which about 62 acres are water. It has a compact shape, about three-tenths of its boundary pointing to the north-west, three-tenths to the south-west, and four-tenths to the east. The topographical features are as follows:—A hill of moderate height is found in the northern part, which is connected by a ridge with a higher hill situated outside the estate. Knockboy hill slopes down to the west, south, and east, the slope being of an undulating character, thus producing various smaller hillocks, until it runs out into bog up to 10 feet deep on the south and east boundaries. There are several small loughs on the south-west and east boundaries. The underlying rock is granite, which appears in solid masses in the more elevated parts, but is generally broken up into a coarse sand near the surface. The soil is peaty throughout, and differs very considerably in depth. On the slopes the peaty soil reaches only a moderate depth, which, in this respect, is everywhere fit for planting. On the more level parts the bog attains various depths up to 10 feet, if not more.

Owing to its position on the immediate west coast of Ireland, Knockboy is exposed to the influence of strong westerly gales and the accompanying spray of salt-water. This is especially the case on the top, and the western and south-western slopes of Knockboy hill; but owing to the moderate height of the hill, these effects are also visible on the eastern slope, though perhaps not to the same extent.

Fencing.—The area has been fenced in, the fencing consisting mostly of galvanised iron posts and wire, erected on the Carrimony¹ system; the posts are generally butted into stone. Part of the fence, on the west, consists of a turf dyke with two wires on the top. I understand that the fencing costs about 1s. per running yard.

Draining.—On the slopes, where the peaty soil is shallow, surface drains have been cut, wherever required; these drains are, naturally, irregularly distributed over the area. On the

¹ Ordinary galvanised wire with metal standards, set in stone.

boggy parts the drains are 30 feet apart, and from 3 to 6 feet deep, according to circumstances, so as to give everywhere a sufficient gradient. The drainage water goes into the various loughs. The cost of draining differs very considerably, having ranged between 10s. and 40s. an acre.

Planting Operations were carried out over the following areas:—

Season 1891-92, about 90 acres.	
„ 1892-93, „ 200 „	
„ 1893-94, „ 200 „	
Total, about	<u>490</u> „

A great variety of trees were planted, as will be seen from the following list:—

<i>Broad-Leaved Species—</i>	No. of Trees.
Alder, black,	56,000
„ white,	57,600
Ash, common,	13,500
„ mountain,	18,000
Beech,	11,000
Birch,	42,500
Buckthorn,	40,000
Chestnut, Spanish,	1,000
Elder,	38,900
Elm,	11,500
Oak,	3,000
Poplar, black,	41,400
„ white,	24,000
Sycamore,	60,700
Willow, Gort,	18,500
„ Huntington,	17,000
	<hr/>
	154,600
<i>Conifers—</i>	
Fir, silver,	5,000
Larch,	443,900
Pine, Austrian,	35,400
„ Corsican,	9,000
„ Hooked,	10,000
„ Maritime (Pinaster),	3,000
„ Pumilio,	94,400
„ Scotch,	943,300
Spruce, Norway,	419,600
„ white American,	10,000
	<hr/>
	1,973,600
	<hr/>
Grand Total,	<u>2,428,200</u>

The planting was generally done according to the notching system, partly in autumn and partly in spring.

The Results of Planting are so far disappointing. Beginning with the broad-leaved species, I may say that—

Birch,	} are practically all dead.
Elder,	
Mountain Ash,	
Willows,	
Sea Buckthorn,	

The remaining broad-leaved trees have suffered severely, dying from the top downwards; still a good many are alive, and these should be cut back before the growing season of 1896 commences. Only a few alder, here and there, are doing well. Some oak and beech are alive, but nothing can be expected of them.

Of the conifers:—

Corsican Pine,	} are practically all dead.
Maritime Pine,	
Silver Fir,	

Larch is dying down from the top.

Spruce is partly dead; still a good proportion is alive, though most of these look miserable, having only the last season's needles on. Only in a few boggy parts, where grass grows, have they done better.

Austrian pine has done fairly well.

Scotch pine differs very much in different parts; in some places they have done fairly well, in others they look weedy and lanky; still the vacancies are not very numerous.

Mountain pines (*Pumilio* as well as *Hooked*) have done best of all; they look very well; it should be noted that they have only been planted lately.

To sum up: So far only Mountain, Austrian, and Scotch pines have proved that they will thrive in a locality like Knockboy. Of these the Scotch pine is the most valuable timber tree. Austrian pine comes next, and the Mountain pine cannot be expected to yield anything but shelter, and finally firewood. As regards the remaining species, the experiment is not conclusive. As far as I could observe, the various works connected with this plantation have been carefully carried out by the forester in charge, but I could, of course, not judge in how far the plants

had suffered in transit before they reached Knockboy, and were taken charge of by the forester. I am inclined to think that many of the plants must have arrived in a condition which made them unfit to cope with conditions so unfavourable as those found at Knockboy; at least I cannot explain in any other way why such species as alder, birch, and willow should have proved such failures.

2. POINTS TO BE CONSIDERED IN PLANTING IN COUNTY GALWAY.

In considering the advisability, or otherwise, of continuing planting operations in a district like County Galway, three main points require special consideration, and these are,—

- (a) The salt spray carried inland by the sea winds.
- (b) The heavy westerly gales to which the district is exposed.
- (c) The boggy nature of the soil.

As regards the first and second points, I arrived at definite conclusions during my visit to Galway. The third point was of a much more difficult nature, and I considered it desirable to go and see some older plantations on bog lands of varying depth. For this purpose I visited a number of places situated in the North of Germany, between Bremen, Hamburg, and Cuxhaven on the North Sea. There I examined plantations on bog lands up to 24 feet deep, and I am now in a position to express a definite opinion.

(a) *The Salt Spray.*

The strong westerly winds blowing direct from the sea are so heavily laden with salt spray, that they exercise a most injurious effect upon the young trees of most species. Indeed, the forester of Knockboy informs me that, frequently after one day's gale, the foliage of the plants looks burned up. The effect decreases with the distance from the sea-shore, so that it is probably not felt beyond five miles or so in a direct line from the sea. Unfortunately the whole of Knockboy is situated within that distance. As far as the present experiment goes, it appears that the effect is more severe in the case of broad-leaved species than of conifers. At any rate, only the pines and spruce seem to have withstood this injurious influence, but I should not be

surprised if further experience were to prove that alder and birch will also overcome it. All the other timber trees will always have a hard struggle against this injury, and in parts to such an extent that I consider profitable forestry out of the question on the slopes which are immediately facing the west coast.

(b) *The Westerly Gales.*

The strong winds generally blow from a direction which lies between south-west and north-west; hence woods growing on such aspects are specially liable to be thrown or crippled in their development. The effect decreases on going inland in an easterly direction. The conclusion to be drawn is that, immediately near the sea-shore, profitable forestry is only possible on slopes with an aspect between south-east and north-east, and on level land lying to the east of fairly high hills. With increasing distance from the coast, northern and southern slopes may be added, and, under proper arrangements, westerly aspects also. Knockboy Hill, being of very moderate height, gives little protection even to its eastern slope. On the other hand, at Ballinahinch, profitable forestry can already be carried on in spite of the westerly gales, a fact which is proved by the fine woods (including oaks and silver firs) which have been produced there. And on the slopes running down towards Lough Corrib, as well as in the vicinity of Oughterard generally, very promising woods of various species, more especially of larch, Scotch pine, spruce, and silver fir have been produced.

(c) *The Boggy Nature of the Soil.*

The soil throughout the Knockboy estate may be described as more or less boggy, except small portions on the hill where the rock appears on the surface. The depth of bog varies from a few inches to over 10 feet. So far, it has not been possible to observe any decided difference in the progress of the young trees on shallow and on deep bog. The oldest plantation is, however, only four years old, and this particular area is exposed to other very unfavourable conditions described under (a) and (b). Of the older plantations which I saw in County Galway, none are situated on deep bog land, so that they do not teach us in how far success on deep bog may be looked for. Under these circumstances I had to look elsewhere for evidence, and this I found in

a number of bogs situated in the vicinity of Bremen and Hamburg. There I visited more particularly the reclamation works which have been carried out in the bogs of Hellwege, Augustendorf, and Burgsittensen.

Hellweger Bog.

This bog has a depth of up to 25 feet. On parts where the peat had been cut, and the upper part only, unfit for fuel, left on the mineral soil, I found very flourishing woods of oak, spruce, and Scotch pine. On the uncut bog, of an original depth of 24 feet, where draining operations were commenced nearly a hundred years ago, and in the vicinity of a settlement, I found very fine spruce and oak woods. Both were about forty-two years old, and the trees showed the following average dimensions:—

Spruce—Height, 54 feet; diameter, 12 inches, measured at 4 feet from the ground. The trees were straight and in every way well grown.

Oak—Height, 45 feet; diameter, 16 inches, measured at 4 feet from the ground, with clean boles up to 23 feet long.

I also found apple trees close by laden with fruit.

All these trees were in the immediate neighbourhood of the settlement, on an area which had been drained for a considerable number of years before the trees were planted. Cattle, pigs, geese, and fowls were constantly straying into these woods, so that the soil had the benefit of their droppings.

Here, then, is an instance which shows that good trees can be grown on bog-land which has been drained for some time, and which has to some extent been manured.

Augustendorfer Bog.

Of this bog an area of about 2800 acres has been planted up with forest trees.

The depth of the bog ranges from 20 to 26 feet, and its composition resembles in every way the deeper bogs found in County Galway. The surface is covered with heather, with here and there a little grass. Under the heather lies a thin layer of humus produced by the heather, then comes a layer of light yellowish-brown peat (used for the manufacture of litter), and this goes gradually over into a darker mass, which is cut and used as fuel.

The process of cultivation was as follows:—The area was drained, so that the ditches divided it into strips 30 feet broad. The ditches on each side of the strips were 2 feet deep, while the main ditches were of sufficient depth to carry off the water. During six years the surface layer of the soil was lightly burned, and buckwheat grown. After the harvesting of the sixth crop, the ditches were deepened to 3 feet, and each strip was divided into two 15 feet broad strips by an additional ditch. The soil taken out of the ditches was spread over the intervening areas. Then forest trees were planted, especially oak, spruce, Scotch pine, and later on also larch, Weymouth pine, and Austrian pine, while birch appears in large numbers from seed brought by the wind.

The first forest plantation was made in 1868, so that it is now twenty-seven years old; the youngest is eight years old.

These plantations did very well at first, so that very promising results were expected. At the age of ten to twelve years, however, the trees began to fall off, and now it is clear that the whole must be put down as a failure. The oaks have mostly disappeared, and those which still exist are miserable specimens of the species. The spruce also has done very badly. The Scotch pine suffers dreadfully from the leaf-shedding disease, and from the attacks of an insect (*Retinia buoliana*); in a few places it has done better, where the bog is less deep, but even here it is very branchy. Larch looked miserable in most parts, and only fairly well in a few. Austrian pine, of which only a few specimens existed, had done fairly well, but it had a very bushy appearance. Weymouth pine had, up to an age of fifteen years, done better than any of the above-mentioned pines. Best of all had, no doubt, done birch. That tree was at first cut away, because it threatened to interfere with the other species; now it is being sown in strips to replace them where they have failed.

The result of my inspection of the Augustendorfer Bog is that profitable forestry, without artificial manuring, is not practicable on deep bogs.

Burgsittensen Bog.

I next visited this bog, where I was told plantations have been established on varying depths of bog-land. Here the land had been drained by ditches 15 feet apart, and the species grown were the same as on the Augustendorfer Bog. The depth of bog

ran from perhaps 18 inches to several feet. I went carefully through the plantations, which ran up to an age of about thirty years, and I came to the conclusion that success depends in the first place on the depth of the bog. Wherever it was not more than about three feet, the plantations did well; as soon as the depths increased beyond a yard, the growth of the trees fell off at once. Places with a depth of $4\frac{1}{2}$ or 5 feet could be picked out at a glance by the inferior development of the trees. This I consider a very important lesson, which I learned on this tour.

As regards species, Burgsittensen showed that *splendid* oak can be produced on bog not more than 2 feet deep, and fair oak up to 3 feet deep, but not beyond. Weymouth pine here also had done particularly well; Scotch pine came next, and then spruce. Of larch not much was seen here.

The conclusion to be derived from the above notes may be thus worded:—"On old drained and manured bog-lands profitable forestry can be carried on, irrespective of their depth; on newly drained bog-lands profitable forestry ceases with a depth of bog of about 3 feet, unless such land is manured or improved by bringing mineral soil on to it."

3. PROPOSALS REGARDING FUTURE OPERATIONS.

(a) Knockboy.

Guided by the considerations described above, I have arrived at the conclusion that profitable forestry, as far as the production of timber is concerned, is not likely to be practicable on the Knockboy estate, on account of the heavy salt spray and the strong westerly gales; but that it is practicable a little farther away from the western sea-board, especially on lands which are somewhat protected against the severe gales.

At the same time, as already a considerable outlay has been incurred at Knockboy, I should not abandon the experiment, because, with a comparatively small additional outlay, final conclusions will be arrived at. The land is fenced and drained, and the replanting of parts of the area will not cost much. Should the production of useful timber ultimately prove impossible, then at any rate a valuable shooting preserve will have been established, which is not unlikely to yield an adequate return on the outlay. With this object in view I should propose the following operations:—The first object to be aimed at is to give

shelter against the strong winds and the accompanying salt spray. A single shelter-belt on the western edge of the estate will not give this, because it would take a great number of years to produce it, and then its effect would only reach a comparatively short distance. Shelter must be provided all over the area, and this had best be done by growing strips of suitable trees at intervals of, say, 10 feet. So far we have no final evidence which tree will be best suited for the purpose, but I think a trial should be made with birch, alder, and mountain pine. I propose, therefore, to sow strips of these at intervals of 10 feet, operations to be commenced on the western boundary of the estate, and the strips to run north and south. As I believe sowings will succeed better than planting, I propose that the turf be lightly taken off in strips about 12 to 18 inches broad, so as to get rid of the heather, and that the seeds be sown on these and lightly raked in. Alder and mountain pine should be sown in spring; birch in summer, as soon as the seed is ripe. The percentage of seeds of birch and alder which germinate is small, hence they should be sown rather densely. There should be a number of rows of birch, alder, and pine, each separately, so as to see which succeeds best.

At first only a limited area should be thus treated. If the experiment succeeds, more valuable species can be introduced between the rows, when they have reached a sufficient height to give the necessary shelter.

Although I believe that sowings will succeed best in this case, it is desirable to make another attempt with planting. I propose, therefore, to plant a number of rows with two-year-old seedlings. For this purpose the plants should be raised on a sheltered spot in specially prepared soil, and, when two years old, planted out with a peg or a narrow long spade, so as to get their roots down as deep as possible.

In the present instance I should sow on bog of any depth that may come in the way, as the object is to find out by experiment what can be done on such land. In the case of any new areas being taken up, I shall make different proposals.

(b) *The County of Galway generally.*

As early as December 1885 I pointed out, in a pamphlet written at the request of the late Earl of Carnarvon, then Viceroy of Ireland, that afforestation might prove of great value

to Ireland, and I would invite special attention to pages 23-26 of that pamphlet (printed in January 1886 by Alex. Thom & Co., Queen's printers, Dublin), where I have dealt with the labour question in connection with afforestation.

I still hold the views then expressed, and I am more than ever convinced that afforestation may become a powerful help in settling the Irish land question. How the Government can help in this respect I propose to illustrate in the case of County Galway.

The county has, according to the returns for 1893—

	Area in Acres.	Percentage of Total Area.
Land under crops, including meadows,	202,489	13·5
Land under grass,	723,446	48·1
Land, fallow,	2,402	·1
Woods and plantations,	25,147	1·7
Turf bog,	154,185	10·3
Marsh,	69,074	4·6
Barren mountain land,	261,483	17·4
Water, roads, fences,	64,136	4·3
Total,	<u>1,502,362</u>	<u>100·0</u>

Or, summed up—

	Area in Acres.	Percentage of Total Area.
Land used for agricultural purposes,	928,337	61·7
Woods and plantations,	25,147	1·7
Waste land generally,	484,742	32·3
Water, roads, and fences,	64,136	4·3
Total,	<u>1,502,362</u>	<u>100·0</u>

In other words, 484,742 acres, or about one-third of the county, consists of waste land which gives very little or no return, the only income derived from it consisting of shooting or low grazing rents. I maintain that a considerable portion of this area could be used more profitably by putting it under forest.

It is generally argued against such a measure that the price for timber already produced in County Galway rules very low, and that in consequence it does not pay to plant. Such an argument is, in my opinion, the result of short-sightedness. As long as timber is brought into the market in small quantities, and at irregular intervals in an out-of-the-way locality, fair prices cannot possibly be expected, because remunerative local industries cannot

spring up. If, on the other hand, large quantities are offered for sale regularly every year, a steady trade in timber will spring up, and, above all, local industries will develop. The returns showing the imports of timber into Great Britain and Ireland give their value as about £18,000,000 annually. And, again, the value of wood-pulp imported annually reaches a large figure (I believe considerably over a million pounds in value). Now, amongst the imports of timber are several thousand tons of birch from America, which is used for bobbins and such like articles. Why could they not be produced in a district like Galway? Or, take spruce and Scotch pine, of which the wood-pulp is made, which comes from abroad. There is no reason why wood-pulp factories should not spring up in Galway, especially where water-power is available, if there was an annual outturn of, say, at least 20,000 tons of spruce and Scotch pine timber. Again, the demand for mining props in England and Wales is steadily increasing, and prices are not likely to remain always as low as they happen to be at present. Nor are the imports of large timber likely to continue as freely and at such low rates as at present. Within a very limited space of time, the United States of America will want every stick which Canada can spare, thus reducing the imports into Britain by about one and a half millions of tons, while it is more than doubtful whether the countries around the Baltic will be able to continue to send us as much timber as of late.

On the whole, then, I am more satisfied than ever that afforestation, if done economically and judiciously, will pay in Ireland, especially in districts like County Galway, where water-carriage is close at hand.

Afforestation may be undertaken by the State or by private persons. Whether under existing circumstances much will be done by the latter is doubtful, because times are bad, and many private owners are short of cash. It is a question worth considering whether the State could not help by making suitable advances.

In the case of agricultural holdings, the State, I understand, advances money, which is repaid, capital and interest, in a number of years by annual payments of 5 per cent. on the amount advanced. The agriculturist can do this as he reaps his first crop at the end of a year. In the case of forests, on the other hand, the returns do not commence until after the lapse of a series of years, and few proprietors could afford to pay at once

5 per cent. on any advance made for the purpose of planting. I should, therefore, urge upon the Government the question whether advances for planting could not be made on the following conditions:—

(1) That the amount advanced shall be sufficient (and no more) to meet the cost of draining, fencing, and planting.

(2) That the proprietor shall pay $2\frac{1}{2}$ per cent. (the rate at which Government can borrow money) annually on such advance, until the plantations commence to yield a return; commencing from that moment the annual payment to be raised sufficiently to repay capital and interest within a limited period of time. *Example*:—In the case of a larch or Scotch pine plantation, $2\frac{1}{2}$ per cent. might be paid during the first twenty-five years; after that, from 7 to 10 per cent. until the capital and interest are paid off.

(3) Government to have a lien on the plantation until the advance is paid back, and consequently a certain control over the management.

If Government were willing to consider any such plan, the details of the scheme could easily be worked out.

Meanwhile the State might set an example by acquiring suitable lands, either by purchase or on lease, and putting them under forest. For this purpose I should propose Oughtierard as the centre of operations. In that vicinity I have seen various blocks of waste land fit for planting, and an effort might be made to secure a certain area, say 5000 acres to begin with. The land need not be in one block; on the contrary, it should be composed of a number of blocks to be taken up where suitable land is available. It would, however, be advisable not to go below a certain minimum of size for each block, say about 500 acres.

Of the land so secured, a certain proportion would, in all probability, consist of deep bog. In planting, this should for the present be passed over if more than 3 feet deep and if occurring in large patches. Small patches, up to 4 or even 5 feet deep, might be planted.

The draining of the land should be done in strips 30 feet broad, and the soil taken out of the ditches should be uniformly spread over the intermediate strips, especially if the soil so taken out consists partly of mineral substances. Draining need not, at the outset, be done deeper than 2 feet, and the ditches should be

laid out systematically so that all parts remain accessible. With this end in view, roads should be laid out in the first place, whenever possible, east and west, and the 30 feet broad strips should run at right angles to the roads, that is to say, north and south. Of course the special configuration of the ground may necessitate deviations from this plan. Assuming a daily wage of 2s. for a man, the draining should not cost more than 30s. an acre.

Any intervening patches of deep bog may be partially drained by a few ditches, so as to prepare them for future planting, should further experience be encouraging.

Fencing, at 1s. the running yard, may be put down at 10s. an acre all round.

Draining and fencing together, might cost about £2 an acre.

The details of the planting as regards species and method cannot be given once and for all; they must be decided according to the situation, soil, and other conditions in each case. Generally speaking, there is no reason why it should cost more than £2 an acre.

Total estimated cost, about £4 per acre.

The cost of supervision need not be high. The forester at Knockboy, if transferred to Oughterard, could carry out the works here contemplated, if occasionally advised by an expert of wider experience than he has as yet been able to acquire. At the outset, however, a definite plan of action for each block should be drawn up.

The important point, as regards any direct action on the part of Government, is that forests should not be created in large blocks, where special forest labourers would be required. What I am specially looking for is the establishment of moderate sized blocks scattered over the country, lying between the cultivated fields and the grazing grounds of the small peasantry. In the latter case the man who cultivates a few acres of land has an opportunity of earning some additional money by working in the plantations during winter, when his fields do not require his attention. This is a point to be kept steadily in view, because its realisation will much contribute towards the peace of the country, and it will help to cut away the ground under the feet of the political agitator.

XX. *The International Congress of Sylviculture.*

By J. S. GAMBLE, C.I.E., M.A., F.R.S.

This Congress was one of the first of the long series of International Congresses which took place at the Great Exhibition, and it is, it is hoped, to be the first of a long series of important Forest Congresses to be held at short intervals in the future. It opened on the 4th June, in the Congress Palace, close to the Alma Bridge. There were delegates present representing most of the countries of the world, but, naturally, the great majority of those who followed the discussions were French, mostly gentlemen connected with the Forest Service. So far as is known, England was represented only by Mr Stafford-Howard, Commissioner of Woods and Forests, and India by Dr Schlich and Messrs Fisher and Gamble, all old Indian forest officers. Messrs Cadell, Moir, Hearle and Carr were also present to represent the Indian Forest Service unofficially.

The proceedings of the Congress opened with an introductory speech by M. Jean Dupuy, the Minister of Agriculture. He began with a welcome to the foreign members, and then proceeded to discuss the position of the Exhibition as "not only a marvellous spectacle offered to the world, but also presenting, for all civilised people, a powerful interest as being the résumé, the synthesis, the relief map, so to speak, of human progress." He then proceeded to show how Sylviculture, so important in the economy of nations, could not fail to take a place, a great and honourable place, in the Exhibition. The Minister was followed by the Director-General of Forests, who, after thanking him for presiding and opening the Congress, pointed out the importance of an international understanding on the subject, so as to take stock of the forest resources of the world, in view of the probable wood famine which, before long, may be expected to be a serious difficulty.

These preliminaries were followed by what was the most important paper read before the Congress, that by M. Mélard, Inspector of Forests, on the insufficiency of the supply of building timber in the world. In an able discourse, he pointed out that the supply of such timber was already diminishing, that most countries actually at the present day were importing more timber than they exported, and that in those few countries where the

exports still exceeded the imports, there were serious signs of the supply falling short before long. Taking the nations in order, he discussed the question as regarded each of them; and gave statistics, both of the quantity of material imported and exported, and of the value of the excess of one or the other. The following average figures of the values will be found interesting. They are in millions of francs.

	Excess of Imports.	Excess of Exports.
Great Britain,	471	...
France,	99	...
Germany,	344	...
Belgium,	102	...
Holland,	18	...
Denmark,	31	...
Spain,	30	...
Portugal,	5	...
Italy,	31	...
Switzerland,	15	...
Greece,	3	...
Bulgaria and Servia,	3	...
Austria-Hungary, . . . . .	...	199
Norway, . . . . .	...	47
Sweden, . . . . .	..	198
Finland, . . . . .	...	89
Russia, . . . . .	...	134
Roumania, . . . . .	...	5
United States, . . . . .	...	100
Canada, . . . . .	...	127
British India, . . . . .	...	14
China and Japan,	4	...
South Africa,	9	...
Mexico,	2	...
Argentina,	26	...
	1193	913

He went on to point out how the excess in Austria-Hungary, Russia, and the United States was much threatened, partly by increase of population and partly by industrial development; and how the excess in Norway was menaced by the deterioration of the forests; so that there only remained three countries where the forest resources were capable of helping in the future, viz., Sweden, Finland and Canada, but that what they could produce was quite insufficient, in presence of the increase in population and the development of industrial work, not only in Europe and

America, but in China, Australia, South America, and South Africa, so that it was clear that we were on our way to a timber famine. He gave us fifty years only before such a catastrophe should take place. His recommendations were — (1) that the destruction of forests should be stopped, partly by strict legislative measures on the part of Governments, partly by making private forest owners understand that their interests lie in taking care of the capital stock, and only exploiting so much as may be calculated to be the interest on it; (2) that forest property should be helped by not being too heavily taxed; (3) that measures should be at once taken to utilize all available waste lands by replanting and restoration. The paper was listened to with very great interest, and the thanks of the Congress unanimously voted to M. Mélard.

On the 5th June, the first work done was to subdivide the Congress into three sections, viz.: (1) Forest Economy; (2) Influence of Forests from the point of view of the maintenance of the soil, the water supply, and of meteorological phenomena; and (3) Application of Natural Sciences to Sylviculture; and this having been done, the sections separated to carry on their deliberations, which continued on the 5th, 6th, and 7th.

In the **First Section**, the *first* subject was the question of the treatment of silver fir forests, and the advisability of converting into forests of silver fir all coppice lands of poor growth in mountain regions. The chief speakers were MM. Runacher, Huffel, and Mer. No very definite conclusion was arrived at, it being agreed that the best method of treatment for silver fir forests was still in doubt. Then came the important question of thinnings, discussed, after the reading of an able paper by M. Broillard, by M. Boppe and M. Mer especially. It was generally agreed that the principle to be followed in thinnings was that of working by careful regard to canopy; that the canopy should be lightly opened but not interrupted, and that the undergrowth should be carefully respected. The *third* question was that of the utility of cultivating the soil in regeneration fellings, and it was generally agreed that such cultivation, accompanied by artificial seed sowing, was most useful. The *fourth* question, the treatment of coppice under standards, so as to increase the production of timber material, gave rise to considerable discussion, and it was agreed that in those cases where good oak saplings were not to be found in sufficient

number to give a good series of reserves; groups of coniferous trees might be planted, under which afterwards the oak might reappear, the conifers serving to give a considerable amount of useful produce. The *fifth* subject was the address by M. Mélard, to which reference has already been made; and the *sixth* was a paper by M. Guyot on the subject of international legislation for mountain forest lands. The *seventh* subject was that of the use of exotic, acclimatized, or naturalized species of trees in forest growth. The cultivation of exotic trees at Vaux (Loir et Cher) was described by M. Cannon, and an important paper was read by M. de Vilmorin on the exotic forest trees found in France; while M. Pardé, whose experience of the cultivation of exotic trees was drawn from those of the Domaine des Barres, in the Loiret, originally planted by the De Vilmorin family, and now the property of and worked by the State, described the chief exotic forest trees from the forest point of view. It was agreed that more experiments were required, and that the results of such experiments should be carefully watched, recorded, and made public. The *eighth* subject was that of experimental stations, and here also it was agreed that more such stations were wanted in France, and that they should be better connected with each other, the results of their researches being regularly published.

In the **Second Section**, the first subject discussed was forest meteorology, and the influence of forests on the subterranean waters in the plains regions; the result of the discussion being that it was agreed that more accurate study of the action of forests on springs and on hail-storms required to be undertaken at all experimental stations, and that orographic maps ought to be prepared showing the density of forest growth in different regions, so that the question might be more fully discussed at the next Congress. The rest of the subjects chiefly regarded the great works undertaken in France for the restoration of denuded mountain slopes; the works necessary for the protection of mountain forests from avalanches; the regulation of hill pasture; the reclothing of dunes on the sea-coast; and the protection of forests from fire. The latter subject gave rise to a long discussion, in which many foreign foresters took part, the general gist of which was to show the great importance which the subject possesses for all those forest lands where fire is possible and the means of prevention inadequate.

The **Third Section** was chiefly occupied in discussing the

need for experiments on forest soils, the necessity of having good botanical forest maps, and the improvement of systems of forest transport.

The final sitting of the Congress was a general one, and was very largely attended, for there were many French and other foresters interested in the important question of the permanency of the Forest Congresses, and whether such Congresses should be held as a separate institution, or whether they should be held at the same time as, and as a section of, the Congresses of Agriculture. After a long discussion, it was finally agreed that there were many advantages to be obtained from the Forest Congress being made a branch of that of Agriculture. The President, then, M. Daubrée, closed the sittings by thanking the members for their presence, and for the valuable assistance they had afforded to the important discussions.

The visit of the members of the Congress to the forest exhibits of the different countries at the Exhibition, was made on the afternoon of the 8th. The members met in front of the splendid Forest Palace, and began their sightseeing with the magnificent pieces of timber lying outside, which were explained and discussed by MM. Rudolph and Bouvet. These pieces consisted of huge logs of oak and silver fir. Then we visited, led by M. Thil, the French forest exhibit, with its splendid collections, its beautiful photographs and water-colour pictures of mountain restoration works, and its well-arranged collection of hunting trophies. In turn we then explored, in each case under the guidance of the officers in charge, the great collections exhibited by Russia, Austria, Hungary, Roumania, Canada, the United States, Japan, and Sweden. From the Forest Palace we passed to the Trocadéro, visited the Algerian section, the exhibits of the Imperial Russian Apanages in the Siberian Court, and the collections of British India and West Australia.

The most important of the collections exhibited were, after the French Government one, those of Russia, Austria, and Hungary, between which there was little difference to be noted in respect to excellence. The exhibits of Roumania, Canada, Sweden, Japan, and the United States of America were also of importance; while of those which were housed apart from the Forest Palace, the most noticeable undoubtedly were those of British India, West Australia, Algeria, Russian Siberia, and the French Indies.

In the French Section, the chief interest lay in the "*reboisement*" works, the Forest administration being clearly especially proud, as well it might be, of the work they have done in stopping the damage done to the cultivated lands in the valleys of the Alps and Pyrenees by the constantly increasing devastation of landslips. These works have now gone on for about forty years, with the most satisfactory results. The Government has spent about $2\frac{1}{2}$ million pounds sterling, and have re clothed more than 600 square miles of country, stopping landslips, rendering torrents inoffensive, and safeguarding from damage very large areas of valuable land which had previously been threatened. The works undertaken were illustrated in the Exhibition by a beautiful series of water-colour drawings and large photographs, and by a diorama in two scenes, one showing the same locality as the other, but at the end of ten years after the commencement of work. "*Reboisement*" work is naturally carried out in different ways, according to the different characters of the localities, but, speaking generally, the first thing is to regularize the beds of the torrents by means of barriers, which usually consist of fascine-work at the top of the ravines where there is not much water, and heavy masonry walls below, where the current is strong and many boulders are brought down. Trees and cuttings are planted near the streams, and the seeds of grasses and herbs and bushes are sown in order to create a vegetation, tree-planting being usually only carried out afterwards, when that vegetation is assured.

In the French Section also, the fixing of sand-dunes, the methods of stopping avalanches, road-making and house-building, were all well illustrated, and there was a large collection of the woods and products of the French forests, and of the many valuable publications which have been prepared by members of the forest staff. And here it is right to mention the great liberality with which the French Government presented free to the members of the Congress, copies of the valuable papers written specially for the Exhibition. The most noticeable of these papers was that of M. Mélard on the probable early wood famine, to which allusion has already been made. "*Reboisement*" works are dealt with in a long series of a dozen or more interesting papers. M. de Gorsse discusses the treatment of the torrents of the Pyrenees; M. Champsaur, those of the classic grounds in the Lower Alps; M. Bernard, those of the Upper Savoy moun-

tains, especially the valley of Chamouni; and the landslips in that same valley, and especially that which overwhelmed the baths of St Gervais in the night of 11th July 1892, are described in a long and admirably illustrated paper by M. Kuss. The torrent of Rieulet, in the Pyrenees, is fully described by M. Dellon; and the methods of settlement employed at Pellafol, in the Isère, by M. Bernard. The best kinds of herbs and trees to use in the works are fully treated in an interesting paper by M. Bauby. Messrs Campardon and Buisson discuss the systems of improved pasturage; M. Campagne the works necessary to protect forest and uncultivated lands against avalanches; and M. Calas the recommendation of the extension of the use of Salzmann's variety of the *Pinus Laricio*, which has been found valuable in "reboisement" plantations. The same author has a monograph of the processional caterpillar of the moth *Cnethocampa pityocampa*, with suggestions for the best system of counteracting its ravages.

Among other subjects on which important papers were printed and distributed, may be especially noted M. Lafond's work on the sand-dune plantations on the coast of the Bay of Biscay; M. Delassasseigne's very interesting paper on fire-protection; and M. Arnould's work on international measures necessary for the protection of useful birds.

In the Russian Section, the most noticeable exhibit was the fine series of sections of trees. As is well known, the forest flora of Northern Russia is a very poor one, the chief forest trees being the spruce and Scots pine, but in Siberia and the Caucasus there are many other species, and the value of their timber is well illustrated by the sections. Canada and Roumania have also fine series of wood sections, whose preparation must have been a difficult work. The Austrian and Hungarian sections have no very special exhibits, but they have represented almost every branch of forestry, and more especially those branches which belong to forestry in its scientific side; working-plans, experimental stations, researches on rate of growth, "reboisement" works, planting and sowing are fully shown, as fully as are the methods of extraction of timber, and the utilization of forest products in general. Both of these countries presented to the Congress for free distribution copies of valuable papers on forestry. The most important of those presented by Austria is the official guide to the forests, published by the Ministry of

Agriculture at Vienna, and official papers on forest police and forest "*reboisement*" are also of great interest. The question of beech in the Austrian forests is the subject of a paper by Herr Hufnagl; and a full, well-illustrated account of the small forest wood-industries of Austria is contributed by Prof. Lauboeck. The "*reboisement*" works in the Karst region, that curious denuded tract of mountain slopes on the Illyrian coast, are fully described in a paper by Herr Pacich. The treatment of spruce forest, and the best systems of preventing the barking of the trees by large game, or the death and damage of forest growth by bad procedure, are discussed by Herr Hermann Reuss.

The Hungarian contributions to the literature of the Congress are too many to be all mentioned here, but it is right to call attention to Herr Vadas's history of the Forest School of Selmeczbanya, and the same author's very interesting paper on the cultivation of willows as a protection against inundation. The Government publications refer (1) to the forest law of 1879; (2) to the preparation of working-plans; (3) to the organization of the forest staff; (4) to forest experiments and experimental stations; (5) to the organization of special schools for forest guards; and (6) to the history of the National Forest Society. And here it is also right to mention a very interesting account of the development of sylviculture in the Austrian territories of Bosnia and Herzegovina, by Herr Petraschek, who was himself present at the Congress to represent these provinces.

The forest exhibits of the United States were chiefly intended to illustrate forest utilisation; the most noticeable features of their section were the beautiful transparencies in the windows illustrating the giant trees of the western States, and the panels and sections of fine-grained woods in the American ch  let.

In the Japanese Court, richly marked bamboo culms formed a remarkable exhibit, as did the huge planks of *Cryptomeria* and other woods.

In the Swedish Section the Congress admired a diorama picture of a pine forest, with a lake and mountains beyond, lit up by the glowing colours of a northern sunset; the large model of a saw-mill and timber export yard in the Gulf of Bothnia; and a pyramid of wood paving blocks marked with the brands of the various firms dealing in that important and increasing article of trade.

In the British Indian Section, the inspection by the Congress

was hampered by the great crush of other sight-seers, still, though the crush was detrimental to a full appreciation of Mr Ribbentrop's beautiful trophy and the carved showcases of the School of Art of Malmaison and Lihore, the Congress was able to see fairly well the forest show in the galleries, and admire the maps and plans, the fine photographs, and the Debra Dün collection of products destined to be preserved for the future at Kew.

In the West Australian Court everybody was interested in the huge sections of "Karri" and "Jarrah" which stood sentinel before the doors, and in the excellent way in which the exhibition of these woods had been taken advantage of to serve two purposes, the embellishment of the Court and the display of the capabilities of the woods. They had been employed in the paving of the Court to show their use as paving blocks, in the paving of the stairs in small cubes to show their use for inside floorings, in the balustrades and railings to show their capabilities for furniture and interior decoration, and in railway waggons to show their use for carriage-building. The whole display was most creditable, and was greatly admired by those members of the Congress who stayed on to the end. We had a long afternoon, and most members were very tired when their labours were over. It is scarcely too much to say that had the Forest Palace and its exhibits, increased by the inclusion in it of the collections of those countries who, perhaps mistakenly, preferred to be represented in their own special buildings (no mention has here been made of the forest exhibits, many of great importance, shown by Italy, Finland, Servia, Mexico, and other countries in their own exhibitions in the national palaces, as they were not visited by the Congress), been a separate Exhibition apart from the other portions of the great world's show, and displayed, like the Edinburgh Exhibition of 1864, as a separate thing, they would have formed a collection which alone would have attracted crowds and been a wonderful success.

The last day of the Congress, June 9th, was devoted to an excursion to the Forest of Fontainebleau, one of the largest of the Government forests of France, containing 17,000 hectares. It was a whole day's excursion, and was a very enjoyable one, both from the forest point of view and from that of the scenery, and the members received the greatest help and courtesy from the Inspector in charge, M. Rousc. The party was headed by

M. Daubrée, Director-General, and there were representatives of almost all the nations of Europe.

The party left the Lyons terminus early, and arrived at Fontainebleau at 10.30 A.M., where carriages were in waiting, and a start was at once made, in rather hot weather, for a drive round the most interesting parts of the forest. At midday the restaurant at Franchard was reached, and the party were saluted with the strains of the well-known "*cor-de-chasse*" welcoming them to the dejeuner. After the meal, speeches were made by members of most of the nationalities represented, and the excursion was then continued to other interesting parts of the forest, ending up at the railway station, where the train was taken at a little before 6 P.M. The forest of Fontainebleau is chiefly on sandy soil, with here and there small outcrops of the chalk, and the chief and most important tree is the oak, of the variety *sessiliflora*. Oak constitutes about 50 per cent. of the individual trees of any size in the forest, and its growth is excellent, Fontainebleau being one of its best localities in France. Some trees still exist known to be over five hundred years old, and to have more than 6 feet in diameter. The few oaks of the variety *pedunculata* found here and there are probably the result of sowings of acorns collected elsewhere. Next in importance among indigenous trees is the beech, which is found to the extent of about 15 per cent.; but the trees are not very good, and they are more valuable for the help which they give sylviculturally to the good growth of the oak than for their industrial importance. Among other broad-leaved trees common in the forest, the hornbeam and birch are most noticeable. A considerable area is covered with Scots pine, which is, however, not indigenous, having been introduced so recently as 1786 in the first plantations made at that time by Dr Lemonnier, the first physician to King Louis XVI. The seeds were brought from Riga, in Russia, and this circumstance was taken advantage of by M. Kern, the Director-General of the Imperial Forest School at St Petersburg, at the dejeuner, to emphasize the close relations between Russian and French forest officers. The greater part of the pine forests were, however, planted in 1830-1848, and the tree is now completely naturalized. Unfortunately, of late years, the extension of touring, especially by cyclists and auto-car drivers, has had the serious result of causing extensive fires, usually lit by the careless use of wax matches and vesuvians, so that not only is it necessary for the

staff to be constantly on the alert in dry weather, but endeavours have had to be made to replace the pine by less inflammable species.

The first Working Plan of the forest was made in 1861, and under it 13,724 hectares were devoted to high forest, 1618 hectares to coppice, and 1631 hectares to special working. This plan was kept in force and worked till 1880, when, owing to much damage done by frost and snow, many of its provisions had to be suspended and the dead wood cleared out. A new Plan was then found necessary, and this was made and brought into force in 1892. This new Plan divided the forest into five sections, which it will be interesting to enumerate.

	Hectares.
Section 1. <i>High Forest of Broad-leaved Trees.</i>	
9 working circles, treated, on a rotation of 120 years (4 periods of 30 years), by the method of successive regeneration fellings (shelter-wood compartment method),	7,239
Section 2. <i>High Forest of Conifers.</i>	
3 working circles, treated, on a rotation of 72 years (8 periods of 9 years), by the same method,	3,292
Section 3. <i>High Forest in Selection.</i>	
5 working circles, with a rotation of 7 years for the selection fellings,	2,975
Section 4. <i>Coppice with Standards.</i>	
3 working circles, with a rotation of 30 years for the coppice,	1,758
Section 5. <i>Artistic Parts.</i>	
1 working circle, without fixed system, maintained to preserve ancient trees and picturesque localities,	1,616
	16,880

And this is the Plan which is now in force, and which is giving such excellent results.

In a Congress at which so many foresters from all parts were assembled, there were naturally several interesting meetings of a more convivial character. On the 6th a dejeuner was given at the Restaurant de la Belle Meunière, close to the Jéna Bridge, by the French members of the Congress to their foreign guests. There were many speeches, and the excellent fare and the cordial reception were greatly appreciated. On the 7th, again, the foreign

members were invited to the dinner given by the Mutual Aid Society of Forest Officers in the splendid Salle Hoche, where the hospitality of the French hosts was again unbounded, and the evening was spent in the harmony which usually characterizes such forest réunions.

There can be no doubt that the Forest Congress of 1900 was a great success, and it may be hoped that future ones will be equally so, and that the cordial and excellent understanding which animates forest officers of all countries, whose subject has no relation to the difficulties of current politics, will tend to improve the mutual relations of these countries amongst themselves, and make for that permanent peace which all those who desire the welfare of the human race must ardently wish for. For the first of the series of great Forest Congresses, no better hosts could be found than the French; for hardly anywhere, after all, is hospitality and good-fellowship so thoroughly understood as in France, especially when the whole of the meeting is animated by the same *esprit-de-corps*, the same intense interest in all that appertains to the management of forests and the extension over the world of the benefits of forest conservancy.

XXI. *A Battle with Beetles.* By JOHN CLARK, Forester,
Haddo, Aberdeen.

The Pine Beetle (*Hylesinus*¹ *piniperda*) is found more or less in all Scotch fir woods. When the woods are in a healthy condition they will be few, but if otherwise, they will be more numerous; and after a fall by a gale of wind, every twig of one year's growth—in the neighbourhood of the fall—may be bored and killed.

After the gale of November 1893, the Pine Beetles increased with alarming rapidity; and the gale of December 1894 supplied them with a very large number of trees in condition for breeding purposes, the result being that by the beginning of October 1896, almost every terminal shoot not under $\frac{3}{16}$ ths of an inch in diameter contained one or more beetles. The consequence was that thousands of the most vigorous Scotch fir trees died from the attack; and had it not been that many of the trees were well matured, and that the main crop of their terminal shoots, being under $\frac{3}{16}$ ths of an inch in diameter, were safe from attack, not a single fir tree would have been left alive in the woods that had been partly blown down by the gales. When the blown-down trees were all dead, and were therefore of no use to the beetles for breeding purposes, a large number of standing trees that had the bulk of their annual shoots destroyed by boring, became very weak, and offered the beetles the very conditions they delight in for breeding purposes. In order to save such trees, I prepared "trap" trees on a large scale, and by the middle of March 1898 all the Scotch fir woods were provided with them. The trees I selected for traps in which *Hylesinus piniperda* might breed, were trees of small commercial value; they were cut down by the root and left lying where they fell, the branches not being removed. By the middle of April, all the trees thus laid down were fully occupied by pairs of Pine Beetles, and the traps had a very peculiar appearance, being covered over with tiny heaps of bore-dust; so numerous were the breeding-tunnels, that many of the larvæ perished from want of food.

The number of eggs in each tunnel were from 70 to 120, the tunnels being 3 to 5 inches long. I found on an average

¹ Or "*Hylurgus*."

12 tunnels to one superficial foot of bark, and in some instances as many as 20 to 24 to one foot.

By the first week of May I found the whole of the trap trees fully occupied, and during that week I cut down a fresh lot of trees for traps. On the eighth day thereafter, beetles began to occupy them. Again, in the first week of June, I cut down a few more trees for traps, and on the seventh day beetles began to occupy them. The tunnels were less numerous in the trees cut down in May than in those cut down in March; and in those cut down in the beginning of June, the tunnels were but thinly scattered over the lower part of the tree.

On the first of July I began the work of destroying the broods, by stripping the bark from the trunks with old spades. The trees were collected into suitable centres and barked, this being a very easy process, as the larvæ had eaten the whole of the inner liber, and thus detached the bark from the stem.

Two men collected and stripped about twenty-eight trees per day, each tree containing on an average about ten thousand larvæ and beetles, young and old. In all, about five hundred stems were used as trap trees, and by means of these not less than five millions of beetles must have been destroyed during the summer of 1898.

Again, by the middle of March 1899, the fir woods were provided with trap trees, and by the middle of April they were largely occupied by pairs of beetles. During the season about two hundred trees were used as beetle traps; all these were fully occupied, and were then treated as in the summer of 1898. A new enemy to the beetles I found in many of their breeding-tunnels, viz., *Rhizophagus depressus*. This is a small insect about the same length as the beetle, but very narrow and thin, and of a dark colour. In the tunnels in which I found this insect, the eggs of the Pine Beetles had disappeared, and it soon became evident to me that *Rhizophagus* had devoured them. In some of the woods, so numerous were the "egg eaters" that nearly one-half of the tunnels failed to hatch out a single grub.

A second enemy of our pest also appeared in the form of the Large Spotted Woodpecker, which is rarely seen in Aberdeenshire. These birds appeared in twos and threes during the autumn of 1897, and disappeared again in the spring of 1899. They fed on the grubs of weevils and beetles, and by tapping on the bark could locate the exact spot where the grub was hidden.

A third enemy of *Hylesinus piniperda*, and also a useful assistant in destroying large numbers of weevils and beetles in the grub stage, is the squirrel, by whom we were frequently guided to standing fir trees, which, though they had green tops, were infested with grubs of beetles and weevils. The squirrel found the grubs in the upper part of the trees, where the bark was not over one-fourth of an inch in thickness, and where they pass through the pupal stage, buried between the bark and the wood. Where the bark is over a quarter of an inch in thickness, the grubs of both beetles and weevils, when full fed, retire into it, and there the squirrel cannot get at them. I think that the squirrels would not feed on grubs unless they were short of other food; and in support of this opinion I may say that from 1895 to 1899, when I observed them eating grubs, Scotch fir cones were not to be found in this district. Although the squirrel has been of some use in destroying beetles and weevils from 1896 to 1899, I sincerely regret that at the same time they do serious damage to young Scotch fir woods in parts of Scotland. In this district, however, they have been kept well under, and I have not seen so much as one fir tree peeled by the squirrel.

During the past summer, we have again, by means of trap trees, destroyed a great many beetles; but they are now greatly reduced in numbers, and many of the injured fir trees have, during the past summer, made normal growth.

In the course of my operations against the Pine Beetle, I have had the opportunity of studying the habits of other beetles and insects that do damage to our Scotch fir woods, such, for example, as the Crutch Beetle (*Hylesinus palliatus*), *Bostrichus bidens*, the two-toothed beetle, which is one of the smallest of the tribe, and *Bostrichus lineatus*. I have also found specimens of another beetle enemy, viz., *Clerus formicarius*. The Giant Wood Wasp (*Sirex gigas*) and the Steel Blue Wood Wasp (*Sirex juvenis*) do serious damage to felled timber, rendering it almost useless; but I have not known either to attack a healthy growing tree.

Dr R. Stewart MacDougall, the Honorary Consulting Entomologist of the Society, has been my tutor and guide in the operations I have carried out during the past four years. I worked out many of his suggestions, and have found them to be most effectual. The assistance I have received from him is indeed one of the greatest benefits I have enjoyed from my connection with the Society.

XXII. *Notes on the Importance of Tree Seed-Testing.* By
JOHANNES RAFFN, Skovfrøkontoret, Copenhagen,
Denmark.

As I believe that the tests of seeds of conifers and deciduous trees and shrubs which I have had carried out since 1888, when I started business, might be of general interest, I take the liberty to hand over the following abstract of these for publication in the *Transactions of the Royal Scottish Arboricultural Society*. As far as I know, such extensive experiments have not been carried out anywhere before, and I therefore hope that they may be of practical value for Scottish forest owners, amongst whom extensive experiments with many different rare species of conifers and deciduous trees are going on.

As will appear from the Tables of the tests, many species, especially of deciduous trees, have only given negative results of the tests, as, for instance, *Carpinus*, *Carya*, *Tilia*, and others; but, of course, such seeds as take years to germinate cannot be made to grow by artificial means within a reasonable time. Also some conifers have failed, such as *Ginkgo*, which usually germinates easily enough, and *Juniperus*, *Pinus cembra*, *P. koraiensis*, and *P. Parryana*, but these again are slowly germinating species. Still there are plenty of good results, as I hope will appear from the following report.

I shall now first direct attention to the results of the testing of the germination, and then afterwards mention the figures found for the weight of the seeds.

GERMINATION OF CONIFER SEEDS.

In composing the Tables, I should have liked to divide the tests into two periods, an older, from 1888-1892, and a newer one for the following years, as I have done in the Danish *Tidsskrift for Skovvæsen* (*Chronicle of Forestry*); but in order not to take up too much of the limited space here, I shall confine myself to an extract thereof, as it very distinctly shows that the work of the testing establishments has not been in vain, as all the worst figures fall in the older period.

The following results, giving the "Real Value,"¹ will be found in the Tables:—

Abies balsamea (Danish seed), . . . for 12 tests, min. 6·53, max. 59·96
 ,, *pectinata* (German seed), . . . for 10 ,, ,, 5·68, ,, 68·16

But a division into two periods, as mentioned above, gives the following figures for Real Value:—

Abies balsamea, for 5 tests, 1887-1888 to 1891-1892, min. 6·53, max. 58·3
 ,, ,, for 7 ,, 1892-1893 to 1899-1900, ,, 24·6, ,, 59·96
 ,, *pectinata*, for 4 ,, 1887-1888 to 1891-1892, ,, 5·68, ,, 50·60
 ,, ,, for 6 ,, 1892-1893 to 1899-1900, ,, 18·4, ,, 68·16

Now, everybody knows that there may be great difference in the percentage of germination of the *Abies* species in different years, even when absolutely fresh seed is in question. But we also know that this world is not nearly as good as it ought to be, and it therefore happens in years when seed is scarce, that old seed is put on the market, and very often at doubled prices, and I dare say all will agree with me that it is then very useful, by the assistance of the testing establishments, quickly to have this substantiated. This progress in the improvement of Real Value is proved by many species, of which I shall only mention a few of the most important:—

Pinus montana uncinata (Danish seed), 6 tests, 1887-1888 to 1891-1892, min. 54·49, max. 95·9.
 ,, ,, ,, (Danish seed), 22 tests, 1892-1893 to 1899-1900, min. 63·20, max. 96·0.
 ,, *sylvestris* (Finnish seed), 5 tests, 1887-1888 to 1891-1892, min. 38·5, max. 88·7.
 ,, ,, (Finnish seed), 12 tests, 1892-1893 to 1899-1900, min. 50·2, max. 92·8.
 ,, ,, (Scotch seed), 3 tests, 1887-1888 to 1891-1892, min. 41·1, max. 95·6.
 ,, ,, (Scotch seed), 8 tests, 1892-1893 to 1899-1900, min. 62·8, max. 92·1.
Picea excelsa (Finnish seed), 3 tests, 1887-1888 to 1891-1892, min. 65·35, max. 92·1.
 ,, ,, (Finnish seed), 2 tests, 1892-1893 to 1899-1900, min. 96·6, max. 97·71.
 ,, ,, (Swedish seed), 7 tests, 1887-1888 to 1891-1892, min. 73·33, max. 97·61.
 ,, ,, (Swedish seed), 5 tests, 1892-1893 to 1899-1900, min. 86·6, max. 96·5.

On the other hand, no improvement is to be found in the germination of the German spruce seed, but rather a little decline.

¹ "Real value" means the number of pure and germinating seeds in 100. Thus, if a sample showed percentage of germination 90, and percentage of purity 80, the real value would be $\frac{80 \times 90}{100} = 72$, in other words, each 100 lbs. of seed contain 72 lbs. that are both pure and capable of germinating.

The Danish spruce seed is not good either, but the production thereof has hitherto been unimportant, as only now and then small quantities are saved, and these are not usually put on the market.

The German spruce seed has an average Real Value of about 80 per cent., the Tyrolese of 84 per cent., while the Swedish and Finnish spruce seed reaches about 90 per cent. The highest figure has been 97·71 per cent., for Swedish seed.

As an instance of retention of germinating power, mention may be made of a sample of *Picea excelsa borealis*, Norwegian seed, grown north of the Polar circle, which was tested here in 1889, when five years old, and germinated in thirteen days 46 per cent. and in thirty days 63 per cent.

The production of seed of *Picea alba* is, in contrast to *P. excelsa*, of considerable importance in Denmark, as also that of *Pinus montana uncinata*, because both these species are so excellently suited for cultivation in the poor, dry, and above all tempestuous heaths of Jutland. This is why I have, in the course of my experience, had no less than twenty-six tests carried out with the seed of *P. alba*, and the following are the results:—Average Real Value about 75 per cent.; minimum 10·94, maximum 91·09. Divided into two periods:

Picea alba (Danish seed), for 8 tests, 1887-1888 to 1891-1892, min. 10·8,
max. 91·09.
,, ,, (Danish seed), for 18 tests, 1892-1893 to 1899-1900, min. 23·66,
max. 90·5.

As it appears, the progress in quality for this species has not been great, and this for a certain reason, which it might possibly be of some interest to make known. The very mild and damp winter in Denmark in 1898-1899 rendered both cleaning and storing of many species of seed very difficult, and especially the seed of *Picea alba* suffered. I had a quantity of this, which in November 1898 contained 95·50 per cent. of clean seed, and had a Real Value of 79·27 per cent. After a second winnowing in the course of the winter it was brought to contain 98·50 per cent. clean seed, and still the Real Value appeared in the spring only to be 55·16 per cent., and it had by that time a slight mouldy smell, for which reasons it was of course not sold. A new quantity of 2 cwt. was then received from one of our State plantations in the dunes, and this was on arrival here apparently of sound and fine quality, the seed having been taken out of the cones by sun-drying during the preceding summer. It was therefore without

hesitation distributed to the nurseries. But when, after thirty days, the result of the test was obtained, it showed that although the seed had a purity of 92.80 per cent., it only had a Real Value of 23.66 per cent. But the results of the sowing in the nurseries was still worse, for after a dry and hot spring only about 1 per cent. germinated. The reason that seed giving over 23 per cent. of Real Value may produce only 1 per cent. of plants in the nursery, is because a sample of such poor quality contains many seeds which will germinate under the favourable conditions of a laboratory test, but which have not sufficient energy of germination to overcome the influences of an unfavourable spring.

In the following spring the nurseries, of course, got compensation for the amount paid for this seed. Supposing it had not been tested, and perhaps only some of the nurseries had complained, then it would have been very excusable if the seedsman had blamed the dry spring, or everything else but the seed, for the bad result. If this unfortunate year had not occurred, the minimum Real Value of eighteen tests of *P. alba* for the years 1892-1893 to 1899-1900 would have been 75 per cent.

Similar bad results with the seed of *P. alba* occurred in the same year in several other places, and are attributable to too close and energetic rubbing off of the wings, which has hurt the coat or the tips of the seeds, and thereby rendered them liable to the attack of mould.

The Tables show that our Danish seed of *Picea alba* appears on an average of twenty-six tests to contain 97.35 per cent. of clean seed. If such a high degree of purity were not so much insisted on, the seed would not need to be so hard cleaned, and would therefore retain its power of germinating longer than now.

I have only instanced these cases to show that the interests of the seedsman and the seed-testing establishments are in harmony, and that it is not correct to say that the seedsman necessarily places himself in opposition to the seed-testing establishments, and tries in every possible way to throw suspicion on them. But unfortunately in many cases this charge against the seedsman is only too well justified, and it is now high time to abandon the bad custom of selling by sample without also knowing something about the quality of the seed as determined by test.

Having sold out the whole of my spruce seed, I bought in the spring of 1900 from German Silesia another quantity from a very fine sample. In sending the order, I added that I assumed

that the seed would show a Real Value of at least 70 to 75 per cent. When the seed, after arrival here, was tested, it showed a Real Value of only about 40 per cent., and a second test carried out at Zürich confirmed this. Fortunately there was still time to get a new and better supply from Thuringia, which was distributed gratis to the nurseries that had unfortunately been supplied with the Silesian seed before the result of the test was known.

But the good Silesian gentleman is still of the opinion that he did his duty by supplying the seed exactly "to sample," while my opinion is that the sample ought only to serve as an index of the genuineness and cleanness of the seed, but that this, in the interests of honest dealing, must also be able to germinate, and if time is not allowed for a test to be carried out before the sale, compensation must be given afterwards.

The seed of *Larix leptolepis* of last season furnishes an example of the need for caution. I received in the spring 1900 a quantity of Japanese larch seed from a noted firm in Japan, and paid for it on receipt ("against bill of lading"), as the custom is in dealing with Japan. By transshipping at some Chinese port the seed had got delayed from four to five weeks, and I did not receive it till the end of April, when it was high time to have it distributed to the nurseries. But when, at the end of May, the result of the test came to hand, it appeared to germinate only 18.50 per cent., and to have a Real Value of 14.80 per cent., and even then it has hardly produced any plants in the nursery.

Of course I at once made complaint in Japan, and was by return of post promised compensation for the seed next season, or as soon as a new and good crop of seed was available.

This is all very well, but it would have been very much better if the Japanese had tested the germination before shipping the seed from Japan. It is always better to have no seed at all than to have worthless stuff; and especially is this the case when the European seedsman dare not venture to give any warranty for the Real Value of tree seeds sent from abroad, unless he has his remedy against his suppliers.

But what is good seed and what is not? That is not always easy to decide. Looking at several other of the Japanese species, they appear to have a strikingly low germination, but I dare not say whether this is less than normal or not. The figures for *Chamaecyparis obtusa*, 19.35 per cent.; *C. pisifera*, 10.67 per

cent. ; *Cryptomeria japonica*, 15·20 per cent. ; *Thuja Standishii*, 9·40 per cent. ; *Tsuga Sieboldi*, 0·44 per cent.—are all from the tests of the spring 1900. Of *Abies brachyphylla* I have had two tests carried out, one in the spring of 1889 and another in the spring of 1900, and the result is a minimum Real Value of 5·90 per cent. and a maximum of 6·73 per cent. I should like to know if this is normal. I suppose the experiments of a longer series of years are necessary to decide this.

INFLUENCE OF THE LOCALITY ON THE SIZE OF SEEDS.

In looking through the column for the weight of 1000 fresh seeds, one cannot avoid noticing the very great difference in the size of the seed of the same species from different localities, and it will then be seen that the size of the seed has a direct relationship to the locality where it is produced. German-Tyrolese and Danish spruce seed is, on an average, about twice as heavy as the Scandinavian-Finnish spruce seed. The highest weight I have found for 1000 fresh seeds of spruce is 0·34 oz., and the lowest 0·14 oz. The former came from the centre of Europe, and the latter from the north of Norway, within the limits of the Arctic Circle.

Exactly the same difference in the weight of spruce seed, according to the latitude in which it is grown, is observable in regard to the height of the locality above sea-level. Of two lots of spruce seed from the Tyrol, of which the first was alleged to have grown about 1800 feet above the sea, and the other from 3000 to 3300 feet above the sea, the weight of 1000 fresh seeds was found to be 0·26 oz. and 0·25 oz. respectively.

According to Cieslar,¹ the weight of 1000 fresh seeds of spruce can vary between 0·50 oz. for seed from Carinthia, about 1400 feet above the sea, to 0·15 oz. for seed from the southern Tyrol, about 5000 feet above sea.

The same will be found to be the case when the results for *Pinus sylvestris* are examined. The Scotch-grown seed has the highest weight—the average weight of eleven tests being 0·24 oz. for 1000 fresh seeds (the maximum found here being 0·25 oz.). The average of seven samples from central Europe, Hesse, Bavaria, and Austria, is 0·21 oz. (maximum 0·23 oz.), and for the Scandinavian-Finnish seed the average is 0·16 oz.

¹ Dr Adolf Cieslar, "Neues aus dem Gebiete der forstlichen Zuchtwahl," *Centralblatt für das gesamte Forstwesen*, 1899, parts ii. and iii.

(maximum 0.19 oz.). The lowest weight has been 0.14 oz., for a sample of Finnish seed.

Also *Pinus montana uncinata* appears from the Tables to have the same property; the French seed from Briançon, in the Haute Alpes, is much larger than what has been grown on the Danish heaths.

Also larch seed gets smaller the higher in the mountains it is grown. Dr Cieslar, in his above-quoted paper, gives 0.18 oz. per 1000 for seed grown 3500 feet above the sea as the lowest weight, and 0.25 oz. as the highest weight from 2900 feet above the sea. My tests show an average weight of 0.21 oz. for nineteen lots of seed from the Tyrolese and Swiss Alps, and 0.19 oz. for three lots of seed of Silesian origin.

By and by, when it, as may be hoped, will be understood how great an influence the origin of the seed has on the future trees, the importance of the figures will be evident to all practical foresters and honest seed merchants.

Numerous experiments have shown that the spruce raised from seed from Finland grows too slowly in the insular climate of Denmark and in the central European lowlands, at any rate while it is young; while, on the other hand, the spruce from the central European lowlands will not thrive far north. German Scotch fir does not thrive in Denmark, Scandinavia, and Finland, and its cultivation has not given good results in the Baltic provinces,¹ while trees from Scottish-grown seed seem to have the greatest power of resistance in the stormy climate of Jutland. Cieslar² further points out that the spruce and larch from high elevations do not thrive well in the lowlands, while, on the other hand, the lowland spruce cannot thrive in the highlands, and finally, that the Scandinavian Scotch fir grows considerably slower in the Austrian lowlands than their own native fir.

All this ought to make it clear to every one how important it is, by the aid of seed-testing, to be able to secure seed from the places that are likely to be most serviceable.

Exactly the same difference in the size of the seed, according to the place of origin, seems to assert itself on the great areas of North America.

¹ M. v. Sievers, "Ueber die Vererbung von Wuchsfehlern bei *Pinus sylvestris*, L.," *Mittheilungen der Deutschen Dendrologischen Gesellschaft*, 1895.

² Dr Adolf Cieslar, "Neues aus dem Gebiete der forstlichen Zuchtwahl," *Centralblatt für das gesammte Forstwesen*, 1899, parts ii. and iii.

From the Tables, it will be seen that I have tested the seed of some American species from different localities, and the weights in ounces per 1000 seeds are as follows :—

	Pacific Coast.	Colorado.
<i>Abies concolor</i> ,	1·36	0·96
„ <i>grandis</i> ,	0·79	0·44
<i>Pinus ponderosa</i> ,	1·96	1·02 ¹
<i>Pseudotsuga Douglasii</i> ,	0·39	0·35

These figures are, as the Tables show, the average of several samples tested during a series of years. The lowest figures for fresh seed that I have found are for *A. concolor* 0·74, *A. grandis* 0·32, and *P. Douglasii* 0·33, and these are all from Colorado seed. As the glaucous varieties of *A. concolor* and Douglas fir from the Rocky Mountains of Colorado appear to be much more hardy (even if they are a little slower growing and smaller) than the light green varieties from the Cascade Mountains near the Pacific coast, it is most desirable that seed-tests should be capable of determining with certainty that the seed offered is the kind we want.

The seed of Sitka spruce appears to show a similar marked difference in the size of the grains. I have, for instance, in the spring of 1900, had two lots from two different places. That from Mount Shasta in the northern Sierra Nevada in California, in about 40° north latitude, weighed 0·10 oz., while that from the Cascade Mountains in Washington Territory, in 48° of latitude, weighed 0·16 oz. per 1000 fresh seeds. The average weight of fourteen samples in twelve years has been 0·10 oz.

The figures are, however, still too few for the American species, so that they need not be taken for anything but an indication of the direction in which I think my seed-testing in the near future is likely to develop.

THE SEED OF DECIDUOUS TREES.

There are much less positive results of tests with these, as most of the species germinate too slowly, but still we have the satisfaction to be able to get good results of germination-tests of *Alnus* and *Betula*, and this even in a comparatively short time.

¹ This is the variety known as *scopulorum*, Eng.

In illustration of this, I shall refer to the tests of these species for the season 1899-1900.

SPECIES OF SEED.	The sample contained per cent.			Of the clean seed there germinated:—				Germination in per cent. of the Clean Seed.	Real Value.
	Seed of other Species.	Refuse (Sand, Soil, Scales, etc.)	Clean Seed.	In days.	Per cent.	In days.	Per cent.		
<i>Alnus incana</i> ,	0	50·7	49·3	5	20	28	24	24	11·8
„ <i>glutinosa</i> ,	0·3	44·2	55·5	6	18	31	19	19	10·5
<i>Betula papyrifera</i> ,	0	23·0	77·0	10	10	31	13	13	10·0
„ <i>verrucosa</i> , French seed, .	0	77·0	23·0	13	12	30	13	13	3·0
„ <i>odorata</i> , Norwegian seed,	0	60·8	39·2	5	43	31	50	50	19·6

Anyone will at once notice the very high germinating energy in some cases, so high, indeed, that even in five to six days there has been a sufficient result to make sure whether the seed is good or not, and this is evidently a great aid in purchasing these seeds.

In the autumn of 1899, nearly all the tree-seedsmen of central Europe reported that no new seed of *Alnus* would come into the market in the coming season, and the first sample I sent for testing germinated only 1 per cent. in six days, and 6 per cent. in thirty days; wherefore I refused this and several other lots that were offered. This had the effect of bringing out offers of good seed; but perhaps it had suited better first to get rid of the old stuff to me.

I have often had inquiries regarding the sowing of willow seed, and so early as 1888 I had some of this seed tested. I had a vague idea that it did not grow at all, or else lost the germinative power very quickly. The result was, as appears from the Tables, that seed of *Salix caprea* collected on 15th June, and put to the test next day, in two days germinated 87 per cent. and in six days 93 per cent., while some of the same seed, put to the test twenty-five days later, in ten days only germinated 7 per cent. *Salix purpurea* collected on 25th June, and put to the test sixteen days later, did not germinate at all.

I have placed these results before the Royal Scottish Arboricultural Society, in the hope that they may be found to be of some interest, and I shall also in future, with pleasure, lay my experiences regarding tree seed-testing before my colleagues.

TABLES SHOWING AVERAGE RESULTS OF 12 YEARS TESTING OF TREE SEEDS, 1888-1900.

SPECIES OF SEED.	Number of Tests.	Weight of 1000 Fresh Seeds.		Duration of Tests.	The Samples contained per cent. (Average).					Real Value.	
		oz.	dys.		Refuse (Sand, Soil, Scales, etc.).	Pure Seeds.	Dead Seeds.	Sound but not Germinating ("hard").	Germinating Seeds.	Minimum.	Maximum.
<i>Abies amabilis</i> , Forb.,	3	1.17	33	11.82	88.18	50.80	...	37.38	21.84	54.00	
" <i>balsamea</i> , Mill., Danish seed, . . .	12	0.26	36	3.60	91.40	48.64	2.00	40.76	6.53	59.96	
" " American seed,	1	0.26	39	14.50	85.50	57.21	...	28.20	...	...
" <i>brachyphylla</i> , Maxim.,	2	0.76	31	4.45	95.55	89.23	...	6.32	5.90	6.73	
" <i>cephalonica</i> , var. <i>Reginae Amalie</i> , from Arcadia in Peloponnesus, 6270 ft. above sea,	1	2.61	31	0.10	99.90	42.96	...	56.94	...	...
" <i>concolor</i> , Lindl., Oregon seed, . . .	4	1.36	28	16.00	84.00	60.00	7.00	17.00	7.92	50.42	
" " Colorado seed,	7	0.96	33	4.42	95.58	48.71	...	46.87	14.34	60.58	
" <i>firma</i> , S. and Z.,	1	0.74	32	3.50	96.50	63.69	...	32.31	...	...
" <i>grandis</i> , Lindl., Oregon seed, . . .	2	0.79	31	17.39	82.70	36.40	5.70	40.60	22.62	70.00	
" " Colorado seed,	4	0.44	26	8.86	91.14	56.63	...	34.51	14.25	44.65	
" <i>magnifica</i> , Murr.,	1	2.94	31	11.60	88.40	29.50	49.40	9.50	...	...
" <i>Mariesii</i> , Mast.,	1	0.65	42	4.00	96.00	71.04	...	24.96	...	...
" <i>nobilis</i> , Lindl.,	7	1.04	32	7.47	92.53	60.80	4.72	27.01	15.20	55.60	
" " <i>glauca</i> , Scotch seed,	1	1.46	21	1.50	98.50	63.04	...	35.46	...	...
" <i>Nordmanniana</i> , Lk.,	11	2.27	30	10.70	89.30	60.74	2.56	26.00	16.19	75.68	
" <i>pectinata</i> , D. C.,	10	1.50	34	11.76	88.24	53.58	6.10	28.56	5.68	68.16	
" <i>Pinsapo</i> , Bois.,	1	2.75	22	1.00	99.00	67.32	...	31.68	...	...
" <i>sibirica</i> , Ledeb.,	4	0.41	26	4.78	95.22	61.34	...	33.88	15.75	43.98	
" <i>subalpina</i> , Engelm.,	1	0.34	34	3.70	96.30	49.11	...	47.19	...	...
" <i>orientalis</i> , Endl.,	1	0.47	23	3.00	97.00	...	67.00	30.00	...	...
<i>Chamaecyparis Lawsoniana</i> , Parl., . . .	5	0.072	30	15.30	84.70	63.32	...	22.38	7.10	28.48	
" <i>nutkaensis</i> , Spach.,	2	0.13	28	10.05	89.95	79.65	9.10	1.20	...	...
" <i>obtusata</i> , S. and Z.,	1	0.065	32	10.00	90.00	70.65	...	19.35	...	...
" <i>pisifera</i> , S. and Z.,	1	0.026	42	3.00	97.00	86.33	...	10.67	...	...
<i>Cryptomeria japonica</i> , Don.,	1	0.105	36	5.00	95.00	79.80	...	15.20	...	...
<i>Cupressus Goveniana</i> , Gord.,	1	0.102	23	1.20	98.80	91.98	...	6.92	...	...
<i>Ginkgo biloba</i> , L.,	1	70.14	...	...	100.00	80.00	20.00	...	...	...
<i>Juniperus communis</i> , L.,	1	2.73	...	1.40	98.60	29.60	69.00	...	...	...
" <i>virginiana</i> , L.,	1	0.73	...	1.20	98.80	35.60	63.20	...	...	...
<i>Larix europaea</i> , D. C., Seed from the Alps, . .	19	0.21	29	13.86	86.14	38.51	1.08	46.55	17.70	56.00	
" " Scotch seed,	1	0.15	31	44.60	55.40	47.10	5.55	2.75	...	...
" " Silesian seed,	3	0.19	32	13.73	86.27	38.24	...	48.03	43.15	52.20	
" <i>leptolepis</i> , Murr.,	7	0.13	35	14.70	85.30	55.13	...	30.17	12.40	38.08	
" <i>sibirica</i> , Ledeb.,	9	0.41	32	3.30	96.70	49.90	...	46.80	13.56	59.10	
<i>Libocedrus decurrens</i> , Torr.,	1	0.93	26	38.70	61.30	44.75	5.30	11.25	...	...
<i>Picea ajanensis</i> , Fisch.,	1	0.07	43	9.70	90.30	38.38	...	51.92	...	...
" <i>alba</i> , Lk., Danish seed,	26	0.11	28	2.65	97.35	21.03	2.78	73.54	10.84	91.09	
" " Canadian seed,	1	0.086	34	6.50	93.50	7.48	14.96	71.06	...	...
" <i>Engelmanni</i> , Engelm. (<i>glauca</i>), . . .	1	0.127	27	6.30	93.70	10.78	...	82.92	...	...
" <i>canadensis</i> , Lk., Tyrolese seed,	13	0.28	21	2.47	97.53	13.23	...	84.30	61.19	90.37	
" " German seed,	6	0.28	23	2.47	97.53	13.75	6.80	76.98	67.48	90.38	
" " Danish seed,	4	0.28	32	2.55	97.45	29.69	21.83	45.93	44.62	76.32	
" " Swedish seed,	12	0.19	22	1.29	98.71	8.90	4.45	85.36	73.33	97.61	
" " Norwegian seed,	4	0.19	22	2.15	97.85	17.10	6.30	74.45	55.16	86.91	
" " Finnish seed,	5	0.18	24	1.57	98.43	9.47	0.51	88.45	65.35	97.71	
" <i>borealis</i> , Glöers, Norwegian seed, grown north of the Arctic circle,	5	0.17	25	1.45	98.55	24.86	3.00	70.69	43.25	94.55	

SPECIES OF SEED.	Number of Tests.	Weight of 1000 Fresh Seeds.	The Samples contained per cent. (Average).							Real Value.	
			Duration of Tests.	Refuse (Sand, Soil, Scales, etc.).	Pure Seeds.	Dead Seeds.	Sound but not Germinating ("hard") Seeds.	Germinating Seeds.	Minimum.	Maximum.	
											oz.
<i>Picea nigra</i> , Lk.,	3	0.12	29	19.35	80.65	23.44	12.11	45.10	41.40	79.02	
" <i>obovata</i> , Ledeb.,	1	0.16	26	4.60	95.40	9.06	...	86.34	...	...
" <i>orientalis</i> , Lk.,	2	0.23	33	7.95	92.05	27.39	...	64.66	60.92	68.40	
" <i>polita</i> , Carr.,	1	0.55	21	12.00	88.00	29.04	...	58.96	...	...
" <i>pungens</i> , Engelm.,	3	0.14	23	8.08	91.92	7.64	...	84.28	75.33	90.72	
" <i>sitchensis</i> , Trautw.,	14	0.10	26	19.76	80.24	19.37	4.39	75.85	16.50	79.12	
<i>Pinus Banksiana</i> , Lamb.,	1	0.13	29	6.00	94.00	18.33	...	75.67	...	...
" <i>Cembra</i> , L.,	3	8.40	24	0.80	99.20	19.88	73.40	6.92	72.52	90.00	
" <i>contorta</i> , Dougl.,	3	0.13	33	8.38	91.62	10.64	18.29	62.69	61.06	92.97	
" <i>Murrayana</i> , Engelm.,	1	0.13	32	2.20	97.80	13.69	9.78	74.33	...	...
" <i>densiflora</i> , S. and Z.,	1	0.51	35	1.50	98.50	25.51	...	72.99	...	...
" <i>insignis</i> , Dougl.,	1	0.82	30	0.50	99.50	54.72	30.85	13.93	...	...
" <i>Koraiensis</i> , S. and Z.,	1	15.64	40	3.80	96.20	...	...	...	...	...
" <i>Laricio</i> , Poir.,	5	0.50	30	1.28	98.72	27.82	2.74	68.16	51.17	94.66	
" <i>austriaca</i> ,	8	0.67	30	1.76	98.24	15.54	4.88	77.82	62.91	86.56	
" <i>Massoniana</i> , Lam.,	2	0.47	29	1.95	98.05	22.54	...	75.51	57.42	93.60	
" <i>montana ucinata</i> , Danish seed,	28	0.23	29	1.10	98.90	6.00	15.12	77.78	54.49	96.00	
" " French seed,	2	0.27	25	3.90	96.10	9.60	27.80	58.70	81.86	91.14	
" <i>Parryana</i> , Engelm.,	1	16.66	...	...	100.00	...	100.00	...	...	...
" <i>Pinaster</i> , Sol.,	2	1.70	20	1.00	99.00	21.80	39.60	37.60	74.30	80.10	
" <i>ponderosa</i> , Dougl., Oregon seed,	3	1.96	30	4.50	95.50	33.40	30.60	31.50	36.75	88.65	
" <i>scopulorum</i> , Engelm.,	2	1.02	40	1.65	98.35	36.74	11.47	50.14	44.36	78.86	
" <i>resinosa</i> , Sol.,	1	0.33	15	4.50	95.50	8.91	...	86.59	...	...
" <i>rigida</i> , Mill.,	2	0.23	37	1.55	98.45	8.34	6.12	83.99	86.19	94.02	
" <i>sylvestris</i> , L., Scotch seed,	11	0.24	28	3.50	96.50	26.94	4.37	65.19	41.12	95.62	
" " German seed,	1	0.20	20	2.90	97.10	15.70	9.80	71.60	...	...
" " Swedish seed,	5	0.18	24	0.60	99.40	3.95	5.95	89.50	91.98	97.71	
" " Norwegian seed,	3	0.179	24	1.10	98.90	20.80	8.00	70.10	69.09	91.36	
" " Finnish seed,	17	0.166	26	1.08	98.92	17.86	10.20	70.86	38.45	92.84	
" <i>Strobus</i> , L., Tyrolese seed,	4	0.69	44	8.13	91.87	20.42	27.52	34.93	63.80	86.44	
" " German seed,	8	0.63	42	6.50	93.50	19.66	40.84	33.00	52.40	86.40	
" " American seed,	2	0.65	37	5.00	95.00	16.76	30.47	47.77	62.78	93.70	
" <i>Thunbergii</i> , Parl.,	1	0.47	34	3.30	96.70	19.19	...	77.51	...	...
<i>Pseudotsuga Douglasii</i> , Carr., Oregon seed,	4	0.39	30	7.10	92.90	25.20	24.90	44.80	58.83	80.93	
" " Colorado seed,	7	0.35	34	8.76	91.24	22.94	10.04	58.26	12.70	86.77	
<i>Sciadopitys verticillata</i> , S. and Z.,	1	1.07	39	2.00	98.00	14.70	...	83.30	...	...
<i>Sequoia gigantea</i> , Torr.,	1	0.27	51	2.80	97.20	74.36	...	22.84	...	...
<i>Taxus baccata</i> , L.,	2	1.96	...	1.50	98.50	19.70	78.80	...	58.80	98.80	
<i>Thuja gigantea</i> , Nutt., American seed,	3	0.037	34	16.50	83.50	31.70	...	51.79	26.40	70.65	
" <i>occidentalis</i> , L., European seed,	3	0.044	29	29.05	70.95	51.22	...	19.73	4.65	41.70	
" <i>Standishii</i> , Carr.,	1	0.02	43	38.00	62.00	52.60	...	9.40	...	...
<i>Tsuga canadensis</i> , Carr.,	1	0.09	48	3.40	96.60	79.21	...	17.39	...	...
" <i>Sieboldii</i> , Carr.,	1	0.074	43	62.00	38.00	37.56	...	0.44	...	...
<i>Acer campestre</i> , L., Danish seed,	3	2.73	20	2.60	97.40	13.70	83.70	35.00	68.40	99.00	
" <i>platanoides</i> , L., Norwegian seed,	5	3.67	20	5.60	94.40	38.60	54.80	1.00	36.89	75.00	
" <i>Pseudo-Platanus</i> , L., Danish seed,	3	2.41	22	18.20	81.80	17.10	62.30	2.40	52.04	75.06	
" " German seed,	2	2.90	25	11.20	88.80	33.25	63.60	1.95	50.44	82.00	
" <i>rubrum</i> , L.,	1	0.42	20	8.60	91.40	17.60	72.80	1.00	...	...
" <i>saccharinum</i> , Waugh.,	1	2.27	20	16.10	83.90	49.60	34.30	...	...	...
<i>Alnus glutinosa</i> , Willd., German seed,	16	0.03	30	38.22	61.78	51.66	...	10.12	0.71	25.60	
" <i>incana</i> , Willd., German seed,	16	0.02	32	55.11	44.89	36.80	...	8.09	0.96	18.80	
" " Norwegian seed,	5	0.02	28	43.27	56.73	43.79	...	12.94	7.74	18.90	
<i>Betula nigra</i> , L.,	2	0.03	21	39.80	60.20	49.36	...	10.84	0.94	33.50	
" <i>odorata</i> , Bechst., Norwegian seed	10	0.01	30	61.26	38.74	23.89	...	14.85	4.43	29.95	

SPECIES OF SEED.	Number of Tests.	Weight of 1000 Fresh Seeds.	Duration of Tests.	The Samples contained per cent. (Average).					Real Value.	
				Refuse (Sand, Soil, Scalos, etc.).	Pure Seeds.	Dead Seeds.	Sound but not Germinating ("hard") Seeds.	Germinating Seeds.	Minimum.	Maximum.
<i>Betula papyrifera</i> , Mchx.,	7	0.01	32	35.65	64.35	56.83	...	7.52	1.18	17.41
" <i>verrucosa</i> , Ehrh., German seed,	21	0.005	30	67.08	32.92	30.37	...	2.55	0.57	20.07
" " " French seed,	3	0.004	31	76.25	23.75	21.63	...	2.12	1.14	3.00
" " " Swedish seed,	1	0.005	34	80.00	20.00	17.90	...	2.10	...	...
<i>Carpinus Betulus</i> , L., German seed; without wings,	1	1.42	21	2.60	97.40	47.60	49.80	...	...	...
<i>Carpinus Betulus</i> , L., Danish seed; with wings,	1	2.50	...	38.80	61.20	17.15	44.05	...	...	...
<i>Carpinus virginiana</i> , Mill.,	1	0.72	23	3.50	96.50	29.10	66.40	1.00	...	...
<i>Carya alba</i> , Nutt.,	2	129.53	...	...	100.00	...	100.00	...	...	...
" <i>amara</i> , Nutt.,	1	145.18	...	29.50	70.50	...	70.50	...	...	...
" <i>porcina</i> , var. <i>microcarpa</i> ,	1	119.21	...	...	100.00	...	100.00	...	...	...
<i>Corylus Avellana</i> , L.,	1	35.80	...	...	100.00	10.00	90.00	...	...	...
<i>Fagus sylvatica</i> , L.,	3	7.87	27	5.05	94.95	12.10	38.75	44.10	78.70	94.60
<i>Fraxinus excelsior</i> , L.,	3	2.45	...	8.90	91.10	1.80	89.30	...	79.42	99.20
" <i>pubescens</i> , Lam.,	3	1.17	30	1.00	98.40	10.80	83.70	3.90	84.13	94.56
<i>Hippophae rhamnoides</i> , L.,	1	0.27	45	1.70	98.30	89.94	...	8.30	...	...
<i>Laburnum vulgare</i> , Gledsch.,	1	0.91	30	1.90	98.10	2.00	60.70	35.40	...	...
<i>Liriodendron Tulipifera</i> , L.,	1	1.03	30	21.60	78.40	70.00	5.90	1.90	...	...
<i>Magnolia acuminata</i> , L.,	1	6.33	...	...	100.00	...	100.00	...	...	...
" <i>grandiflora</i> , L.,	1	8.36	...	...	100.00	10.00	90.00	...	...	...
<i>Negundo fauciflorum</i> , Nutt.,	2	1.42	30	16.50	83.50	5.00	66.00	12.50	66.84	91.80
<i>Platanus occidentalis</i> , L.,	1	0.17	30	10.80	89.20	86.50	...	2.70	...	...
<i>Prunus Avium</i> , L.,	1	6.12	...	1.60	98.40	11.80	86.60	...	...	...
" <i>cevasifera</i> , Ehrh.,	2	15.49	...	...	100.00	2.00	98.00	...	96.00	100.00
" <i>domestica</i> , L.,	1	18.48	...	...	100.00	...	100.00	...	...	...
" <i>damascena</i> ,	1	20.68	...	...	100.00	4.00	96.00	...	...	...
" <i>Mahaleb</i> , L.,	1	3.39	...	0.50	99.50	7.90	91.60	...	...	...
<i>Pyrus comanensis</i> , L.,	3	1.05	23	1.90	98.10	20.60	75.50	2.00	54.77	89.48
" <i>Malus</i> , L.,	1	1.11	15	7.60	92.40	9.25	78.40	4.75	...	...
<i>Quercus Cerris</i> , L.,	3	126.91	33	19.90	80.10	29.60	32.60	17.90	15.12	89.68
" <i>conforta</i> , Kit.,	1	76.16	30	19.20	80.80	5.95	...	75.15	...	...
" <i>macrocarpa</i> , Mchx.,	1	106.47	...	45.80	54.20	43.36	10.84	...	...	...
" <i>palustris</i> , Muenchb.,	1	49.35	...	...	100.00	...	100.00	...	...	...
" <i>pedunculata</i> , Ehrh.,	5	117.98	29	11.45	88.55	13.72	13.78	56.05	25.73	87.84
" <i>rubra</i> , L.,	2	95.51	36	1.00	99.00	29.70	44.50	24.80	58.60	80.00
<i>Robinia Pseud-Acacia</i> ,	1	0.71	30	3.10	96.90	1.90	45.60	49.40	...	...
<i>Rosa canina</i> , L.,	2	0.68	...	0.80	99.20	2.00	97.20	...	95.80	98.60
" <i>uralensis</i> ,	1	0.45	...	3.70	96.30	...	96.30	...	...	...
<i>Salix caprea</i> , L., tested at once after collecting,	1	0.003	2	...	...	...	...	87.00	...	...
<i>Salix caprea</i> , L., tested 25 days after collecting,	1	0.003	10	...	...	...	...	7.00	...	...
<i>Salix purpurea</i> , L., collected 16 days,	1	0.003	7	...	...	...	...	0.00	...	...
<i>Sambucus nigra</i> , L.,	1	0.99	32	36.49	63.50	19.10	44.50	...	...	...
<i>Sorbus Aria</i> , Crantz.,	1	15.95	...	0.10	99.90	48.00	28.00	...	...	...
" <i>aucuparia</i> , L.,	1	6.60	...	1.10	98.90	40.00	105.00	...	...	...
" <i>torminalis</i> , Crantz.,	1	13.22	...	1.20	98.80	20.00	208.00	...	...	...
<i>Spartium scoparium</i> , L.,	3	0.26	28	1.90	38.10	6.84	33.27	55.99	79.15	98.00
<i>Tilia cordata</i> , Mill.,	2	1.16	...	2.90	97.10	4.85	92.25	...	90.52	93.98
" <i>vilgaris</i> , Hayn.,	2	3.71	...	2.50	97.50	9.75	87.75	...	83.57	91.93
<i>Ulex europaeus</i> , L.,	2	0.23	26	2.30	97.70	18.70	33.34	45.66	66.80	91.20
<i>Ulmus campestris</i> , L.,	1	0.41	21	41.80	58.20	35.60	10.90	11.70	...	...
" <i>fulva</i> , Mchx.,	1	0.43	21	24.60	75.40	67.10	8.30	...	...	...
" <i>montana</i> , With., Danish seed,	3	0.44	28	30.30	69.70	30.60	11.90	27.20	2.20	55.80

} of 100 berries.

XXIII. *Damage to Woods and Agricultural Crops by Sparks from Railway Engines.* By Colonel F. BAILEY.

During recent years, the question of financial responsibility for the numerous and disastrous fires in woods, agricultural crops, stacks or buildings, which have been caused by sparks from railway engines, has forced itself on the attention of landed proprietors and tenant farmers with increasing urgency; and the Council of the Royal Scottish Arboricultural Society have considered it their duty to take the matter up.

The following statement of the law on the subject is extracted from "Deas on the Law of Railways," 2nd edition, revised by Ferguson, 1897:—

"Where the Legislature has sanctioned the use of a locomotive engine, there is no liability for any injury caused by using it, so long as every precaution is taken consistent with its use. But where there has been negligence, the company will be liable in damages; and in cases of fire, at all events, the onus of proving that all reasonable precautions have been adopted lies upon the company. The fact of the fire is itself *prima facie* evidence of negligence, and evidence is admissible that other engines of the company have emitted sparks reaching the premises in question. Where trimmings of a hedge had been left by railway workmen, an engine passed, and within a short time a large amount of property was destroyed by fire, for which no other cause could be assigned; it was held that there was evidence of negligence, and that the damages were to be measured by the price to be paid to an unwilling vendor. And where no statutory authority for the use of engines has been given, the company will be liable, though all precautions have been taken.

"Provided the engine is of the best construction, and the proper safeguards are used for minimising the risk of fire damage, the railway company is impliedly indemnified against the consequences of its use. The owners of a flax store, near a railway line, which had been set on fire by a spark from a passing engine, brought an action against the railway company, alleging that the engine was improperly constructed, in respect that it had no 'spark arrester.' The defenders maintained that in the more modern engines the use of spark arresters had been given up, both because they impaired the efficiency of the engine, and because other means as efficacious to prevent the issue of sparks were adopted. The House of Lords held, affirming the First Division, that no negligence had been proved against the company; and the observation was made by Lord M'Laren, that railway companies are not under a legal disability to improve the efficiency of their engines, merely because such improvement may tend in some degree to increase the risk of setting fire to adjacent property."

In 1893, when delivering judgment in the Flax Store case above alluded to, the Lord Chancellor said :—

“It is now well-settled law that in order to establish a case of liability against a railway company, under such circumstances it is essential for the pursuers to establish negligence. The railway company having the statutory power of running along the line with locomotive engines, which in the course of their running are apt to discharge sparks, no liability rests upon the company, merely because the sparks emitted by an engine have set fire to adjoining property. But the defenders, although possessing the statutory power, are undoubtedly bound to exercise it reasonably and properly, and the test whether they exercise the power reasonably and properly appears to me to be this. They are aware that locomotive engines running along the line are apt to emit sparks. Knowing this, they are bound to use the best practicable means according to the then state of knowledge, to avoid the emission of sparks, which may be dangerous to adjoining property; and if they, knowing that the engines are liable thus to discharge sparks, do not adopt that reasonable precaution, they are guilty of negligence, and cannot defend themselves by relying upon the statutory power. About the law as I have thus expressed it, I do not think there is any controversy between the parties to this litigation.”

Numerous decisions have been given in the Courts under the same law; and, in view of the difficulty of proving legal “negligence,” it is not surprising that these decisions have almost invariably been given in favour of the railway company. A notable exception is the case of *Twinch v. The G. W. Railway Company*, which was tried by Mr Justice Day at the Berks Summer Assizes, on 15th June 1900. The learned judge, when summing up, is reported to have said :—

“It was perfectly clear that the damage was caused by cinders escaping from the leading engine; and the question was simply, did that arise from want of reasonable care on the part of the company? They had nothing to do with the practice of English or Scotch railway companies; whether they were right or wrong was immaterial; but if the French or the American system was more effective, they ought unquestionably to use it. He attached the utmost importance to what was done in other countries, because if foreign countries did damage they had to pay for it, and so they were more likely to study anything which would protect their own pockets than English companies, which were worked under a certain system of protection. The time occupied by the Great Western Railway in making the experiment of a partially extended smoke-box, seemed to him utterly inordinate for any experiment. The defendant company had not called the drivers of the two engines, but he thought the jury must take it, as reasonable men, that one engine did answer and the other did not.”

The jury found for the plaintiff.

In view of the prejudicial manner in which owners and occupiers of land are, with rare exceptions, treated under the existing law, a Bill to amend the law was introduced into the House of Commons, early in 1900, by Mr A. F. Jeffreys. The Bill ran thus:—

“A Bill to Secure Compensation for Damage to Crops by Fires caused by Sparks from Railway Engines.—Be it enacted by the Queen’s most Excellent Majesty, by and with the advice and consent of the Lords Spiritual and Temporal, and Commons, in this present Parliament assembled, and by the authority of the same, as follows:—(1) Where damage is caused to crops, hedges, or plantations by fire arising from sparks emitted from any locomotive engine on railways, the railway company owning such engine shall, notwithstanding their statutory powers and rights to the contrary, or the provisions of any special or general Act relating thereto, be liable to pay to the person whose crops, hedges, or plantations have been so damaged, the amount of such damage, to be recovered in any court of competent jurisdiction. (2) This Act may be cited as the Compensation for Damage to Crops Act, 1900.”

And the following Memorandum was appended to the Bill:—

“Under the present law all damage caused by sparks from road locomotives can be recovered from the owners of the said locomotives, but railway engines are exempt from this law, and the object of this Bill is to put railway engines and road locomotives on the same footing in this respect.”

On the 9th, and again on the 21st May 1900, questions on this subject were asked in the House by Mr Jeffreys, and on the latter occasion a short discussion arose, in which Mr Munro Ferguson and other members took part; but their efforts to induce the Government to take the matter up were unsuccessful.

In the following month, the Council of the Royal Scottish Arboricultural Society issued the following circular, which was distributed not only among the Society’s members, but also among landowners, tenants, and others who it was thought might be interested in the matter:—

“A short Bill, backed by several private Members of Parliament, has been introduced into the House of Commons with the object of placing railway engines on an equal footing with road locomotives as regards liability to pay compensation for damage to crops, woods, etc., from fire caused by the emission of sparks. When leave was asked for facilities to discuss this Bill, the First Lord of the Treasury, while acknowledging the ‘curious discrepancy between the law which applies to road locomotives and that which applies to railway engines,’ stated that the President of the Board of Agriculture had ‘no detailed information as to the damage done by sparks from railway

engines.' And in reply to a question by Mr Munro Ferguson, as to 'whether there had not been a great increase in the number of fires, and in the damage, done in recent years owing to the larger number of fast trains and their enhanced speed, and whether the screens or other precautions formerly taken against engine sparks have not become disused,' the President of the Board of Trade replied: 'I do not see where I am to get such information. I have no doubt that the increased speed of trains adds to the possibility of fires occurring from the sparks from railway engines, but I do not see where I am to get information with regard to the increase of such accidents from that cause.'

"In the circumstances, it is very desirable that information on this important subject should be supplied to the President of the Board of Agriculture and the President of the Board of Trade. The Council accordingly invite members of the Society and others to prepare, and send to the Secretary, full particulars regarding all fires caused by railway engines, which, to their knowledge, have occurred in recent years, but for which no compensation has been received.

"A blank schedule is appended, which may be used in sending in reports. Additional copies of the schedule may be obtained from the Secretary."

Up to the present time thirty-one schedules have been returned. Of these twenty-one relate to woods and plantations, and the remaining ten relate to agricultural crops, grass lands, stacks, and buildings.

Damage to Woods.—The twenty-one cases of damage to woods are estimated to have involved an aggregate loss of about £2300. In only nine of these cases was application made to the railway company for compensation; and in one of the nine only was the claim (£4) paid, the payment being then made "without prejudice." In the other eight cases the companies declined to admit any liability, on the ground that their engines were fitted with proper appliances, and that there had been no neglect on the part of themselves or their servants.

In twelve cases claim for compensation was not made, doubtless because, as is specifically stated in three of the schedules, it was considered useless to apply to the company after the judicial decisions which had been given in like cases.

Damage to Agricultural Crops, Grass Lands, Stacks, and Buildings.—The damage involved is estimated at about £830. In seven instances application was made for compensation, but without success, the grounds of rejection being those given in the case of woods. In the other three instances it was not considered worth while to apply.

We have then this result, that out of thirty-one reported cases

of damage by fire, due to sparks from railway engines, and in which the loss occasioned is estimated at about £3130, £4 only has been paid "without prejudice" to one out of the sixteen owners or occupiers who applied for compensation; and in the remaining fifteen cases it was not thought worth while to apply. It was well known that after the decision of the House of Lords in 1893, the companies were disclaiming all responsibility for the fires caused by the engines, and proof of "negligence" was, generally speaking, impossible. Perhaps if Mr Justice Day's decision of June 1900 had been more widely known, some of those who suffered loss might have been encouraged to press their claims on the companies with greater urgency, or even to carry them before the Courts. But however that may be, the judgment in question is a very important one. It is difficult to understand why railway companies should continue to be "worked under a certain system of protection"; and why an Act entitling a company to construct a railway through the country should involve the neighbouring owners and occupiers in a risk of serious loss for which they are practically unable to obtain compensation, and should force them, besides, to expend large yearly sums on measures of protection which cannot always secure their property against the fire which the companies are carrying through the land.

Every possible effort should be made to alter our law to that which prevails in foreign countries, where, as Mr Justice Day says, if railway companies cause damage of this kind they have to pay for it. As the learned judge observes, the companies are then "more likely to study everything which would protect their own pockets."

It is obvious that the railways must continue to run, and their number will be added to; but it appears to be only simple justice and common sense that they should not enjoy "protection" when carrying fire, for their own profit, through the property of others.

Mr Jeffrey's Bill was blocked; but it is understood that he will re-introduce it during the current session of Parliament; let us hope that it may receive strong support from both sides of the House.

XXIV. *The Annual Excursion in 1900 to Clondeboye, Baronscourt, and Castlewellan, in Ulster.*

The Twenty-third Annual Excursion of the Society took place on the 8th, 9th, and 10th August 1900, when a visit was paid to three of the most interesting residential estates in the northern province of Ireland—Clondeboye, Baronscourt, and Castlewellan.

This is the second time the Society has gone to Ireland, the last occasion being in 1897, when Counties Dublin, Wicklow, and Kildare in the east, and Cork and Kerry in the south, were visited. The "Plantation of Ulster," by King James I. in 1610, had no reference to the "sticking in" of trees, but was the settlement of escheated lands, comprising practically the whole of the northern portion of the country, by Scotch and English colonists, for agricultural and industrial development. Had more attention been paid to forestry when Ulster was being planted in the early years of the seventeenth century, there might to-day have been a great area of valuable woodlands in the province, but nothing was done to foster the culture of woods. Among the inducements held out by the Privy Council when the land was being offered for settlement, was that it was "well-wooded, and its forests were accessible by water." Whatever may have been its condition at that time, Ulster was soon pretty well denuded of timber, and there was decided discouragement to fresh planting on the part of those holding under the London Companies, in face of a reservation to the Irish Society of all timber grown on the lands, with full power to cut it down and carry it away when they saw fit. As a consequence, Ireland, in proportion to its area, is the most sparsely wooded country in Europe, and that the afforestation of waste lands has not been entirely neglected—although there is a vast field still unoccupied—has been due to the enterprise and foresight of a few individual proprietors during the nineteenth century.

First Day—Belfast and Clondeboye.

The Excursion left Edinburgh on the evening of the 7th. The Earl of Mansfield, President of the Society, was unable to be present, being detained on duty with his regiment in London, but there was a muster of nearly one hundred, the company including R. C. Munro Ferguson, M.P., *Honorary Secretary*; Alex. Angus,

Dalzell Gardens, Motherwell; John Annand, Haystoun, Peebles; Robert Bell, Baronscourt, Co. Tyrone; A. W. Borthwick, Edinburgh; John Broom, Bathgate; Charles Buchanan, Penicuik; Dr Cameron, Loanhead; J. J. Cameron, Glasgow; James Cook, Arniston, Midlothian; R. W. Cowper, Tunstall, near Sittingbourne; James Crooks, St Helens; John Crozier, Durris, Aberdeen; Joseph Dick, Wentworth, Rotherham; Robert Douglas, Edinburgh; W. D. Edminson, Berwick-on-Tweed; James Forbes, Overtown, Dumbarton; Robert Forbes, Kennet, Alloa; Alex. Fraser, Raith, Kirkcaldy; R. Galloway, *Secretary and Treasurer*; Thomas Gordon, Edinburgh; George Hannah, The Glen, Peebleshire; George Halliday, Rothesay, Bute; Wm. Henderson, Gosford, Co. Armagh; Wm. Inglis, Brodick, Arran; George Jack, Dalkeith; James Kay, Rothesay, Bute; John Kerr, Yorkston, Midlothian; D. P. Laird, Pinkhill, Murrayfield, *Vice-President*; J. W. Laird, Monifieth; S. MacBean, Bunchrew, Inverness; G. U. Macdonald, Raith, Kirkcaldy; Wm. Mackenzie, Novar, Ross-shire; Geo. Mackinnon, Melville Castle, Midlothian; Wm. Mackinnon, Edinburgh; D. L. Mackintosh, Castlewemyss Gardens, Wemyss Bay; John M'Pherson, Novar, Ross-shire; Alex. M'Rae, Castlecomer, Co. Kilkenny; John Methven, Blythswood Gardens, Renfrew; Alex. Milne, Edinburgh, *Vice-President*; R. P. Milne, Spittal Mains, Berwick; W. Milne, Foulden Newton, Berwick; Andrew Morgan, Glamis, Forfarshire; Malcolm Morgan, Crieff; Hugh Munro, Penicuik; John Murdoch, Dalkeith; W. C. Orkney, Sunnyside, Montrose; A. D. Page, Culzean, Maybole; R. Johnston Paton, Kilmarnock; T. L. Patterson, Hardengreen, Midlothian; George Paxton, Kilmarnock; Jas. Pearson, Sessay, Yorkshire; Henry Philp, jun., Dunfermline; A. Piteaithley, Scone, Perthshire; Colonel Porteous, Turfhill, Kinross; A. D. Richardson, Edinburgh; John Robb, Edinburgh; J. Scrimgeour, Shane's Castle, Co. Antrim; John Smith, Peebles; W. J. Stalker, Nairn; James Stoddart, Bonnyrigg, Midlothian; Robert Storie, Dalkeith; James Tait, Penicuik; James Tait, jun., Penicuik; Wilson Tomlinson, Clumber Park, Notts; R. B. P. Wallace, Leith; John Watson, Edinburgh; Gilbert Wilson, Dailly, Ayrshire; John Wishart, Peebles; besides a number of guests.

The company was divided into three parties, which were taken charge of by three Belfast gentlemen—Mr Hugh Dickson, of the Royal Belmont Nurseries, Mr M'Elval, and Mr Watson. A visit

was paid in turn to several of the great works in the city, where the members witnessed much to impress them with the business importance and vast resources of Belfast. They inspected Messrs Harland & Wolff's extensive shipbuilding yard, the spinning factory at York Street, the tobacco factory of Messrs Gallagher, and the Belfast Ropeworks Company. A visit was also paid to the Royal Irish Distillery at Connswater.

After luncheon, the company started in brakes to drive to Clondeboye, a distance of ten miles, the journey being through a beautiful tract of country skirting the southern side of Belfast Lough. On the way a call was made at the Belmont Nurseries, for the purpose of inspecting Mr Hugh Dickson's splendid fields of roses, and his rich collection of *Begonias* and other flowers, which were greatly admired. Over the Royal arms which surmount the arched entrance to the nurseries, there was a fine display of the Crimson Rambler rose, and there was a wealth of colour for the horticulturist in the tasteful and effective treatment of this floral archway. The nurseries extend to forty acres, and in the rose fields something like 150,000 young roses are grown every year. After their walk through the grounds, during which the visitors saw some acres of fruit trees and shrubs of great variety and fine quality, the drive was resumed to Clondeboye, by way of Holywood and Helen's Bay.

When Lord Dufferin succeeded to Clondeboye there was only a little bit of plantation round the mansion-house, but there are now about three thousand acres of woodlands and policies, in which the planting has been carried out with a view to ornamental effect and sporting purposes rather than with an eye to economic forestry. There was nothing of special note to be seen in the woodlands, the chief feature of the demesne being Helen's Tower, rising on the top of a wooded hill, and from the summit of which an enchanting view is obtained of a grand and extensive panorama, embracing the woods and lakes of Clondeboye, Belfast Lough, the Antrim Hills, the Irish Sea, the island of Arran, Ailsa Craig, the coasts of Ayrshire and Wigtownshire, the Isle of Man, Strangford Lough, and the Mourne Mountains—a magnificent stretch of scenery, which, for variety and picturesqueness, could hardly be surpassed.

The party went over the house, where they examined with much interest the rich store of artistic treasures, instruments of warfare, and sporting trophies, gathered together by Lord Dufferin

during the long and eventful diplomatic career in which he filled the highest posts in the service of the Crown.

On leaving the house the party walked through the Pinetum, a lovely part of the demesne, in which a good deal of interest was evinced, and some healthy, well-formed trees were seen. The pines were all planted by Lord Dufferin some forty years ago, and include *Abies grandis*, *Picea Morinda*, *Taxodium sempervirens*, and *Cupressus macrocarpa*, running up to 50 feet in height. There was also a fine group of silver firs girding 12 feet.

On the way to the carriages the party proceeded through Crawfordsburn Glen, a beautiful ravine planted with ash, elm, and larch, and the property of Colonel Sharman Crawford, a name well known in connection with the first Irish Land Acts. It contains some picturesque waterfalls, and there is lovely foliage on all sides. The return journey to town was then commenced, and Belfast was reached at nine o'clock.

THE ANNUAL DINNER.

The Annual Excursion Dinner of the Society was held in the evening. After dinner, the chairman, Mr Munro Ferguson, M.P., said that, owing to the late hour to which their day's outing had extended, it had been decided that they should keep their speeches for a future occasion. But there were two toasts which must be drunk, "The Queen" and "Our Guests." He knew they would drink the health of the Queen with great enthusiasm, for in those dark and even humiliating days through which we had passed, no one had done more to give spirit to the nation than the Queen, and if anyone had a spark of loyalty in his breast, that spark was blown into a flame when Her Majesty came to Dublin to show her appreciation of the valour of her Irish troops. Mr Laird, Convener of the Excursion Committee, in proposing the healths of the guests, said that in their old and esteemed friend, Mr Hugh Dickson, with Mr M'Erval and Mr Watson, they had had three admirable guides, and the Society thanked these gentlemen very heartily for having made their visit to the north of Ireland so pleasant. Mr Watson and Mr Dickson suitably acknowledged the toast. Mr Charles Buchanan said he was sure they would not like to separate without asking Mr Munro Ferguson to convey to Lord Dufferin their thanks for the very enjoyable afternoon they had spent in his grounds; and he also

wished to express their thanks to Colonel Sharman Crawford for enabling them to view his beautiful glen. This brought the proceedings to a close.

Second Day—Baronscourt.

The second day's excursion was to the Duke of Abercorn's beautifully-situated estate of Baronscourt, in County Tyrone, which was very aptly described by Mr Munro Ferguson as "one of the great Irish homes." With an area, within the demesne, of 5777 acres, it is one of the finest residences in the north of Ireland. Travelling by special train from Belfast on Thursday morning, the party reached Newtown-Stewart, which is pleasantly situated on the Mourne River, shortly before eleven o'clock. The Duke of Abercorn was not able to meet his visitors when they arrived, having to preside over a meeting of Tyrone County Council, but he joined them later, and, accompanied by his son, spent the rest of the day with them. They were, however, taken charge of by Mr Robert Bell, the factor, a Scotsman, whose efficient management has done much to improve and develop the estate.

On entering the grounds of Baronscourt, the party drove by the side of three beautiful lakes, in the middle of the policies, and then left the conveyances and proceeded on foot along lovely walks to inspect the natural beauties of the extensive demesne, with its fine old trees and shrubberies. On the way to the deer park—which extends to 800 acres, and is stocked with Japanese, Chinese, American, and fallow deer—the Duke of Abercorn and Lord John Hamilton joined the party, who, under His Grace's guidance, proceeded to examine a fine old beech tree, girthing 14½ feet, and with a remarkable spread of branches. Some old Scots firs were observed, and large specimen trees of various kinds were to be seen on all sides, while there was a luxuriant growth of the common rhododendron, which, as the Duke observed, seemed to thrive and spread in all directions. The visitors then entered the mansion-house, which is one of the finest in the country, and contains some artistic treasures of great interest and value. It was built about a hundred and seventy years ago, and is in the Grecian style of architecture. The Duke, having formally welcomed his guests, they passed into the grand entrance hall, with its rare paintings by Vandyck and Gainsborough, its

old armour, tattered colours of the Inniskillings, and great open hearth upon which a log fire crackled.

At one o'clock the Duke entertained the visitors to a sumptuous luncheon, served in the spacious dining-rooms. The Duke of Abercorn presided, and was supported by Mr Munro Ferguson, M.P.; Col. Porteous, Turfhill; Mr D. P. Laird, Convener of the Excursion Committee; Mr Alex. Milne, Edinburgh; Mr Robert Galloway, S.S.C., Secretary to the Society; Mr Charles Buchanan, Penicuik; Mr Jas. Cook, Arniston; and the Rev. F. W. Hamilton, Rector of Baronscourt. Lord John Hamilton and Mr Bell were the croupiers. In proposing the health of the Queen, his Grace said they all rejoiced when Her Majesty was in good health, and everything prospered with her. They rejoiced in the early part of the year when she so courageously and so nobly came over to Ireland, and now they all sorrowed with her at the loss of a Royal Prince. As Scotsmen, they all looked with pleasure to the time when, after the hard work of the session, Her Majesty would be able to enjoy the bracing air of the hills around Balmoral, and the more temperate zone and soft-breathing air which was wafted through the pine woods of Abergeldie and the surrounding district.

Mr Munro Ferguson said it was a matter of regret that their president, Lord Mansfield, was not there to propose the Duke of Abercorn's health. In coming to Ireland, the Society saw what a great place it might be. They saw that wonderful luxuriance, and they felt there was plenty of elbow-room, and they found that so much was done by nature that a great deal was learned during their visits to Ireland. There was no more beautiful place in the world than one of these great Irish homes. It was a great privilege to them to be enabled to visit Ireland, but a greater privilege to come there and be entertained by one of the heads of the great house of Hamilton. In listening to the strains of the bagpipes outside, he felt almost like an ambassador in another land, who sat by right upon his native soil. He asked them to drink prosperity to the House of Hamilton.

The Duke of Abercorn, in responding, said it was a great pleasure to both himself and the Duchess to give them a hearty welcome to Baronscourt, and he regarded it as a privilege to be allowed to entertain so many experienced gentlemen connected with the Royal Scottish Arboricultural Society. He need not say that he was very proud of that place, although the weather

had not been exactly what they could have wished, because a thickly wooded demesne like Baronscourt required the sun to develop its various beauties. They had come to a place that was rather peculiarly situated, because Baronscourt was really one large bog. The country surrounding it was bog, and it was only on certain hills that there was a gravelly or dry soil. As they had seen, there was a great fecundity of plants and shrubs, including a too great abundance of rhododendrons. He wished to warn them against rhododendrons, for it was impossible to eradicate them. They were like weeds, and grew everywhere, and the more they cut them, the more they grew. They were planted at Baronscourt when they were esteemed a rare shrub, and they had increased in a marvellous degree.

In their walks that morning they would have been able to realise something of the extent of Baronscourt. The total area of the demesne was 5777 acres, of which 3702 acres were plantations, 1792 acres comprised the two home farms, 96 acres were grounds not planted, 35 acres were gardens and lawns, and 150 acres were water. He thought they would agree that that was a pretty large extent to look after, and they would also agree that if it was land that would fetch £1 or £2 an acre, it would be much more profitable to the owner.

His Grace said he was proud of the manner in which Mr Bell had managed the estate, and of the energy which he put into all his work. In concluding, he said that those who could appreciate rain—water unmixed with whisky—and warm sunshine, when the sun did shine in that district, and who could appreciate a warm and hearty welcome, had only to come to the north-west of Ireland.

After luncheon, a visit was paid to the beautiful flower-gardens, which are laid out on an Italian design in picturesque beds, all impression of flatness being removed by beautiful yews and very fine specimens of the Lawson golden cypress (*Cupressus lawsoniana lutea*). A very artistically-formed pergola or arbour, running from the terrace to the lake, and covered with roses, clematis, and Virginia creeper, was much admired. The party having been photographed on the steps of the terrace, next proceeded to one of the home farms, where all the apparatus of a well-appointed dairy was seen at work. A walk through Cloonty Wood brought them to the conservatories, a very complete range of glass, consisting of large span-roofed vineries, peach-

houses, and green-houses, containing a choice collection of plants, all in the best of order.

The company brought the day's outing to a close by partaking of tea at Lislear Fort, on which a neat little tea-house has been erected for the members of the family, and here Lady Alexandra Hamilton and Lord Claud Hamilton joined them. Before they took leave of their noble host, Mr Laird proposed a vote of thanks to his Grace's factor, Mr Bell, for the part he had played in their pleasant and profitable day. Mr Bell having replied, and three cheers having been given for the Duchess of Abercorn, the party bade adieu to Baronscourt, and drove back to Newtown-Stewart.

Third Day—Castlewellan.

From a practical point of view, the greatest treat was reserved for the closing day of the Excursion, when the members of the Society returned to County Down on a visit to Castlewellan, the far-famed seat of the Earl of Annesley, and another of those rich demesnes with which Ireland abounds. The gardens contain perhaps the finest collection of trees, shrubs, and herbaceous plants that is to be found in the kingdom, and afford a refreshing glimpse of the choicest forms of vegetable life in all their varied beauty and grandeur. The grounds are famous for their wealth of rare trees and shrubs, which are cultivated in the open air with remarkable success, and are full of interest alike to the forester, the horticulturist, and the botanist.

Lord Annesley has always been a great lover of plants; since he left the army he has devoted himself to his favourite pursuit, and from a wide field of travel has brought together a unique collection, containing much that is prized by the student of botany. He has carried out in an ample degree Sir Walter Scott's maxim, which he prints in front of the Castlewellan plant catalogue: "There is no art or occupation comparable to planting: it is full of past, present, and future enjoyment." It would be hard to say whether his lordship or Lady Annesley is the greater enthusiast in all that pertains to forestry and horticulture, or which of them takes the keener interest and pleasure in the personal supervision of their rich possessions; but certain it is that her ladyship has a thorough knowledge of the science of botany, is well versed in the nomenclature of plants, and is ready and able to discuss with experts any point on which a practical question might arise.

Leaving Belfast by special train at eight o'clock on Friday morning, the company arrived, after an hour's run, at Newcastle, a favourite watering-place on Dundrum Bay, and set amid beautiful surroundings. A drive of four miles brought the visitors to Lord Annesley's beautiful home, which is situated at a high elevation, looking down on the plain that stretches from Dundrum to the Mourne Mountains, and commands striking views of Slieve Donard and the other northern peaks of the mountains, with purple-clad hills on all sides. In addition to the pinetums, there are no fewer than fourteen different gardens within the grounds, all possessing distinctive features of their own, and managed with the utmost care and skill. The Castlewella catalogue testifies to a kindly soil and genial climate, for it contains a remarkable list of some two thousand varieties of choice plants growing in the greatest health and luxuriance, and includes some which are not to be found even in Kew. At every turn the eye is filled with unmixed pleasure, and the spectator is fascinated with the scene of beauty which he beholds, and over which he would fain linger long. The grounds have been planted and cultivated for ornamental purposes, but there is all the same a good quantity of valuable marketable timber.

On entering the policies the party were met by Mr Thomas Ryan, the land steward, who was brought up on the estate, and who has for twenty-five years shared Lord Annesley's arboricultural tastes, and exerted himself to make the estate one of the most attractive, as it is one of the most famous, in the country. The Earl and Countess joined them early in the forenoon, and spent four hours in accompanying the visitors in their inspection of the grounds. Beginning with the pinetums, of which there are several, the company first examined a big *Wellingtonia*, which Mr Hugh Dickson of Belfast (who was with the party) dispatched to Castlewella in 1854, when he was in the service of Dickson and Sons, Edinburgh. It was measured, and girthed 15 feet 6 inches. Several of the *Auracarias* are the finest to be seen anywhere, some of them being quite perfect specimens. Palms, including the *Chamærops Fortunei*, have been growing in the open for the last twenty years, a sufficient evidence of the mildness of the climate. A handsome cypress is *Cupressus macrocarpa lutea*, a variety of recent introduction, and growing to a height of 15 feet. What in most places is a green-house plant, the *Lomatia pinnatifolia*, was seen, with the beautiful dark-

green foliage. Another conservatory plant, the *Pittosporum Mayii*, was also found in the open-air, forming a magnificent bush 15 feet high and 10 feet in diameter. Some notable specimens of *Pinus insignis* are here, and the rare and beautiful Mexican pine, *Montezumae*. There are about twenty very pretty types of bamboos, including *Arundinaria Falconeri*, and some fine examples of *Dacrydium Franklini*, a yew which grows to the height of a forest tree in New Zealand. Specimens of *Cupressus lawsoniana lutea* abound, some of them being over 20 feet high, and their golden foliage brightening up their surroundings. Another rare and beautiful tree is the *Larix Kampferi*, a Chinese larch, altogether unlike others of the species except in the wood. Close by is a specimen of the curious umbrella-tree of Japan, *Sciadopitys verticillata*, the leaves of which are arranged precisely like an umbrella. Although not seen at their best, there is a splendid group of Japanese maples, of which about thirty varieties are in the grounds. *Daphniphyllum glaucescens*, a rare Japanese plant, was seen in all its splendour; the Patagonian holly, *Desfontainia spinosa*, with its bright scarlet flowers, was very attractive; and a very pretty avenue of standard Portugal laurels leads up to a terrace from which a charming view is obtained.

After walking through the orangery and conservatories, a fine range of glass, in which there is a profusion of rare hothouse plants — including a new *Begonia* called after the Countess of Annesley—a visit was paid to her ladyship's own garden, situated in a picturesque corner of the grounds, and including, among other choice plants, *Vitis Coignetia*, a Japanese vine whose leaves in the autumn assume a lovely scarlet colour. A duck-pond near by, filled with Canadian geese and a variety of ducks, has a very pretty background, in which the New Zealand *Olearia Huastii*, with its white, thorn-like blossom, is conspicuous. On the way to the Deer Park a charming garden was passed through, in which were growing in great luxuriance *Cordylines* and *Arundos* from New Zealand, red maples and *Retinosporas* from Japan, the iron-tree from Persia (*Parrotia Persica*), Himalayan rhododendrons, *Hypericums*, *Cupressus*, and *Abies* of all sorts, Indian azaleas in all varieties and colours, a very rare specimen of *Stephanandra flexuosa*, and a splendid *Eucalyptus coccifera*, measuring 60 feet in height. A short distance above this garden is the bamboo garden, which is admirably situated for these

giant grasses, the ground being well sheltered by large clumps of the choicest sorts of rhododendrons, over 20 feet in height; and here bamboos from Japan, *Arundinarias* from the Himalayas, and the *Phyllostachys* from China are to be seen.

The Deer Park, which extends to 600 acres, and is stocked with Japanese, red, and fallow deer, is situated on the top of the hill, and is approached by a path leading through a lot of fine larch trees, from eighty to a hundred years old. The summit of the hill, which is at an elevation of 800 feet above sea-level, affords a magnificent view of the surrounding country, the Mourne Mountains forming the background, with the majestic Slieve Donard towering to the height of nearly 3000 feet above the sea, while close at hand are the heathery tops of Slieve-na-Slat. Within the park there is a very interesting pleasure-ground and several small lakes. The grounds are laid out and planted with great taste, and contain a selection of the rarest flowering shrubs and conifers. The islands in the lakes are planted with pampas grass, rhododendrons, azaleas, cypresses, cryptomerias, and hydrangeas, which afford shelter and protection to the ornamental water-fowl. The Spring Gardens, which were next visited, are about twenty acres in extent, and lie to the south and west of the Castle. They contain some splendid English and Turkey oaks, giant hollies, immense specimens of the bird-cherry, masses of the finest Himalayan and hybrid rhododendrons, Japanese red maples, and choice flowering and foliage shrubs. In front of the demesne there is a large lake, a mile and a half in length, with beautifully wooded banks, along which clumps of *Gaultheria Shallon* were growing in great luxuriance. Some silver firs were measured in this locality, and girthed 12 feet 4 inches, 11 feet 2 inches, and 10 feet 6 inches. Having finished their interesting ramble through the grounds, the visitors returned to the vicinity of the Castle, a stately edifice in the Scottish baronial style of architecture, built in 1854 from the grey granite of the estate quarries.

It is impossible to give even an outline of all that was seen during the limited time at the disposal of the company, but what has been said will indicate the wealth and magnificence of the unique collection of plants grown at Castlewellan, which one and all of the visitors were loth to leave.

After luncheon, which was served in the Winter Garden, the company were photographed in front of the mansion. Before

leaving the grounds, Mr Alex. Milne proposed a hearty vote of thanks to the Earl and Countess of Annesley for their kindness in having afforded them an opportunity of seeing their magnificent collection of the vegetable kingdom. It had been, he said, a great treat for them to examine these fine plants, so full of interest to the arboriculturist and the horticulturist, and the visit had been one of intense pleasure. Lord Annesley, in replying, said it was well known that Scotland grew the best gardeners in the world, and he felt very highly honoured in seeing there that day the very best gardeners in Scotland, because he considered them the very pick of the trade, and if they were satisfied with the plants he had shown them, he regarded that as very high praise indeed. Both the Countess and himself had been highly pleased to see them.

The party drove round the lake on their way back to Newcastle, and on the journey inspected some other pinetums, which contained fine varieties of trees. A splendid example of the *Pseudotsuga Douglassii*, planted about forty years ago, was seen growing to a height of 100 feet. There were some beautiful and well-developed *Araucaria imbricata*, showing marvellous growth. A noble specimen of *Pinus insignis* was about 80 feet high, and well furnished to the ground. Fine specimens of the *Abies magnifica* and of the *Abies nobilis* were growing side by side, and brought out the distinguishing characteristics of the two species. The drive was continued through Tullymore Park, the residence of the Earl of Roden, and a richly wooded demesne bordering on the unenclosed uplands of the Mourne Mountains. Some fine old trees were observed in the park, and there was a nice avenue of *Cedrus Deodara* about a mile in length.

The return journey was made to Belfast in the evening by special train from Newcastle. This brought the official Excursion to a close, but about fifty of the members remained till next day for a supplementary trip to the Giant's Causeway.

REPORTS BY THE HONORARY SCIENTISTS.

1. *Report on the Meteorology of Scotland for the Year ending 30th September 1900.* By R. C. MOSSMAN, F.R.S.E., F.R.Met. Soc., Honorary Consulting Meteorologist.

The following condensed abstract of the prevailing meteorological conditions over Scotland during the year under review is principally based, as formerly, on Dr Buchan's reports and accompanying statistical data supplied to the Registrar-General of Scotland. The monthly summaries of the London Meteorological Office have also been utilised, in addition to those taken for the Scottish Meteorological Society.

The averages with which the monthly means have been compared are for the period 1856-1900, except during the last quarter of 1899, when the means available were for the forty years ending with 1895. As comparatively few of the stations are provided with sunshine recorders, the remarks on this element of climate are not so representative of the country, as a whole, as are those for temperature and rainfall.

REMARKS ON THE WEATHER.

October 1899.—The weather of October was for the greater part fair and dry, with a rather high mean temperature and a deficiency of rainfall. The mean temperature, on the average of sixty-seven stations well distributed over the country, was $47^{\circ}\cdot 8$, or $1^{\circ}\cdot 4$ above the normal. The highest values were $50^{\circ}\cdot 0$ at Ballachulish, $49^{\circ}\cdot 8$ at Airds, and $49^{\circ}\cdot 7$ at Leith; and the lowest, $44^{\circ}\cdot 7$ at Benquhat, $45^{\circ}\cdot 1$ at Braemar, and $45^{\circ}\cdot 7$ at Lednathie. The mildest weather was thus experienced at stations where the prevailing westerly winds blew directly off the sea, the lowest temperatures being recorded at inland or elevated positions. The average rainfall was 3·10 inches, or 23 per cent. below the

average. The deficiency was most marked in the east of Scotland, where the amount was very generally less than half the normal, the driest stations being Peterhead, Aberdeen, Lednathie, Montrose, Logie Coldstone, and Arbroath, where only a quarter of the average was precipitated. At some of the west coast stations there was a slight excess. The greatest rainfalls reported were 10·6 inches at Glencarron, 9·2 inches at Fort William, and 7·2 inches at Stronvar; and the smallest, all under three-quarters of an inch, at Aberdeen, Montrose, and Dalkeith. Bright sunshine was just the average, taking the country as a whole, but there was a rather decided excess in north-eastern districts.

November 1899.—The characteristic features of the weather of the month were a high mean barometric pressure, very high mean temperature, an excess of rainfall, and a deficiency of bright sunshine. The mean temperature was $46^{\circ}\cdot4$, or $5^{\circ}\cdot8$ above the average. In Edinburgh the average temperature was $47^{\circ}\cdot4$, being absolutely the highest for November since the record commenced in 1764, the next mildest being in 1818, when the mean was $46^{\circ}\cdot7$. The temperature at sixteen of the Scottish Meteorological Society's stations did not descend to the freezing point, while at Airds 38° was the lowest value reported. The excess of temperature was less in the north than over the inland stations, and was equally partitioned between day and night. The mildest weather was recorded in the west, Poltalloch having a mean temperature of $48^{\circ}\cdot8$, and Lochbuie and Airds $48^{\circ}\cdot7$. The lowest values, on the other hand, were recorded at the hill stations, Braemar being the coldest, with a mean of $42^{\circ}\cdot7$, closely followed by North Esk Reservoir, with $42^{\circ}\cdot9$, and Tillypronie, $43^{\circ}\cdot3$. The mean rainfall was $4^{\circ}\cdot85$ inches, being 27 per cent. above the average. Over the greater part of the country it was above the average, but there was a deficit "in the extreme south-west, from Islay to Wigtownshire, and over a somewhat broad strip, from the east coast inland, and stretching from the Tweed to the Pentland Firth." The heaviest falls were 16·8 inches at Glencarron, 13·7 inches at Stronvar, and 12·6 inches at Fort William; the smallest being 0·8 inch at Peterhead, and 1·4 inch at Gordon Castle and Aberdeen. The largest daily amounts registered were 1·7 inches at Braemar and Glenlee on the 3rd, and 2·1 inches at Braemar, 2·0 inches at Glenlee, and 1·9 inches at Ochertyre on the 7th. Measurable rain fell on 27 days at Sumburgh Head, Laudale, and Fort William, and on 28 days at Glencarron.

Bright sunshine was everywhere under the average, the percentage of the possible duration ranging from 22 at Aberdeen and Marchmont to only 5 at Fort Augustus and Fort William.

December 1899.—The weather was cold and variable, with hard frost about the middle of the month, and snow between the 8th and 14th, and in western and northern districts between the 21st and 29th. The mean temperature was $35^{\circ}\cdot6$, or $2^{\circ}\cdot2$ under the average, there being a great deficiency at inland and eastern places south of the Caledonian Canal. The highest values were $39^{\circ}\cdot9$ at Airds, $39^{\circ}\cdot5$ at Deerness, and $39^{\circ}\cdot3$ at Peterhead; and the lowest, $30^{\circ}\cdot9$ at Braemar, $31^{\circ}\cdot3$ at Lednathie, and $31^{\circ}\cdot7$ at Stronvar. At Glenlee, on the 14th, the thermometer fell to $0^{\circ}\cdot9$. The mean rainfall was 4·16 inches, closely approximating to the normal, but was distributed in an unusual manner over the country, being nearly double the average in the county of Wigtown and the south of Argyll, but only half the average at Fort Augustus. The greatest downfalls recorded were 10·7 inches at Lochbuie, 8·1 inches at Monach, and 7·6 inches at Roshven; and the least, 1·4 inches at Ladylaw, 1·5 inches at Dalkeith, and 1·7 inches at Wolfelee. Bright sunshine was very generally under the average, there being, however, an excess at Fort Augustus. The percentage of the total possible varied from 14 at Strathpeffer Spa to 4 at Fort William and Glasgow.

January 1900.—The weather of January was very changeable, with frequent rain in most districts, and falls of snow in the north and east. The mean temperature was $38^{\circ}\cdot5$, being a degree and a half above the average, this excess being normally distributed. The mildest places, as is usually the case in months characterised by a prevalence of west and south-west winds, were on the west, in situations facing the sea, Lochbuie having an average temperature of $42^{\circ}\cdot6$, and Airds $41^{\circ}\cdot6$. The lowest values, on the other hand, were at the hill stations, Braemar being the coldest, with a mean of $34^{\circ}\cdot7$, Lednathie, Leadhills, and North Esk Reservoir following with a mean of $34^{\circ}\cdot9$. An unusual feature was the remarkable nocturnal warmth, the lowest temperature recorded anywhere being $20^{\circ}\cdot0$, on the 1st, at Dollar. At Leith the thermometer at no time during the month fell to freezing point. The mean rainfall was 5·14 inches, or 25 per cent. above the normal. There was a slight deficit in Galloway, and from Cape Wrath to Skye, but elsewhere there was a very

general excess, which reached a maximum of 103 per cent. at Campbeltown and 93 per cent. at Montrose. The rainfall on the shores of the Moray Firth was also greatly above the average. The wettest stations were Lochbuie, with a downfall of 13·5 inches, Glencarron 12·8 inches, and Stronvar 11·6 inches; the smallest precipitation, on the other hand, occurring at Paisley and Corstorphine with 2·2 inches, and Cupar with 2·3 inches. The number of rainy days was singularly large, amounting to 23 on the mean of all the stations. Rain fell on every day of the month at Fort Augustus and Edinburgh (Royal Observatory), and on 30 days at Dumbarton. Bright sunshine did not differ much from the mean, the percentage of the possible ranging from 24 at Aberdeen to 7 at Fort William.

February 1900.—The weather of February was very rough and unsettled, with severe gales and snow-storms, and a very low mean temperature, which, on the average of all the stations, was only 32°·2, or 6°·1 under the normal. The only colder February since 1856 was that of 1895, when the mean was 29°·0. In both these months there was a great excess of north-easterly winds. The mean temperature was highest, 36°·8 at Airds, 36°·0 at Lochbuie, and 35°·7 at Rothesay and Stornoway; and lowest, 27°·6 at Braemar, 27°·7 at Leadhills, and 28°·7 at North Esk Reservoir. The temperature fell to -3° at Kingussie, -2° at Braemar, and -1° at Drumlanrig, these low values being recorded on the 11th or 12th. The mean rainfall was 3·55 inches, being 14 per cent. above the average, the excess being most marked at Duns Castle, where the normal was exceeded by 210 per cent., while several stations in Galloway had double the average. There was a large deficiency in the western and central parts of Scotland, especially to the west of a line drawn from Nairn to Oban. The maximum falls were 6·9 inches at Duns Castle, 6·2 inches at Leadhills, and 5·3 inches at Glenlee, the minimum being 1·2 inches at Dunrobin, 1·4 inches at Inverness, and 1·7 inches at Fort Augustus. Severe south-easterly gales and destructive snow-storms swept over the country on the 15th and 19th. Bright sunshine was above the normal in the north and west, but there was a slight deficiency in the south. The percentage of the possible varied from 34 at Stornoway to 20 at Fort William and Glasgow.

March 1900.—The characteristic features of the meteorology of March were a low mean temperature, a very small rainfall

falling on four days less than the average, and a deficiency of sunshine. The mean temperature was $37^{\circ}\cdot3$, or $2^{\circ}\cdot1$ under the normal, and varied from $40^{\circ}\cdot3$ at Airds, $40^{\circ}\cdot1$ at Lochbuie, and $39^{\circ}\cdot5$ at Smeaton, to $32^{\circ}\cdot2$ at Braemar, $32^{\circ}\cdot6$ at Leadhills, and $33^{\circ}\cdot0$ at North Esk Reservoir and Benquhat. On the 18th, at Haddow House, the sheltered thermometer fell to 3° , and at Braemar to 4° . The mean rainfall was $1\cdot31$ inches, or 54 per cent. under the average. There was a slight excess in north-eastern districts, where heavy snow-falls were of frequent occurrence, but over large areas only from a tenth to a fourth of the normal was collected. The precipitation was greatest, $3\cdot6$ inches, at Tillypronie, $3\cdot5$ inches at Haddo House, and $3\cdot1$ inches at Lochbuie; and least, $0\cdot2$ inch at Dalkeith, Stobo, and Cargen. Bright sunshine was in excess at Fort William and Fort Augustus, but in most other places there was a marked deficiency.

April 1900.—The weather of April was mostly cool and very unsettled till about the middle of the month, but thereafter fine and very warm, a shade temperature of 75° occurring at Aberdeen on the 20th. Snow fell at many places on the 3rd, and in western districts on the 5th. The mean temperature was $45^{\circ}\cdot7$, or $1^{\circ}\cdot7$ above the average. In Shetland and Caithness in the north, and over Galloway in the south, the mean values were in close accordance with the normal; but in the south-east there was an excess amounting to 2° in the district lying between Tweeddale and the Firth of Forth. The mean temperature was highest, $47^{\circ}\cdot1$, at Smeaton, and $47^{\circ}\cdot0$ at Glasgow and Leith; while the hill stations recorded the lowest values, Benquhat having a mean of $41^{\circ}\cdot1$, Leadhills $41^{\circ}\cdot2$, and Braemar $41^{\circ}\cdot5$. The mean rainfall was $2\cdot66$ inches, or 20 per cent. above the average, the excess being large in the north-west of Scotland; but there was a deficiency of from 35 to 50 per cent. “to the east of a line drawn from Peterhead, and passing Braemar, Ochtertyre, and Rosewell to the mouth of the Tweed, the prevailing winds having been, in crossing the Grampians, drained of much of their moisture.” The largest falls were $9\cdot5$ inches at Glencarron, $9\cdot4$ inches at Lochbuie, and $5\cdot9$ inches at Fort William; and the smallest, half an inch at Dalkeith, and close on an inch at Smeaton, Peterhead, and Haddington. Bright sunshine was under the average; the percentage of the possible ranged from 38 at Aberdeen to 24 at Braemar.

May 1900.—In May most of the meteorological elements approximated very closely to the average. The mean temperature was $48^{\circ}7$, or a third of a degree under the normal. The coolest weather was in Shetland, where the mean was about a degree and a half under the normal, while the greatest excess of warmth was a degree, in the county of Edinburgh and Lower Clydesdale. The highest mean values recorded were $51^{\circ}7$ at Smeaton, $51^{\circ}4$ at Paisley, and $51^{\circ}3$ at Dumbarton; and the lowest, $44^{\circ}8$ at North Esk Reservoir, $45^{\circ}1$ at Benquhat, and $45^{\circ}6$ at Deerness. The mean rainfall was 2.52 inches, or 10 per cent. above the average, the excess reaching a maximum of 135 per cent. at the Mull of Kintyre, Leadhills and Stronvar having also double the normal. The greatest deficiency—50 per cent.—occurred in Aberdeen and south of the Firth of Forth. The largest aggregates reported were 8.0 inches at Stronvar, 7.2 inches at Laudale, and 6.8 inches at Leadhills; and the smallest, 0.3 inch at Dalkeith, and 0.7 inch at Peterhead and Wolfelee. Snow showers fell in some of the northern districts on the 12th and 13th, and in Caithness and the Shetlands on the 17th. Bright sunshine was everywhere under the average, the percentage of the possible ranging from 33 at Stornoway to 26 at Fort Augustus, this element of climate being thus distributed with remarkable uniformity over the country.

June 1900.—The more prominent features of the weather of June were a mean temperature slightly under the average, a mean rainfall about a quarter above the average, a marked deficiency of sunshine, and an excess of easterly winds. The mean temperature was $55^{\circ}7$, or $0^{\circ}8$ above the average. There was a marked deficiency of temperature on the shores of the North Sea, this being due to the prevailing easterly winds. In the extreme west of Scotland there was a noticeable excess, which at Kyleakin amounted to $3^{\circ}4$. The mean temperature was highest, $58^{\circ}9$, at Dumbarton and Paisley, and $58^{\circ}6$ at Dumfries; and lowest, $50^{\circ}2$ at Deerness, $52^{\circ}2$ at Peterhead, and $52^{\circ}8$ at Montrose. The mean rainfall was 3.17 inches, or 23 per cent. above the average, being very irregularly distributed. It was from 25 to 75 per cent. under the normal near the coast from the Firth of Forth to Montrose, and in the west and north generally. On the other hand, more than double the average fell at Dumbarton, Stobo Castle, and Cally. The greatest aggregates reported were 6.2 inches at Dumbarton, 6.1 inches at Cally, and 5.0 inches at

Glenlee; and the least, 1·2 inches at Cupar, and 1·3 inches at Kirkwall and Peterhead. Thunderstorms with torrential rains were of frequent occurrence, a remarkably severe electrical display being that of the 11th. Bright sunshine was generally under the normal, except at some places in the north and west.

July 1900.—The weather of July was very changeable, with a high mean temperature. Frequent and severe thunderstorms and a good deal of rain accompanied the shallow barometric depressions which from time to time moved across the country. The mean temperature was $58^{\circ}\cdot9$, being nearly two degrees above the average, and varied from $62^{\circ}\cdot3$ at Smeaton to $54^{\circ}\cdot8$ at Deerness in the Orkneys. The range in the mean temperatures was thus $7^{\circ}\cdot5$. In Shetland the average temperature was slightly below the normal, but there was an excess of three degrees in the valley of the Tweed. Rainfall was 15 per cent. in excess of the normal, and was distributed with great irregularity, being slightly below the mean on the east coast south of the Forth and on the west coast south of the Clyde. The excess was considerable at Bressay, Thurso, and several places in Banff and Sutherland, where nearly double the average fell. The number of days with rain was unusually large, amounting to 27 at Stornoway, 28 at Glencarron, and 29 at Laudale. The greatest rainfalls were 5·8 inches at Cally (Kirkcudbright) and 5·6 inches at Glencarron; and the smallest, 2·2 inches at Wolfelee (Roxburgh), and 2·5 inches at Ochtertyre, Rosewell, and Paisley. Bright sunshine was rather deficient, being just equal to the average in Edinburgh, but all the other stations (except Marchmont) had less than the normal. The wind was light in force during most of the month, but slight north-westerly gales were experienced at a few exposed places in the north on the 6th and 7th, and again on the 30th.

August 1900.—During nearly the whole month very unsettled weather prevailed, with frequent thunderstorms, heavy rains, a rather low mean temperature, and little sunshine. The mean temperature was $55^{\circ}\cdot8$, being about a degree under the average, and ranged from $58^{\circ}\cdot0$ at Glasgow and Cally to $52^{\circ}\cdot1$ at the elevated stations of Leadhills and Benquhat. There was a marked excess of east and north-east winds, which brought about an unusual thermometric gradient, the mean temperature being above the average to the north and west of the Caledonian Canal, but below the normal in other districts, more particularly at places where

the easterly winds blew directly off the sea. The mean rainfall was 23 per cent. in excess of the normal, the only region with any general deficiency being the extreme north of Scotland. In Berwickshire nearly double the average fell. Very heavy rains were experienced from time to time, 2·0 inches, for example, falling at Edinburgh on the 6th, and 2·1 inches at Braemar on the 22nd, while daily falls of an inch or more were of comparatively common occurrence. Gales were frequent, and did considerable damage to the crops. Rainfall varied from 7·3 inches at Glencarron and 7·0 inches at Marchmont and Glenlee to 1·6 inches at Peterhead and 1·8 inches at Sumburgh Head. Bright sunshine was considerably above the average in the north, Stornoway recording 183 hours, but there was a great deficiency in the valleys of the Forth and Clyde, Edinburgh having only 79 hours and Glasgow 89 hours.

September 1900.—The characteristic features of the weather of September were a mean temperature slightly above the average, a mean rainfall closely agreeing with the normal, an unusual excess of winds from the west, and a rather high mean barometric pressure. The mean temperature was $53^{\circ}\cdot 8$, being highest, $56^{\circ}\cdot 3$, at Cally, and lowest, $50^{\circ}\cdot 4$, at Benquhat. The distribution of temperature was in close agreement with the normal everywhere, the excess being more decided in the south in situations sheltered from the prevailing westerly winds than at exposed places facing the Atlantic. The mean rainfall was 3·3 inches, being 8 per cent. under the normal. In the west and north of Scotland it was in many places nearly double the normal; but barely half the average quantity fell in the north-east of Aberdeenshire and in the valley of the Tweed. The largest rainfalls were 9·5 inches at Laudale, 8·8 inches at Lochbuie, and 8·7 inches at Glencarron, and the smallest, 1·1 inch, at Montrose and Broomlands. Bright sunshine was below the average in the north and west, but there was a rather decided excess in Berwickshire. Over the country, as a whole, the values were in close accordance with the normal.

Abstract of Meteorological Observations recorded at Sixty-seven Stations of the Scottish Meteorological Society during the Year ending with September 30, 1900.

	Temperature.		Rainfall.				Sunshine.	
	Mean Temp.	Diff. from Average.	Amount.	Diff. from Average.	Days.	Diff. from Average.	Hours.	Diff. from Average.
	°	°	ins.	ins.				
October 1899,	47·8	+1·4	3·10	-0·93	14	-3	89	-7
November „	46·4	+5·8	4·85	+1·03	18	+2	35	-21
December „	35·6	-2·2	4·16	+0·19	17	+1	24	-21
January 1900,	38·5	+1·3	5·14	+1·28	23	+6	40	-11
February „	32·2	-6·1	3·55	+0·50	14	-1	72	-4
March „	37·3	-2·1	1·31	-1·53	11	-4	102	-14
April „	47·5	+1·5	2·66	+0·44	16	+3	134	-21
May „	48·7	-0·3	2·52	+0·23	14	+1	155	-31
June „	55·7	+0·8	3·17	+0·59	15	+2	154	-35
July „	58·9	+1·7	3·61	+0·46	19	+4	143	-28
August „	55·8	-0·8	4·46	+0·84	15	-1	123	-31
September „	53·8	+1·0	3·33	-0·27	15	-1	125	+2
Year, . . .	46·5	+0·2	41·86	+2·83	191	+9	1196	-222

2. *The following Correspondence has been communicated by PROFESSOR BAYLEY BALFOUR, Hon. Botanist to the Society.*

THE "BLACK" AND THE "ONTARIO" POPLARS.

In reply to a letter received from Mr D. F. Power, Forester, Fetternear, Aberdeenshire, the Professor wrote as follows:—

ROYAL BOTANIC GARDEN,
EDINBURGH, 7th May 1900.

Dear Sir,—I have received from the Secretary of the Royal Arboricultural Society your question, namely, "Is the old Black Poplar, which is mentioned in the old gardening books, and which is supposed to be a native of this country, the same as the Ontario Poplar?"

The Black Poplar, *Populus nigra*, Linn., is an altogether

different plant from the Ontario Poplar, *Populus canadensis*, A. Gray. The latter is known in gardens as *P. ontariensis*. The Black Poplar is only native—if it be native in Britain—in the south of England. *Populus canadensis* is a North American tree, and is considered now to be merely a variety of the Balsam Poplar or Tacamahac, *P. balsamifera*, Linn. The Black Poplar is readily distinguished from the Ontario Poplar, by the fact that the petioles of the leaves are compressed laterally, whilst in the Balsam Poplar the petioles are cylindrical. The Ontario Poplar has also got a more or less aromatic smell, and there are, besides, many technical characters by which the two can be readily distinguished.

Trusting this information will be satisfactory to you.—I am, dear Sir, yours truly,
ISAAC BAYLEY BALFOUR.

Mr D. F. POWER,
Forester, Fetternear, Kemnay,
Aberdeenshire.

THE OAK IN SCOTLAND.

General Sir Peter Lumsden wrote :—

BUCHROBE, DUFFTOWN,
5th November 1900.

Dear Sir,—I cannot account for oak trees in this part of Scotland, on Speyside, scarcely ever having acorns. This year, I see a few coming on now, owing to the long continuous season of damp weather, but in other years they have always been abortions, and although there are some very fine old oak trees, there is scarcely a sapling in the country.

I have always believed in the oak being indigenous to Scotland, but I cannot help thinking that all those about here have been planted. Yet in these counties, Banffshire and Aberdeenshire, we have many places ending with the word "darroch," which I believe to be the Gaelic for oak, such as Craiginदारroch, Clashindarroch, etc.

A friend of mine who was staying with me here, interested in botany, had mentioned the fact to Sir Joseph Hooker, who said that you might be able to enlighten me on the subject. If you could assist me in this matter you would greatly oblige.—Yours truly,
P. S. LUMSDEN,

To the above letter Professor Balfour thus replied :—

ROYAL BOTANIC GARDEN,
EDINBURGH, 19th November 1900.

Dear Sir,—I have received from the Secretary of the Arboricultural Society your letter to him regarding the oak trees in your vicinity.

You are correct in supposing that the oak is indigenous in Scotland. Proof of this is afforded, as you say, by the Gaelic termination of so many place-names, and also by the presence of remains of the oak in peat-bogs. It is, however, well known that in Aberdeenshire and elsewhere in the north, the fruit seldom grows large or ripens, and there can be no doubt that a large proportion of the trees that are now found in the north have been planted. But besides this, even in favourable districts, the oak trees do not produce a full crop every year. This only happens at intervals of a few years, and in unfavourable districts it is quite possible that the intervals may be greatly prolonged between even fair crops.

With regard to the absence of saplings, perhaps the following passage, which I take from Dr Nisbet's recently published volume upon "Our Forests and Woodlands," page 115, gives the explanation :—

"Many of the self-sown oak and beech woods are now found difficult to regenerate naturally. Owing to the want of close cover the soil often gets overgrown with grass, or, worse still, with moss; and then a satisfactory crop of self-sown seedlings cannot reasonably be expected. Soil-preparation of some sort is in such cases absolutely essential to enable acorns and mast to germinate and establish themselves in the soil. Moreover, the change in the conditions between the olden and the present times must also be taken into account. Most of the woods now mature date back to a period when cattle and swine were probably still largely driven into the oak and beech woods for grazing and pannage; and they were in the vast majority of cases, no doubt, the principal agents in obtaining a satisfactory regeneration. The sharp hoofs of the cattle, and the burrowing and wallowing of the swine after satisfying themselves with mast, worked the acorns and beech-nuts into the ground, besides breaking this up so as to loosen it, aerate it, and prepare it generally as an effective seed-bed. Indeed, in many of the Continental woods, and especially in beechwoods, the herding of cattle and the pannage of swine form some of the usual steps taken at the time of a seed-falling for the regeneration of the mature crop of trees. It is cheap, and to a certain extent effective; and it forms a good basis for the assistance of natural regeneration by more elaborate artificial measures in the way of hoeing or digging, sowing and planting.

“A certain amount of soil-preparation to form a seed-bed for the acorns will almost always be necessary. Unless thus enabled to come into actual contact with the soil, perhaps not one-hundredth part of the acorns ever have the very slightest chance of germinating on the dead foliage or weeds which cover the surface of the ground. The necessary soil-preparation can conveniently be made in strips or patches, and of course additional advantage is gained if the acorns are dibbled into these. Otherwise, dibbling of acorns may take place over the whole area without special preparation of seed-beds; but the early development is always best, with the oak as with all other kinds of trees, when the soil has been loosened, and thus aerated and rendered more easily penetrable by the tiny rootlets of young plants.”

Yours very truly,

ISAAC BAYLEY BALFOUR.

Sir PETER LUMSDEN,
Buchromb, Dufftown

NOTES AND QUERIES.

THE "*Transactions*" Committee desire to urge on members of the Society the importance they attach to the publication of short notes on subjects of professional interest. A certain number of formal papers or essays will always occupy a fair proportion of the available space; but the Committee are strongly of opinion that the appearance in the Society's annual volume of numerous well-authenticated facts relating to the raising, tending, and protection, and to the harvesting and sale of forest trees, would form an easy means of communication on such subjects between members of the Society, would tend to encourage careful experiment, observation, and record, and would have an important effect on developing our system of forestry upon correct lines. Such notes could not fail to enhance the interest of the Society's *Transactions*, and they might serve to increase the membership. The Committee will, therefore, cordially welcome contributions of the kind above indicated; and they will also be glad to receive cuttings and extracts relating to subjects of professional interest, some of which might be noticed in the annual publication.

DAMAGE TO PINE WOODS BY CROSSBILLS.

SIR,—With your permission, I would like to bring under the notice of the managers of forests in Scotland one of the difficulties with which we have to contend at Novar, with a view to united action for its removal.

It has been sufficiently demonstrated that the natural regeneration of woodlands is a practical and economical method of re-planting forest areas; and the difficulty I refer to above is the

destruction of pine cones by *Loxia curvirostra*, or common Crossbill. I will not occupy your space with any long description of these small depredators, as I am sure they are well known to every practical forester; but I may mention that they are all the more dangerous from the fact that they are credited with building their nests and hatching their young in all seasons of the year—in December, as in March, April, or May.

In the woodlands on the Novar estates they are very numerous, and cause great damage. They do not confine their operations to ripe cones, but attack the immature ones; these they tear up with their crossed bills in attempting to extract the seed, and the result is that they destroy and break off a large number without obtaining many seeds. In this way they will go from one cone to another until they have gone over the whole tree, and the ground beneath is littered with unripened cones torn to shreds; thus they may deprive the forest of hundreds of seeds without having even satisfied themselves. The forester and keepers have killed over four hundred Crossbills during the last twelve months, but there is no apparent diminution in their numbers.

My object in writing you is, as already stated, to ask foresters all over the country to co-operate in the destruction of these birds, and in using their influence with the Government to repeal the protection they enjoy under the provisions of the Wild Birds Preservation Act of 1890.

Labour in rural districts is annually becoming scarcer and more expensive, and it should be the object of every forester to have as much land as possible stocked by the natural process.

JOHN J. R. MEIKLEJOHN:

SYSTEMATIC NOMENCLATURE OF TREES.

For a long time British botanists, alone among the botanists of the world, called silver firs *Picea* and spruces *Abies*. A few years ago they abandoned their isolated position in this respect, and, following the practice of their foreign brethren, called the spruce tribe *Picea* and the silver fir tribe *Abies*. Is it not time that our nurserymen should alter their catalogues, and that the public should acquiesce in the change now recorded in the Kew list? Why should they continue to call the Douglas fir (*Pseudotsuga Douglasii*) an *Abies*?

F. B.

A SURVIVOR OF THE BLACK WOOD OF RANNOCH.

In the Museum of Science and Art, Edinburgh, may be seen the horizontal section of a Scots fir tree from the Black Wood of Rannoch, Perthshire. The tree was one of those said to have formed part of the old natural forest, and to be of great age. The section, the top of which stood at about 3 feet from the ground, has very coarse bark, and its exterior is deeply fluted, these features giving it an aged appearance. The remaining old trees in the Black Wood are for the most part of a single type, having short and much-tapered boles, with branching, flattened crowns. The annual rings on the section have been carefully counted, and they number about 212, indicating an age of not over 220 years; but a remarkable fact is that some 70 of these rings occur within a radius of $1\frac{1}{2}$ inches, and about 100 occur within a radius of 3 inches. This shows that the tree took something like 75 years to attain a diameter of 3 inches or a girth of 9 inches, and about 105 years to attain a diameter of 6 inches or a girth of 18 inches. After that period increased growing space was probably afforded, and a more rapid development of growth in diameter was permitted. It is interesting to speculate on the conditions (probably of restriction and suppression) under which a tree of this species managed to keep itself alive during the long period indicated by the region of very narrow rings. The section is sound to its centre. F. B.

EXTRACTION OF TREE-STUMPS.

A question having been asked as to the best method of extracting large tree-roots from the ground, the following replies have been received:—

From Mr D. F. Robertson, Dunrobin, Golspie.—It is somewhat difficult to advise without seeing the roots, and where they are situated, and the number of roots.

If the roots are few in number, and very large, and the soil suitable, I would dig holes beside the roots and burn them.

If the roots were numerous and the ground too hard to dig pits, I would hire a traction-engine, with hauling gear and strong wire rope, haul the roots to one or to several depots and burn

them, or bury them in an old disused gravel-pit or any such place which might be situated near by. A good engine, with careful handling, will shift roots up to five tons in weight.

Where there was any difficulty in getting the roots to move when fast in the ground, I have used a heavy charge of dynamite. I found it much better to use an extra heavy charge than a light charge.

I prefer, however, if the soil is suitable, to bury as many roots as possible, placing them well below the surface.

From Mr John Clark, Forester, Methlick, Aberdeen.—I have removed many roots by means of a traction-engine, and I consider this the best method of removing roots that have been cut from blown-down trees. The engine should be placed to the windward of the blown roots, *i.e.*, the engine should be standing near where the top of tree lay, or on that line from the root. A strong chain should be fastened on a strong arm of the root, and the wire rope of the engine should be fastened to the chain and run over a 6 feet larch pole, with a pulley on the top of it. In front of the root a "slyp" should be placed, so that the centre of the root may rest on the centre of the "slyp" when the former is turned over. The root should be cleared of soil and then drawn away by two horses. If the roots are not more than 15 inch in diameter, two horses can tilt them over if they have been prepared or partly cleaned before lifting. The pole, about 5 inch diameter, should be fitted for two supports, to be held in position by a man until the rope gets tight, when he must clear out of the way.

From the late Mr D. Dewar, Forester, Beaufort, Beaully.—When roots of blown-trees have to be removed, we do this by means of blasting with gunpowder. The depth and direction of the auger-hole for the powder have a good deal to do with making the blast effective, and breaking up the roots.

DEATH DUTIES AND TIMBER PLANTING.

The bad effect of the heavy death duties payable by large land-owners, is an evil which can only be properly gauged by posterity. It would appear that the woodland portions of estates are to be the greatest sufferers,—from want of extension,—and at a period

in the history of our country when a large increase in the area under timber is so much required, and for other reasons which need not be entered into at present. It is sufficient to state that woodlands are much too highly rated for all purposes. It is well known to owners and managers of landed property how very unfairly the assessments are made. If large belts of wood are planted to increase the amenity and shelter of the property, and thereby increase the rateable value of the adjoining lands, the assessor allows no deduction from the yearly value of the land so planted, notwithstanding the fact that the lands under wood are planted for the purpose of maintaining, and if possible increasing, the agricultural rents. In keeping with this "red tapeism" is the manner in which the death duties affect woodlands, especially young plantations. These duties, as at present exacted, are an out and out prohibition of planting. To put the matter shortly, the tax is a most improper one as regards woods, and it should be abolished for the good of the nation. What the result would be should a landed proprietor plant a few thousands of acres, it is not difficult to imagine. An example will show the effect. A plantation 80 acres in extent, and thirty to thirty-five years of age, pays death duties upon (1) a valuation of the land, say at 5s. per acre and twenty-five years' purchase, £500; (2) value of the growing timber, at say £20 per acre, £1600—total £2100, less cumulative taxes on the assessable rental, £75—net £2025; whereas duty should only be payable on the capitalised rents, less the £75 of taxes, plus any value the plantation may have over the initial cost, interest on same, management, and maintenance of the fences, drains, and roads. Thus, a plantation thirty years old cost to fence, drain, and plant, say £6 per acre—80 acres = £480; thirty years' interest at 4 per cent., £336; thirty years' rent of lands at 5s. = £600; thirty years' average taxes, £95, 5s.; maintenance, including filling up blanks, cleaning drains, repairs upon roads and fences, £300; management, say £135; total £1946, 5s. Balance over estimated value, £346, 5s., which, together with the amount of net rental, leaves £771, 5s., the amount upon which, in fairness, duty should be charged.

The death duties have another bad effect. Many owners have begun to sell off all the old or marketable timber on their properties, so as to escape the duty. The effect of realising half-matured crops cannot be good either for the individual owner or

for the country. It is in the power of the Royal Scottish Arboricultural Society to make a strong and urgent appeal to Parliament to have the restrictive duties removed.

D. F. MACKENZIE,
Mortonhall.

THE TAP-ROOT OF THE LARCH.

The above heading may appear an unnecessary one to many of your readers whose properties or charges lie in sheltered places. To me, unfortunately, it is a very serious question, as I am anxious to plant larch, and my property is exposed to all the winds that blow. Unless I can get my trees to send down their tap-roots, I shall have to give up the idea of planting larch on the more exposed places, and content myself with planting in its place trees that will send their roots down, and so resist the wind and not be blown down. My experience as a forest-tree planter in this country is comparatively limited, and I therefore write to your paper in the hope that some of your readers may be able to assist me from their practical experience.

I notice that the larch seedling in the nursery bed in good free soil has a distinct and straight tap-root. On the other hand, the mature larch tree, when blown down, shows no tap-root, or rather its tap-root has turned into a lateral root, and runs along a few inches under the ground. What is the cause of this? Is it caused by bad planting, or from the subsoil being too hard or cold for the tap-root to penetrate.

No doubt many of your readers will be able to state whether they have found the tap-roots of mature larch, growing in free soil with good subsoil draining, descending several feet; also whether they have ever seen a mature larch tree with a tap-root of that description blown down? If, under suitable circumstances, the mature tree has a deep tap-root, and if trees of that sort are seldom found blown down, I think we may assume that by getting the larch to send its tap-root down, we may avoid the loss and disappointment of the wholesale sweeping over of trees by our winter gales. The question is, how is this to be done?

If the reason for the tap-root refusing to descend is the coldness of the subsoil, then I conclude the remedy is deep and close draining, to do which effectively is a costly business. If, on the

other hand, the cause is bad planting, by turning the tap-root when planting and so checking its downward course, then some other method than the present "notch" system of stocking our ground is necessary.

I know from my colonial experience, that some plants which have naturally a strong and decided tap-root will not send down that tap-root as they should, if the subsoil is cold or if the tap-root is turned when the tree is planted. I cannot, therefore, help thinking that possibly it is the same with the larch.

The only methods that suggest themselves to me of encouraging the downward growth of the tap-root, are as follows:—

(a) To plant in deep narrow holes, taking care, when planting, that the tap-root is absolutely perpendicular.

(b) Sowing seed *in situ*.

The latter system would not succeed, I fear, in the western districts of this country, as the growth of grass and weeds is so rank that the young seedlings would be choked and smothered. The system of deep holing is, therefore, as far as I can see, the only alternative. I seek information and advice as to whether there is any other practical method.

The initial cost of planting by deep holing is the difficulty, as, in order to make forest-tree planting a commercial success, the initial cost must be kept as low as possible. Interest and compound interest has to be calculated on the initial outlay from the day planting commences till the outlay is repaid by the sale of thinnings and crop.

To cut holes 20 inches deep, and as narrow as a man could work, say 9 inches at the surface, would probably cost about £3, 10s. to £4 per acre, planting 4 feet × 4 feet. That would be a heavy outlay, though possibly it might pay in the long run, if thereby the trees were enabled to stand our winter gales, and so come to maturity. The plants, also drawing nourishment from a greater depth of soil, might yield a greater crop in a given time. However, this is too heavy an outlay to incur over large areas until the advantage has been proved by actual experiments.

It has occurred to me that an intermediate course might be adopted at a reasonable expense, viz., "dibbling." I intend experimenting with the system this year, and shall gladly, if alive, give you the benefit of that experience some years hence, when I am able to judge by results. Meanwhile, I shall be glad to hear if any of your readers have tested this system already, and

with what results. The system of dibbling I propose to adopt, is one I have employed on a large scale in the colonies when money was a scarce commodity, and it was necessary to plant large areas at a minimum cost. The instrument used is a small crowbar, about 3 feet 6 inches long, pointed at one end. This is plunged into the ground, and a small hole of 15 inches, or deeper where possible, is made. The plant is then put in as deep as possible, and then drawn up until the collar is flush with the surface of the ground. The crowbar is then forced into the ground at a point about 12 inches or more away from the plant, and at an angle of 45 degrees, and it is then forced up in the direction of the plant; this operation being continued until the plant is so firmly fixed that it would require a strong pull to extract it. This second hole is then pressed down with the heel firmly, so as to prevent water lodging.

The great point for the planter to remember is, that the deeper his hole for the plant, the farther away from the plant must the crowbar be inserted for the firming process, otherwise his plant will be "hung," *i.e.*, the soil will be pressed round the upper portion of the root, and the lower portion will be in a cavity; this cavity would in wet weather fill with water. To carry out this system of "dibbling," it will be necessary to use only seedling plants. Transplanted plants or large plants would have too many lateral roots, and so could not be planted by this method. The only drawback I see to "dibbling" is, that as only plants free from lateral roots are suitable, it is necessary to use comparatively small plants. Where the vegetation is rank, these may either be smothered, or it may become necessary to clear the rank growth round them for the first year or two. This of course means added expense, which must as far as possible be avoided. In case it may be necessary to clear round the plants for the first year or two, I intend to plant in line in the experimental plot I propose planting this year.

Lining may be an added initial expense, but probably not a serious one. You can easily say what the cost of lining will be, but it is not so easy to state the probable saving that you may make in the future through having your forest lined. The only disadvantage I see in lining is, that it is not beautiful; your forest is too regular.

The possible savings caused by lining are many. In the first place, you will probably save a good deal of the initial cost in the

plants, and especially on hilly ground. I have never taken the trouble to test the actual saving, but say, for the sake of argument, you are going to plant 4 feet \times 4 feet. If you lined off your ground mathematically by base measurement, 4 feet \times 4 feet, you would require 2722 plants per acre. If you line in a rough and ready way, which is all that is practically required, you will probably find that you will use about 6 per cent. more plants, or, say, 2884 to the acre.

If, on the other hand, you do not line, but tell your men to plant 4 feet \times 4 feet by guess work, you will, I expect, find that when you have finished you have used about 15 per cent. more than the base measurement quantity. Then, if it is found necessary to run over your ground and cut down the rank growth of grass, bracken, or scrub, you will find a very considerable saving where you have lines to work on. A man starts on his line, and every 4 feet there should be a plant—if not there is a vacancy—and he need not trouble to clear the ground. Again, in filling vacancies, the same advantage occurs, and no time is lost in looking for them. Many other advantages could, if necessary, be named.

J. ARTHUR CAMPBELL,

Ardnaine, Lochgilphead.

THE GROWING OF DOUGLAS FIR.

British planters should keep in view the important claims of the Douglas fir. It is perhaps chief of the few exotic *Coniferae* that may be planted extensively in this country for the production of good class timber. It grows well in most soils of open texture, which, though poor, gravelly, or even moorish, are not wet; and it succeeds at high altitudes, as well as in glens and on hill-sides, but is no sea-side tree, nor does it succeed in a smoky atmosphere. The Douglas fir is a first-rate tree for filling up gaps in old woods of any kind. It stands shade and drip well, it is practically free from insect attack, and it makes excellent perennial cover.

Hitherto this tree has, as a rule, been planted too thinly on the ground. From four to six feet from plant to plant is a good distance, and for sylvicultural purposes this ought not to be exceeded. In forming a new plantation, let it be pure, as, under ordinary conditions, no other tree can keep pace in growth with the Douglas.

The Colorado variety of Douglas fir is a more stubby plant than

the ordinary variety, and is less apt to produce autumn or second shoots, which frequently get nipped in frosty situations; but it is of much slower growth, and is not likely to supersede the other, as was believed by some foresters a few years ago. J. M.

PRICES OF HOME-GROWN TIMBER.

The prices of home timber are higher at present than they have been for over twenty years. Larch and Scots pine have steadily risen from thirty to fifty per cent. in value during the last four years; and, if we escape a recurrence of severe gales, there seems no reason why the present prices should not be maintained and a further advance be anticipated.

Proprietors, especially those who are now benefiting by the current high prices, should see to it that their available lands are judiciously planted up with suitable species; for sure it is that our woodlands are to be of more commercial value in years to come than they are at present. J. M.

THE NATION'S TIMBER IMPORTS AND EXPORTS.

The Table found over-leaf, which has been extracted from *The Timber News*, records some very remarkable facts in regard to the steady development of the import trade. Taking forest produce of all kinds, the values of imports during each of the three years 1898 to 1900 compare as follows:—

1898,	.	.	.	.	£21,283,974
1899,	.	.	.	.	£22,882,187
1900,	.	.	.	.	£26,700,084

The above figures are exclusive of a sum of £1,177,359, the value of "other sorts," of which the value is not entered for the two first years—possibly because the records were incomplete until 1900. But, neglecting this large sum, it is seen that the imports of 1899 exceeded in value those of 1898 by £1,598,213, while in 1900 there was a further rise in value of £3,817,897. The increase in value during 1899 and 1900, taken together, amounts to no less a sum than £5,416,110, which represents a rise of more than 25 per cent. over the figures of 1898. How long can imports on this increasing scale be continued? The available sources of supply will assuredly shrink or dry up altogether before long; but this will give their opportunity to those home timber-growers who have known how to prepare their estates in time to avail themselves of it. F. B.

REVIEWS OF BOOKS.

TWO NEW BOOKS ON FORESTRY.

We are always glad to welcome any useful additions to the literature of Forestry, and the two volumes before us undoubtedly fall within the scope of this definition. "The New Forestry," by Mr John Simpson (published by Pawson & Brailsford, of Sheffield), is written by a man who has largely emancipated himself from the traditional methods of the old school, and if his writings bear evidence of only a superficial acquaintance with the Continental system, whose praises he sounds, he has at least made a long stride forward on the way to improvement. The other volume, entitled "Our Forests and Woodlands" (Dent and Co., London), is a product of the facile pen of Dr John Nisbet, who is one of our most thorough exponents of the German School of Forestry; but with his experience mellowed and tempered by long service in the East, and by no inconsiderable acquaintance with British conditions.

In point of extent, illustrations, quality of paper and binding, Dr Nisbet's volume is far ahead of the other, and yet it is issued at less than one-third of the price. It is not for us to attempt to explain why Mr Simpson and his publishers have seen fit to charge twenty-five shillings for a book that many houses would have issued at five or six shillings; but at least this may be said, that the price will very materially limit its circulation, and this is to be regretted, in view of the stimulating character of much of its contents.

In a work with any pretensions to be regarded as authoritative, the opinions expressed are the concern of the author alone, but inaccuracies in regard to matters of fact may seriously affect the reader, especially if he be a young student who is incapable of recognising errors when they confront him. In the list of species on page 91 of "The New Forestry," there are many mistakes in the spelling of the scientific names; and elsewhere throughout the text the spelling of foreign words, *e.g.*, Weimar (p. 152), and Kaltenbach (p. 185), suffers at the hands of the author. Throughout the book reference is frequently made to the yield of German forests, and no indication is given that in such cases the cubical

contents represent approximately the actual contents, which are about 25 per cent. more than the results got by the quarter-girth system of measurement as employed in this country. If, for instance, an Englishman were to measure a lot of trees, and give his result as 10,000 cubic feet, a German would make out about 12,500 cubic feet, a result due to the fact that our system takes no account of slabs. Then, again, in connection with the list of species already referred to, the author says: "The species are given in each class in the order of their importance as timber trees;" but who will agree with him that the Corsican Fir and Cluster Fir are the second and third most important species of the *Conifera*, while the Larch comes but twelfth on the list! Possibly this arrangement is the result of confusion between "Class" and "Species," but he who essays to write on "The New Forestry," should show no unsteadiness in his nomenclature. Finally—to bring the unpleasant task of fault-finding to a close—it may be pointed out that the book would have gained by the omission of the chapter on "Insects and Diseases." We are asked to believe that *Hyllobius abietis* attacks only young shoots, whereas most foresters know that it attacks every part of young pines. The definition, "The pine beetle is very small, slender, and dark," is of no sort of value. The author professes to have had no experience of *Trametes raiiciperda*, whereas the context shows that he has confounded it with *Agaricus melleus*. At the end there follows the surprising statement, "Beetles and insects named as attacking the Scotch and other firs, also attack the larch." Turning to the list of insects attacking the Scotch and other firs (p. 190), we find but four enumerated, and, of these, three are the pine beetle, the pine saw-fly, and the pine geometer moth. It would be interesting to know on how many occasions he has found these insects attacking the larch!

But with its many defects the book is well worth reading, and where the author is on the solid ground of his own experience, his remarks are both valuable and fearless. His condemnation of the attempt to practise economic forestry in the presence of a large head of game is no more than just. In this connection, he says: "Here is a description of what usually goes on wherever game, and particularly pheasants, are preserved to any considerable extent, and where the keeper's object is to show a good head of game regardless of the general interests of the estate. From March to Midsummer, as little work as possible must be per-

mitted in the woods, because the pheasants are either laying or hatching; from Midsummer till October, the coverts must be kept quiet and free from intrusion, in case the birds should be scared off the ground; and from October to February, as little forestry work as possible must be permitted till the pheasants are shot. This composes the whole year, during which the forester's work must be done by fits and starts, by the grace of the keeper. True, the author is not very consistent in his denunciation, for two pages further on he states: "The quietness and repose of Continental forests, even of small extent, are a contrast to the hustle that goes on in English plantations." As a matter of fact, it is evident to anyone that much of the arrangement and management of British woodlands are subservient to the interests of game. Not only is the forester excluded at times when sylvicultural work should claim his attention, but in many other ways the woods suffer in the interests of sport. The provision of rabbit and hare-proof fencing—and especially now that these animals have learned to climb!—is a serious burden on forestry. Even in old woods, where the trees are beyond the stage when ground game usually bark them, the presence of rabbits and hares makes any attempt at natural regeneration impossible. Then, again, we may have a wood of Scotch fir or larch, with a mixture of spruce, silver fir, or beech, where the former trees are growing well above the latter, the spruces, etc., in fact, serving the purpose of a soil-protection wood. In this way, they are fulfilling a most useful function, and should a gap occur amongst the Scotch firs or larches, the repressed trees are at once in a position to shoot up and fill the vacant space. But a dense wood offers but little food to rabbits or hares, and the usual result of a hard winter is that the trees constituting this soil-protection wood are destroyed by barking. So long as a proprietor fully recognises the incompatibility of profitable sylviculture and so-called game preservation, no one has any right to object, but it is time to enter a protest when forestry is said to be unprofitable under the conditions that prevail on many estates.

As so often happens in the case of a convert, Mr Simpson not only adopts the new faith, but shows a disposition to go further than those who have never known any other principles. There is much truth in the assertion, when he says, "The opinion is almost universal among owners of woods, that, as soon as a plantation gets crowded, it is going to ruin, whereas it is just in the

condition it should be in." We cannot, however, go so far as he does in suggesting that for the sake of preserving close canopy, even dead trees should often be left standing at the time of thinning. A tree that is dead cannot contribute any appreciable shade, and such a tree is a constant source of danger as a centre for the spread of disease and injurious insects. Moreover, trees that are removed as soon as they have died, or a little earlier, are usually worth something, and go to swell the intermediate returns. The main object of thinning is not the shortening of the period of the struggle for the mastery that goes on between the dominant and the dominated trees of a wood, but the utilisation of the many hundreds of trees that find sufficient growing space on an acre when say thirty years old, as compared with what the ground can maintain a hundred years later. In a state of nature, such trees die and rot on the ground, and yet the final crop is usually of the very highest quality. If, however, they had been judiciously removed in the course of the rotation, the financial returns might have been increased by a half, without interfering with the technical quality of the final felling.

Mr Simpson strikes the nail fairly on the head when he assails the irrational use of mixtures. A few extracts will best illustrate his position. "Unfortunately the excessive number of species included in British tree lists, and recommended for planting, has been the cause of a great deal of indiscriminate mixing, resulting in little else than trouble and loss in the end. . . . It may be asserted that probably nothing has tended more to make the forester's task difficult in this country than the indiscriminate mixing of species of greatly dissimilar habit. It has caused endless trouble in thinning, and much pruning that should never have been needed. . . . The English forester wants to preserve his mixture as he began; and to give weak and strong a chance, he has to fight the battle with the pruning-knife, without regard to overhead canopy." While recognising the desirability of judicious simple mixtures under many, perhaps most, circumstances, there can be no doubt that our English mixtures are, as a rule, far too complicated. In too many cases trees have been introduced without any regard to their sylvicultural requirements. Oaks, spruces, alders, rowans, jostle each other in a way that would, as the author says, "puzzle a Continental forester, who does not contemplate such mixtures as ours." Mr Simpson, as it seems to us, is perfectly right in his

general views, but he rather errs in his detailed recommendations. When he says, "Rapid growers and slow growers should not be planted together," he surely violates a sylvicultural principle. What would he say, for instance, to the mixture of beech and larch, or beech and ash, or silver fir and larch? The first, in each case, is a slow-growing tree in comparison with the second, and yet these mixtures are not only, in many cases, permissible but advisable. Light-demanding and shade-bearing species, in fact, do best in mixture when the former grow more rapidly than the latter, and for this reason the mixture of oak and beech is most satisfactory when the local conditions enable the oak to take the lead.

Mr Simpson also does well to remind foresters that a degree of thinning that might be sufficient for the larch would be excessive for the spruce. It is not more than a few years since British foresters—and only a few even now!—realised the fact that woods of different species must be thinned differently. Mr A. C. Forbes was probably right when he stated in a recent essay that the generally over-thin condition of our woods is largely attributable to the fact that the larch has long held a place of great importance in British woodlands, and foresters have argued that the amount of thinning suitable for this tree could not be bad for others. That is a doctrine which cannot too soon be abandoned, and Mr Simpson's volume may be depended on to assist in disseminating sounder knowledge.

In his volume on "Our Forests and Woodlands," Dr Nisbet devotes the first two chapters to a scholarly summary of the history of the famous English Forests, and of the laws and customs by which they were regulated. The author dwells lovingly on old John Evelyn's "Sylva," and shows that for two hundred years it has exerted an unobtrusive influence on the progress of English forestry. Following the example of other writers, Dr Nisbet lifts up his voice more in sorrow than in anger against a series of Governments that have, one by one, turned a deaf ear to the appeals of individuals and societies for extension of the recognition of national forestry. But if report does not err, Dr Nisbet must recently have derived some encouragement from the statement that the State has acquired 4000 acres in the valley of the Wye, adjoining the High Meadows Woods and the Forest of Dean, and the presumption is that a

part at least of this area will be devoted to silviculture. Signs are not wanting that these State forests in the south-west of England are entering on a new regime, and when the results are demonstrated to be satisfactory, perhaps we may witness a further extension of the principle of State-ownership.

The third chapter is devoted to a historical and technical account of the oak. He puts the case in its most favourable light for the hedgerow oak, when he says: "It is the best of hedgerow trees, for it neither robs the soil of food intended for the crops, nor tends to hinder the plough by throwing out long shallow roots like ash and elm; nor does it injure the crops by overshadowing to so great an extent as some trees." If the oak be tended in a park or hedgerow so as to grow up with a tall straight bole, and a small crown, it will doubtless do the minimum of injury to the crops in its neighbourhood, but this is not the type of stem that one usually meets with under such circumstances, and, on the whole, it must be said that in many parts of the country hedgerow timber is excessively abundant. That a sprinkling of trees along the boundary fences of fields beautifies a landscape, and furnishes a beneficial amount of shade to stock, is readily admitted, but the desirable limit is far exceeded when, as is often the case, one finds trees standing in almost unbroken rows, with a gappy hedge underneath, and deficient crops in their neighbourhood.

The silvicultural treatment of the oak, and, subsequently, of the beech and other forest trees, is discussed in what one may call a popular, though thoroughly sound and scientific fashion. The author does well to emphasise the point that it is nothing unusual for a land-owner to expect a woodman, getting a pound per week or less, to administer plantations having a capital value of £30,000 or more. Fortunately, the proprietors of landed estates are now realising that there are more opportunities for the profitable utilisation of land under wood than they had hitherto imagined, and already some thousands of acres, both in England and Scotland, have been surveyed by competent experts, and put under a well-conceived working plan. This is a development that is sure to spread, and those who are the first to embrace the new principles will be the first to reap the advantages. Education in forestry has been slowly but surely spreading in this country since lectures were started in Edinburgh in 1889. A great impetus was given to scientific progress by the

Society's excursion to Germany some five years ago. In this development Dr Nisbet, by his writings and teachings, has borne an important part, and we are sure that his new volume will do much to advance the forward movement. W. S.

Veitch's Manual of the Coniferae. Second Edition. By ADOLPHUS H. KENT. Pp. 562, and many Illustrations. London: James Veitch & Sons, Ltd., Royal Exotic Nursery, Chelsea (1900).

All lovers of the beautiful in nature, whether directly interested in arboriculture or otherwise, lie under a deep debt of gratitude to Messrs J. Veitch & Sons, of Chelsea, for the publication of this second edition of their already well-known and widely-read hand-book of the *Coniferae*.

The work has been almost entirely rewritten, and the present volume contains a large amount of new matter. This is especially true of the earlier sections; and in this part of the book, perhaps the most important chapter, from a practical point of view, is that devoted to coniferine pathology, including a general account of the more important disease-producing fungi, by such an eminent authority as Professor Marshall Ward, along with a valuable description, from the pen of Mr W. F. H. Blandford, of the chief insect pests, and the injuries which they cause in coniferous wood.

The economic products of the *Coniferae*, ranging, as these do from timber to amber, are also discussed at considerable length. While in the opening chapter the author provides a general description of the morphological characters exhibited by some leading coniferous types, both during germination and in adult life.

In the body of the book—while we must regret the omission of tropical genera and species, which, though unsuited to outside cultivation in these islands, are not unfrequent denizens of our conservatories—we have a detailed account of all the forms likely to be of practical value to the forester; and in this connection a word must be said in praise of the illustrations, which are more than doubled in number, and still retain the high character which distinguished them in the first edition.

The system of classification adopted is that which we owe to Dr Maxwell Masters, with the exception that *Glyptostrobus* is included in *Taxodium*, and a new genus, *Abietia*, is created to combine *Pseudotsuga* and *Keteleeria*; but time alone can show whether this new harbour of refuge will for long protect these weather-beaten plants from the troubled waters of taxonomic discussion.

J. A. T.

OBITUARY NOTICE.

The late Daniel Dewar, Forester, Beaufort.

Like all other societies, the Scottish Arboricultural is doomed to lose its members—"men who can be ill spared"; to have its "blanks which cannot be readily filled." Yet the march of time fills up these blanks, and other men fall in and take the place of those who have gone before.

Mr Dewar took a keen interest in the affairs of the Society; he was one of its oldest and best supporters, and took a lively and intelligent interest in its work. The many members who took part in the Excursion of 1899 to Beaufort and Dunrobin, will recall with pleasure their meeting with him among the trees and woods where he had spent so many years of his life. This Excursion was rendered all the more interesting from the fact that Mr Dewar, early realising the value of "German methods" as applied to tree planting and thinning, had for years before these methods were appreciated or generally understood in this country, adopted the system in his young plantations, and had done so with a success which elicited the warm congratulations of those best qualified to judge. The "natural" system for the reproduction of pine woods, a system commenced at Beaufort by the grandfather of the present Lord Lovat, was continued by Mr Dewar, and was naturally a source of pride to those who took part in it, as well as a matter of much interest to all engaged in tree-culture; for although these woods were far from any busy centre of population and of commerce, many of the greatest foresters of Germany, France, and America, as well as those at home, found their way to Beaufort sooner or later, and there studied with profit the results of Mr Dewar's work.

Mr Dewar was a thoroughly practical forester, and being a diligent student of forest literature, he kept himself well abreast of the times. His professional library was large, and the value of many of his books was enhanced by their being inscribed "with the compliments of the author"; and well might some of

them be so inscribed, for they were enriched from the stores of his ample experience and matured reflection. His reading otherwise was of wide range, his book-shelves containing good editions of many of the poets, side by side with the writings of Matthew Arnold, Adam Smith, Huxley, Froude, Darwin, and many of the best works of a lighter vein. Possessed of a powerfully retentive memory, he could quote, off-hand, without error from his favourite authors, and his conversation was made additionally interesting and entertaining by his ready wit.

With Lord Lovat he was as much the personal friend as the trusted servant, and with the father and grandfather of the present peer he was on precisely the same terms. He was to have retired on Lord Lovat's return from South Africa, and ample arrangements had almost been completed to make his retiral easy and comfortable. But he died in harness; he retired early to bed on the evening of 3rd June, so as to have a good rest—for he had passed some fatiguing days that week; on the following morning he was found dead—his "good rest" was to be a longer one than his stricken widow and sons expected.

One of Lord Lovat's most painful duties at the front was to break the news of Mr Dewar's death to his second son, John, then and now serving with the Lovat Scouts, and fighting for Queen and country.

Mr Dewar was a native of Crieff. After serving his "time" as a forester, he went for some months to the botanical gardens at Washington, U.S.A. On his return he received the appointment of forester to Lord Digby on his Irish estates, thereafter finding his way to Beaufort, where he had charge of the extensive woods of the Lovat estates, a position he occupied for thirty-six years.

Mr Dewar was sixty-seven years old when he died, and it may truly be said of him that he left behind him troops of sorrowing friends. He possessed the best attributes of the typical Scot: sterling and manly in all his dealings, frank and kindly to everyone, and as modest in his bearing as he was cultured in mind and in manner.

JAS. A. GOSSIP.

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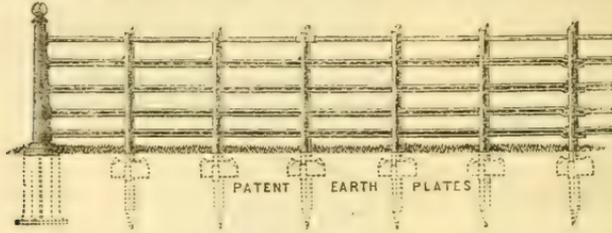
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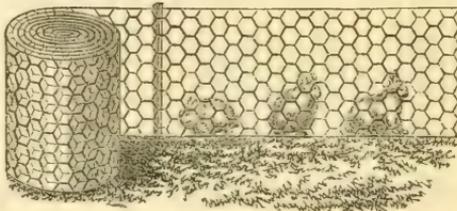
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PROCEEDINGS OF THE ROYAL SCOTTISH ARBORICULTURAL SOCIETY.	

ABRIDGED PROSPECTUS.

Membership.

THE Roll contains the names of over 900 Members, comprising Landowners, Factors, Foresters, Nurserymen, Gardeners, Land Stewards, Wood Merchants, and others interested in Forestry, many of whom reside in England, Ireland, the British Colonies and India.

Members are elected by the Council. The Terms of Subscription will be found on the back of the Form of Proposal for Membership which accompanies this Memorandum.

The Principal Objects of the Society,

and the nature of its work, will be gathered from the following paragraphs :—

Meetings.

The Society holds periodical Meetings for the transaction of business, the reading and discussion of Papers, the exhibition of new Inventions, specimens of Forest Products and other articles of special interest to the Members, and for the advancement of Forestry in all its branches. Meetings of the Council are held every alternate month, and at other times when business requires attention ; and Committees of the Council meet frequently to arrange and carry out the work of the Society.

Prizes and Medals.

With the view of encouraging young Foresters to study, and to train themselves in habits of careful and accurate observation, the Society offers Annual Prizes and Medals for essays on practical subjects, and for inventions connected with appliances used in Forestry. Such awards have been granted continuously from 1855 up to the present time, no fewer than 390 Medals and Money Prizes having been presented.

School of Forestry.

Being convinced of the necessity for bringing within the reach of young Foresters, and others interested in the Profession, a regular course of systematic Instruction, such as is provided in Germany, France, and other European countries, the Society, in 1882, strongly urged the creation of a British School of Forestry ;

and with a view of stimulating public interest in the matter, a Forestry Exhibition, chiefly organised by the Council, was held in Edinburgh in 1884.

As a further step towards the end in view, the Society, in 1890, instituted a Fund for the purpose of establishing a Chair of Forestry at the University of Edinburgh, and a sum of £584, 3s. 10d. has since been raised by the Society and handed over to the University. Aided by an annual subsidy from the Board of Agriculture, which the Society was mainly instrumental in obtaining, a Course of Lectures at the University has been delivered without interruption since 1889. It is recognised, however, that a School of Forestry is incomplete without a practical training-ground, which, if attached to it, would be available, not only for purposes of instruction but also as a Station for Research and Experiment, and as a Model Forest, by which Landowners and Foresters throughout the country might benefit. The Society has accordingly drawn up a Scheme for the Establishment of a State Model Forest in Scotland which might serve the above-named objects.

The Government, unfortunately, does not see its way to give immediate effect to this Scheme; but Mr Munro Ferguson, M.P., for a part of whose woods at Raith a Working Plan has recently been prepared, and is now in operation, has very kindly agreed to allow Students to visit them; and he has also placed at the disposal of the Society a bursary of £30 per annum, for a few years, for the benefit of Students who, with a view to undertaking the management of woods in the United Kingdom, may study Forestry and kindred subjects at the Edinburgh University.

Excursions.

During the past twenty-four years, well-organised Excursions, numerous attended by Members of the Society, have been made annually to various parts of Scotland, England, and Ireland; and in 1895, a Tour extending over twelve days was made through the Forests of Northern Germany. These Excursions enable Members whose occupations necessarily confine them chiefly to a single locality to study the conditions and methods prevailing elsewhere; and the Council propose to extend the Tours during the next few years to Sweden, Norway, France, and Southern Germany. They venture to express the hope that Landowners may be induced to afford facilities to their Foresters for participation in these Tours, the instructive nature of which renders them well worth the moderate expenditure of time and money that they involve.

The Society's Transactions.

The *Transactions* of the Society are published annually, and issued *gratis* to Members. A large number of valuable Papers, including Prize Essays and reports of the Annual Excursions, have appeared in them, and have thus become available to Students as well as to those actively engaged in the Profession of Forestry. Copies of the *Transactions*, which now extend to sixteen volumes, are to be found in the principal Libraries of the United Kingdom, as well as in those of the British Colonies and of America.

Honorary Consulting Scientists.

Members have the privilege of obtaining information gratuitously upon subjects connected with Forestry from the Honorary Scientists, whose names and addresses will be found on page 23 of the Proceedings appended to this Part.

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

Local Secretaries.

The Society is represented throughout Scotland, England, and Ireland by the Local Secretaries whose names will be found on page 23 of the Proceedings appended to this Part. They are ready to afford any additional information that may be desired regarding the Conditions of Membership and the work of the Society.

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Special Notices to Members.

THE READING OF PAPERS.

Members are invited to read short papers on any subject connected with Practical Forestry at the Annual Meeting in January, or at the General Meeting to be held at the time of the Excursion. Members who may desire to do this are requested to intimate the title of their subject, in writing, to the Secretary, not later than 1st January or 1st June 1902, and to state the time they require for reading the paper.

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.

ILLUSTRATIONS FUND.

The Council begs to draw special attention to this Fund, the object of which is to defray the expense of illustrating the Society's *Transactions*.

THE SOCIETY'S ALBUM.

The Council wishes it to be known that the Society has an Album of Photographs of Members, and that the Secretary will be glad to receive contributions.

NEW MEMBERS.

The Council has 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 Member 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.

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Candidate's { *Full Name*,
Designation,
Degrees, etc.,
Address,
Life, or Ordinary Member,
Signature,

Proposer's { *Signature*,
Address,

Seconder's { *Signature*,
Address,

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. Every Proposal for Membership shall be made on the FORM provided for the purpose, which must be signed by two Members of the Society as Proposer and Seconder, and delivered to the Secretary to be laid before the next meeting of the Council. The Proposal shall lie on the table till the following meeting of the Council, when it shall be accepted or otherwise dealt with, as the Council may deem best in the interests of the Society. The Proposer and Seconder shall be responsible for payment of the new Member's first Subscription.



THE ROYAL SCOTTISH ARBORICULTURAL SOCIETY AT CULZEAN CASTLE, 6TH AUGUST 1901.

TRANSACTIONS

OF THE

ROYAL SCOTTISH ARBORICULTURAL SOCIETY.

XXV. *The Forestry Exhibition at Paris and Some of its Lessons.*¹

By J. S. GAMBLE, C.I.E., F.R.S., etc.

There are, no doubt, many members of the Society who visited the great Exhibition which was held last summer in Paris, and were delighted with the many wonderful things which were there collected from all parts of the world. It seems sad to those who, like myself, were not only there as visitors, but took part in the work, that those splendid buildings, those magnificent exhibits, those great records of human industry, art and labour, should now be dispersed and doomed to disappear, so that soon there will remain but few traces of them. It behoves us the more, therefore, to do what we can to take stock of what we have seen, and endeavour, if we can, to draw some lessons from it which may be useful to ourselves, to the United Kingdom, and to its colonies and dependencies.

Among the most interesting and handsomest buildings in the Exhibition was one which occupied what was perhaps one of the finest sites in Paris, and which could not fail to attract the attention of the visitor. I refer to the "Palais des Forêts, de la Chasse et des Cueillettes," a fine building on the left bank of the Seine, just below the Jéna Bridge, and almost overshadowed by the Eiffel Tower. It was a huge building, quite an Exhibition in itself, one which, at any other time, would alone have drawn crowds of sightseers; but, in 1900, though it was always thronged, I am afraid that, among so many splendid buildings, such a wealth of beautiful objects and interesting shows, it hardly attracted quite the attention that its contents deserved. This was the home of Classes 49 to 54 of the Exhibition Catalogue,

¹ Written to be read before the Society at its meeting in January 1901.

the classes which included forestry, hunting, shooting, fishing, and the various products of all grades of interest connected with woodland craft. Many of those here present would no doubt be more interested if I were to describe in detail the varied exhibits connected with sport; but in my subject to-day, before such an audience as that of the members of the Royal Scottish Arboricultural Society, I shall do better to confine myself to the more immediately interesting show that was made by the exhibits representing sylviculture and the utilisation of forest products. It will suffice to tell you that the sporting trophies and the exhibits of sporting weapons made a very fine show; and that fisheries and fish culture, a subject which in France is part of the business of forest officers, who are all "Agents des Eaux et Forêts," and not merely forest managers only, were shown in surprising and wonderful detail. There one saw tanks with the most valuable of the fish produced in European streams, oyster beds with the live oysters apparently only waiting to be removed for the table, and life-like groups representing the sponge and coral fisheries of the Mediterranean. In the Russian section you saw tubs of preserved sturgeon and barrels of caviare, while nets and fishing implements generally decked the roof and festooned the arches of the handsome central hall.

The countries whose forest exhibits found place in the Forest Palace were France, Russia, Austria, Hungary, Roumania, Sweden, Japan, Canada, and the United States. The forest exhibitions of the French colonies, the Dutch and Portuguese colonies, Siberia, British India, Ceylon and Western Australia, were all in the Colonial Section in various buildings dotted about the Trocadéro Gardens. Those of Italy, Norway, Portugal, Servia, Bulgaria, Finland and Mexico were in the national pavilions in the magnificent Rue des Nations along the Seine. Some countries were not, or hardly, represented at all, such as Germany, Holland, Belgium, Switzerland, Denmark, Spain, the South American Republics, and the British colonies other than those already mentioned: the absence of German exhibits, and the lessons likely to be drawn from a comparison of the advanced German methods of forestry, having been a regrettable and noticeable flaw in the international character of the forest portion of the great show.

The exhibits of the French Section were in two portions: *first*, that of the Forest Department; and, *secondly*, those of private

exhibitors and forest societies. In France, the National Department of Forestry is concerned only with the management, growth, and tending of the forests; all produce is sold in the forests, standing, so that the great works of conversion and extraction, which are such a feature of forest work in Germany, Austria and Hungary, were but little represented. Sylvicultural work was, however, represented by copies of forest working plans, with the control books belonging to them, and by numerous valuable books on forest subjects. In France, all the State forests and the Communal forests which are managed by the State are under regular working plans, calculated to provide for a permanent annual yield in material such as is most required, and for a progressive improvement of the capital stock. The yearly fellings, or *coupes*, are marked by the forest staff, and the marked trees sold in block standing in the forest; but the export roads, and perhaps also sledge-ways and other aids to extraction, are maintained by the Department. There were several very interesting exhibits to show the progress made in forest roads and forest works. Timber was represented by a large series of wood specimens contributed by the Forest School at Nancy, and on the walls was quite a wonderful series to illustrate the small forest industries and the local uses to which the products of the forests are put. But the chief exhibits were those which illustrated the very important works which France has undertaken of late years in the re-clothing of denuded mountain slopes, the stoppage of landslips and avalanches, the regulation of torrential streams, and the planting up of coast sands. These works were illustrated by a series of models, photographs, water-colour drawings, a diorama showing a hill-side before and at the end of several years after reclamation, and a series of books and pamphlets. The French Government, in the last forty years, have reclaimed nearly 640 square miles of country, and spent about $2\frac{1}{2}$ million pounds sterling; the results have been excellent, and they are justly proud of their success. The subject, however interesting for those who live in countries where the mountains are liable to denudation, as they are in the European Alps, the Pyrenees, and other great mountain ranges, is not of such interest to us, who in these islands have only to do with moderate elevations, comparatively easy slopes, and a moist climate; but the study of the work done in France is of the highest importance to those who have anything to do with the ranges of the Himalaya, and who know how terrible

are the effects of landslips and avalanches, and how badly some valleys are becoming denuded in consequence of a neglect of proper protection of the forests. Some small attempts have been made in India to stop the ravages of torrents, and of course wherever it has been able to step in, the Forest Department has tried to urge the formation of permanent reserved forests on slopes which are liable to damage; but this is not much when compared with what remains to be done. Except a few forest officers who have studied the subject, and a few others such as the late Mr B. H. Baden-Powell, whose recent death Indian forest officers have especial reason to deplore, and who was probably the first to draw the serious attention of Government to the matter, the Indian officials have not appreciated the extent of the danger; and one of the first of the lessons for the British Empire which I think we may draw from the Paris Forestry Exhibition is that something requires seriously to be done in the Himalaya before it is too late. In some places it already is almost too late; for I have myself seen hill-slopes which, when I knew them first, were covered with fine forest of big trees, but are now scored with landslips, and their gentle streams converted into torrents, because the trees had been cut down and burnt to make patches of poor cultivation. The subject requires to be taken up seriously and systematically, as is done in France, Austria, Hungary, and elsewhere; but anyone who knows India and the "sufficient for the day" policy of Indian administrators, knows that the chances of anything of use being done are small indeed.

The question of the fixing of shifting coast sands and dunes is one which is of more general interest in this country, as any one who, like myself, has visited the important works undertaken near Forres, on the coast of Morayshire, can testify. In France these works have been of the greatest importance, and I daresay some of those here present have visited the extensive and important works which the French have undertaken on the coast of the Bay of Biscay. There is no harm, however, in again referring to them. In 1779 the work began under the celebrated engineer Brémontier, and in 1864 it was almost completed, an area of about 260 square miles having, during the interval, been reclaimed and afforested, nearly all of it with the Pinaster (*Pinus maritima*), at a cost of about £620,000. In some other exhibits of different countries interesting accounts were given of similar works: thus the Portuguese Government had some valuable drawings of works under-

taken on the coast of Portugal; while the German Government exhibited, through their Department of Public Works, in the Champ de Mars, an important series of drawings, photographs, and relief models showing the work done on the coast of the North Sea with the Scots pine (*Pinus sylvestris*). Nearly the whole of the North German coast has now been afforested to cover the sand-dunes and prevent the shifting sands from invading the cultivated lands behind them; only a small section still remains to be done on the Kurische Nahrung, the spit of land between the sea and the Kurische Lake, which lies between Königsburg and Memel. In other countries, also, similar works have been successfully undertaken, one of the most noticeable being that accomplished in British India, where large coast areas on both sides of the peninsula, but especially on the Coromandel Coast, have been reclaimed by means of the *Casuarina*. The lesson to be drawn from these exhibits is that wherever we have, either in the United Kingdom or its colonies and dependencies, similar difficulties, where the sea sands tend to work inland and destroy cultivation, the remedy lies in following the lead given by Continental nations, and in turning the sands to account as forest. We have already made a beginning in Scotland and in India.

Before leaving the subject of the French Forest Exhibits, it seems right to refer to the remarkable pamphlet published by the Government, containing the paper read by M. Mélard, Inspector of Forests at Paris, before the Forest Congress. M. Mélard discussed the question of the supply of timber in the world, classifying the countries under the heads of those whose exports exceed their imports, and those whose imports are in excess of their exports. The results arrived at are remarkable, and read us a very important lesson. It appears that the only countries in Europe in which the exports of building timber exceed the imports are—(1) Austria-Hungary, with Bosnia, Herzegovina, and also Roumania, where the exports are chiefly of oak, less important in general building than the deal woods of other countries; (2) Russia and Finland; (3) Sweden and Norway. In all the rest, the United Kingdom, France, Germany, Italy, Spain and Portugal, Belgium, Holland, Denmark, etc., the imports exceed the exports, often very largely. In the rest of the world, exports exceed imports only, so far as statistics are available, in the United States, Canada, and British India, other countries showing an excess of imports. The figures given by

M. Mélard, which I have adopted, may perhaps require some revision, especially as they are only brought up to date of 1898, but the net result is that, for the world, so far as is known, the imports exceed the exports by £3,437,115, which perhaps represents the exports of Australia, various parts of Africa, Siam, the French and Dutch Indies, Turkey, and minor countries generally. The accompanying Table gives the figures I have compiled from the work of M. Mélard.¹

Year.	Country.	Excess Imports over Exports.	Excess Exports over Imports.
		£	£
1898	Great Britain,	20,523,758	
"	France,	4,436,977	
"	Belgium,	4,084,485	
"	Holland,	725,808	
"	Switzerland,	590,197	
"	German Empire,	13,741,240	
"	Denmark,	1,241,095	
"	Spain,	1,180,802	
"	Portugal,	200,024	
"	Italy,	1,245,461	
1897	Greece,	130,741	
1898	Bulgaria,	89,980	
"	Servia,	14,493	
"	Austria-Hungary, . . . . .	.....	7,941,422
"	Norway, . . . . .	.....	1,868,497
"	Sweden, . . . . .	.....	7,927,086
"	Finland, . . . . .	.....	3,529,536
1897	Russia, . . . . .	.....	5,361,285
1898	Roumania, . . . . .	.....	159,121
1897-98	United States, . . . . .	.....	3,981,463
"	Canada, . . . . .	.....	5,077,756
1898-99	British India, . . . . .	.....	548,062
1898	China,	145,069	
1897	Japan,	13,642	
1898	South Africa,	343,006	
1896-97	Mexico,	87,640	
1898	Argentina,	1,036,925	
	Total,	39,831,343	36,394,228
	Difference,	3,437,115	

The quantity of wood exported as paper pulp has not been included in these figures, but it is well to mention that it amounts for Sweden and Norway to about £1,500,000 sterling, and for Canada to about £6,500,000, total £8,000,000.

¹ Since this Table was compiled, Dr W. Schlich's paper, read before the Society of Arts on 27th February 1901, has given what are probably more accurate figures. [The paper will be found at p. 355.—ED.]

M. Mélard's important work concludes by pointing out that of the countries which still supply timber, that supply is diminishing in Austria-Hungary, the United States, and Russia, by the increase of population and industrial development, and in Norway by the exhaustion of the forests, so that only Sweden, Finland, and Canada remain, and they will be unable alone to keep up the supply. Neither in Sweden nor in Canada is a sufficient attempt being made towards a proper management of the forests and a proper husbanding of their resources, so that a wood famine seems imminent, and M. Mélard thinks that before fifty years are out, that famine will make itself seriously felt.¹ The lesson we have to take to heart, in the British Empire, is that in Canada especially, in India and Australia, and even in Great Britain, we must set to work seriously to consider the state of affairs. As it is chiefly in the supply of the pine-timbers, which we know as deals, that the famine will be felt, the first thing to be done is for the Government of Canada to take the matter up, reserve lands for forest, ascertain the value of the forest capital stock, regulate its working by means of plans destined to prevent cutting more than the interest on the capital, ascertained to be the permanent annual yield, and provide for proper regeneration. And in these islands also, forestry must no longer be considered, as it only too often is now, a means of keeping up woods as a home for game, or as a beautiful adjunct to charming estates, but it must be taken up seriously and professionally. Above all, as it is timber of good quality and size that will be required, we must give up those open-grown woods, and that practice of over-thinning, which tend to produce only small and knotty timber of low quality, and try to obtain long sound boles, and wood that can compete with that produced in the great forests of North America in size and quality. Again, as it is timber fit for sawing that will be wanted more than fuel, the present system of growing coppice-woods only for broad-leaf trees must be exchanged for that of High Forest.

On leaving the French Section and descending to the basement on the level of the river quay, one passed first of all through part of the Fisheries Exhibition, and then reached the long building in which the national forestry collections were arranged.

The first one arrived at was that of Russia, and the first exhibit was an immense map showing the distribution of forest—

¹ M. Mélard's conclusions are given *in extenso* at p. 334.—ED.

State, communal, and private,—a map which was most interesting. To an Englishman, the first point of remark was that the scale was in English measure, 25 versts to the inch, and this seems to be the usual thing. The colouring of the map showed that, except the forests of the Caucasus, much of the southern half of Russia is bare of forest, the forest area then increasing largely, until in the north, between the parallels of St Petersburg and Archangel, the colouring is almost complete. Much of this forest area must be very far, not only from the coast but even from navigable waterways or railway lines, and thus difficult to work with profit. The chief forest trees are the spruce and Scots pine; but in places, it is interesting to note, there are forests of nearly pure lime trees, worked for bast fibre, bark, boots, and minor industries, such as boxes and baskets. The area of forest in the Russian Empire comes to something under 100,000 square miles. It is hardly unfair to suppose that, in the north especially, much of this forest consists only of stunted, very slowly-growing trees, giving but little timber, and that of small size.

The preparation of working plans for the Russian forests began in 1840, and already most of the Government forests of the centre and south have been placed under systematic working, while considerable progress is being made in the huge areas of northern Russia and Siberia. The working plans are of the simplest character, chiefly providing for selection fellings on an area basis, the areas being fixed in five-yearly plans of operations. By degrees, no doubt, these arrangements will be modified and improved as experience is gained, but at present fellings are confined to mature trees, up to the calculated amount of the annual yield. So far as is possible, all material is sold standing, so that the conversion and extraction of the produce is made by the purchaser. In addition to the extraction of the principal product, timber, much attention is paid to the economy of refuse material, and the utilisation of trees of the less valuable kinds. Thus, in pine woods, the stumps are used for the manufacture of tar and turpentine; in birch woods, the wood is distilled for the manufacture of acetate of lime and methylated spirit, and the bark is converted into tanning extract, used for preparing Russian leather; in lime forests, as already mentioned, the bast and bark are utilised, and so on; while the manufacture of resin and turpentine from the Scots pine is, in some provinces, an important industry, whose value may be gauged by the fact

that in 1898 these products were exported to a value of about £180,000. If such energy can be displayed in the proper management of forests in regions which, like these of northern Russia, are but poorly supplied with railways and means of transport, it ought to be possible to do more in Great Britain. We have here in places large areas of pine forest, often of branching trees poor in capability of yielding timber, but which might be utilised, without the need of felling, as a source of supply of resin and turpentine, in order to lessen the amount which the country has to purchase from abroad, and chiefly from France and America. In the Russian Section there was an important exhibit by the Muscovite Society of Forestry, whose headquarters are at Moscow, and whose work I shall refer to later on.

The grand collections sent by Austria and Hungary were most complete in every detail. Sylviculture in all its phases, Forest Utilisation in many branches, Forest Protection, Reboisement work, Forest Law, Forest Education, Forest Surveys, and Forest Engineering, all found excellent and interesting representatives among the varied and beautiful exhibits. Sylviculture was represented by pictures and photographs of forests, both natural and artificial; sections of trees cut and arranged so as to show the growth and analysis of type-stems of different species, accompanied by tables of form factors and graphic statements of increment; models and tools to represent plantation work and so on, but most especially by copies of selected working plans, with the maps and control books belonging to them.

In connection with Forest Utilisation were seen specimens of the various tools used in forestry, models of export-roads, sledge-roads, tram-lines, wire tramways, saw-mills, rafting works, and catching booms, required in the export of timber; while such forest industries as the manufacture of paper-pulp, the preparation of charcoal, tar, turpentine, acetic acid, and such-like products, the cutting of veneers and parquet-wood, the manufacture of shoes, pipes, baskets, and of innumerable other small articles whose preparation gives employment to thousands of skilled workmen in villages adjoining the forests—all these and many others evince the great importance to wealth and prosperity which is given by the possession of such valuable forest estates. Among special Reboisement works which were represented, came the Austrian works in the Alps, where about

250 square miles of country have been reclaimed, and those in the Hungarian region of the Karst, near Fiume, where most important works are being successfully carried out. Forest Protection was illustrated by so many interesting and important exhibits, that it would be impossible here to mention most of them; and it must suffice to say that insects and their ravages, destructive fungi and their effects, were the most especially noticeable. Except perhaps in Germany, nowhere have the ravages caused in forests by destructive insects and fungoid diseases been studied in greater detail and with greater success as regards prevention and cure than in Austria and Hungary. While on this subject I may mention that in the Italian pavilion also, the collections illustrating these very important matters were especially noticeable and good. Forest Law was illustrated by the various legislative acts of the two Governments, and Forest Education by quite a large series of pictures, books, and models from the great forest schools, especially from that of Selmezbánya, in Hungary. Forest Surveys and Forest Engineering were fully represented by beautiful maps, plans in relief, pictures, photographs and models of houses, and models and pictures of roads and export works. In addition, Forest Botany was represented by well-prepared herbaria, Zoology by birds, mammals, and insects, and even the soils of the different classes of forest were shown.

The chief lesson, as it seemed to me, which these splendid collections brought forward was that Forestry, besides being in itself a science of importance, requires for its successful carrying out, not merely a smattering but quite an intimate knowledge of several sciences. In such countries as Austria and Hungary, and we know the same to be true of Germany and other countries as well, a forest officer is bound to be an all-round scientist. Physics and chemistry, meteorology and geology, botany and zoology, all come in, and all have to be considered in the daily work of a forest officer. I am the more glad to be able to draw attention to this especial point, as, recently, a considerable amount of discussion has taken place on the question of the scientific knowledge to be required of candidates for the Indian Forest Service. I am glad to say that it has been admitted by most of those who are most competent to speak from experience, that scientific aptitude and a liking for science are requisites of the first importance in the selection of candidates for forest appointments,

but that the present system of recruiting for the Indian service is not arranged to attract such men. Indeed, I consider that the present system, to a very large extent, favours those whose education has been literary rather than those who have been trained in scientific subjects; and I think that the three years' training which is afterwards given does not fully supply the deficiency.

As a forester of over thirty years' experience, my own opinion is that a really successful forest officer must every day—indeed, every hour—as he goes about his work, apply scientific methods and a love for science to a correct appreciation of the phenomena which he comes across, in whatever country he may have to work; and more especially is this necessary in countries like India, Africa, Australia, etc., where the species of tree, the plants of the forests, the animals, birds, and insects, the rocks and soils, are not so well known and so thoroughly understood as are those of countries like Great Britain. To do the best he can for his charge, a forester must study the species of trees which compose his forests, and endeavour to utilise them all to the best advantage, investigating their products; and to do this fully he must know their names and their position in botanical arrangement. If he finds his trees diseased, he has to work out the cause, which may, perhaps, be one of those terrible pests like the “Nun” moth, capable of destroying miles of valuable forest in a single year; perhaps one of these almost equally terrible but less easily seen enemies, such as the *Trametes* fungus, which can spread itself underground from root to root in groves of young trees, and do incalculable damage in the most insidious manner.

Here, in Scotland, foresters are in most cases more or less born to the work, and their powers of observation of forest phenomena are developed by experience obtained at perhaps the most impressionable age; but valuable as is the experience so gained, it is far more so when it can be rightly guided and directed by a scientific educational training.

Next to the development of powers of accurate observation, I should place, as most important for a forester in any country, a preliminary scientific aptitude and a liking for outdoor life, improved and directed by scientific training; and for this reason I can only regret that the recommendations made recently by the British Association were not adopted. Those recommendations urged the importance of selecting candidates of scientific aptitude; but the authorities seem to prefer to select men, excellent, no

doubt, in other respects, but who could just as soon, and indeed do sooner, adopt the career of police officers. I ought to explain that the examinations for forest and police officers are at present nearly the same, and as the successful candidates of the right age have the right of choice of the one they prefer, they most frequently choose the police, because their service begins at once, instead of after the heavy expense of a three years' training-course. This system would seem to present a bar to the obtaining of the best men for forest work, especially men with scientific aptitudes.

In France and other European countries, where the forest service is a kind of *corps d'élite*, the students for the special Forest Schools are mostly selected from the most suitable of the students at the Colleges of Agriculture, so that before they begin their special training they are already interested in and well grounded in science. In this country, with scientific degrees conferred at the universities, and more especially at Cambridge and Edinburgh, a very little alteration in the age of admission and rules of selection would be necessary to ensure candidates having already a good grounding in preliminary science, and a considerable special botanical and forest knowledge as well.

Another lesson which might be drawn from the exhibits shown in the Austrian and Hungarian Sections is that of the development of modern methods of utilisation of forest products. Take, for instance, paper-pulp. M. Mélard told us, as I have already mentioned, at the Forest Congress, that the paper-pulp industry in Sweden and Norway and Canada could be valued at about £8,000,000 sterling. A considerable portion of this is purchased by the United Kingdom; but I believe very little, if any, is produced here at all. The chief tree used for paper-pulp is the spruce, grown in close plantations to avoid knots in the wood, and cut at a comparatively early age, when capable of giving straight pieces free from knots and branches, of from 4 to 8 inches in diameter. According to Mr W. R. Fisher, in his work on "Utilisation," there were in 1892 about six hundred factories for paper-pulp in Germany, and two hundred in Austria-Hungary, producing annually about 270,000 tons of pulp. There seems no reason why much of the private forest-land in the United Kingdom should not be devoted to wood-pulp timber-growing, and there is every reason to think that it would be a profitable industry.

Among other countries represented by Forest collections at the

Exhibition, the United States and Canada made an important show—not so much from the point of view of scientific forestry, as from the display of fine timbers, and from the obvious fact that, at any rate in the United States, the importance of having permanent forest reserved areas, and of treating these areas in the most systematic and economical manner, is being recognised. Many large reserves have already been formed and placed under Working Plans; and under the guidance of such foresters as Messrs Hough, Fernow, and Pinchot, the value and importance of scientific working, replacing the old system of lumbering without much thought of reproduction, is receiving great attention. It is encouraging also to read, in Mr J. M. Macoun's interesting pamphlet on the "Forest Wealth of Canada," that "wise laws have been made by the provincial and federal Governments, having for their object the preservation of the forests; and the owners and lessees of timber limits now exercise greater care than formerly in the prevention of fires, supplementing to a very considerable extent the efforts of the Government to lessen the destruction of valuable timber from this cause. The various Governments are taking steps towards the re-forestation of the denuded areas under their control, and though the actual work so far done in this direction is not great, preliminary investigations are being made which will enable them to apply the methods best suited to each district." So far as it goes, this is good, but I have not heard of any steps having yet been taken to set apart permanent forests, get together a professional staff, ascertain even roughly the amount of the capital stock, and restrict fellings to the amount which can be calculated as the permanent annual yield. As I have already remarked, it is to Canada and its forests, more than to any other country, that the world will have to look for its supply when the time of wood-famine predicted by M. Mélard arrives; and it may be hoped that the lesson will attract the earnest attention of the Government of the Dominion before it is too late.

Among the exhibits of British colonies most noticeable were the splendid specimens in the West Australian Court illustrating the trade in the "Jarrah" and "Karri" timbers, species of *Eucalyptus*. Outside the doorways, were huge sections of these trees; inside, nearly all the fittings, even the floors and staircases, were made of them, and it was obvious that no pains were being spared to advertise the value of these woods. Any professional

forester, however, visiting the West Australian Court, would naturally ask himself how far the cutting of so much fine timber is balanced by provisions for reproducing the forests cleared. The supply has been talked of as "inexhaustible"; but it does not seem that the very necessary steps which are required to really make them so have yet been commenced. It may be hoped that a lesson will be learnt from the association at Paris of the magnificent products of forests not worked in a systematic manner, with those of countries where the estimated annual yield only is allowed to be cut, after very careful and scientific calculation; and that, before it is too late, the companies and societies now engaged in bringing to market as large an amount of material as they possibly can yearly, will be induced to take steps to make sure that they are not overcutting, and that their permanent returns are not being endangered by the absence of measures of reproduction.

The collection sent from British India, which I had myself the duty of arranging, was intended generally to show the progress made of recent years in the scientific management of the Indian forests, and specially to let the builders and furniture manufacturers of Europe know what can be done with the best of the Indian woods in the way of art furniture, and especially of carving. The Indian forests have one principal export timber, the teak, the amount of the supply of which is regulated under systematic working plans, so that any chance of overcutting may be obviated. There is no difficulty about the sale of the yearly outturn, and the timber is well known all over the world, so that special exhibits to make it known and advertise it were unnecessary. But it was not so generally known how well the teak could lend itself to carving; and under the arrangements made by the Inspector-General of Forests, Mr Ribbentrop, this was represented by a very fine carved staircase, and by carved showcases in the Imperial Court. The other export woods of India are the blackwood, padouk, satinwood, ebony and sandal, and the export trade in them is not very great, though about equal to the demand. They are not obtained from gregarious trees or produced in great abundance; so that it was unnecessary, as with teak, to have them very fully represented as timbers, though, with a view to increasing their value, it was deemed important to show their capabilities for carving. In addition to these woods, however, India produces several which are common and capable of

being supplied in quantity, the supply being at present greater than the demand. Among such woods are ironwood, saj, toon, thingan, eng, and others, and it is hoped that the trade in these will improve. The exhibits which illustrated scientific management, the maps, working plans, books, and photographs were very greatly appreciated, and our foreign critics were full of praise for the admirable work which India has done, as the most extensive pioneer of forest conservancy in tropical countries. Indeed, I believe that its only earlier competitor was Java, for I think real forest conservancy in the Dutch Indies was probably instituted earlier than it was even in British India.

I now come to a matter which perhaps will more directly interest you, and that is the question of what should be done in the United Kingdom to bring forest conservancy to something like the level which it has reached in the great Continental countries, as well as in India and in the Netherlands Indies. The first and most obvious recommendation has often been made, and probably more often before the Royal Arboricultural Society of Scotland than anywhere, and that is the institution of State reserved forests and a State Department. To a small extent, such a Department already exists, as we know; but we cannot shut our eyes to the fact that though much has been said, even in Parliament, on the subject, and much has been written, little or nothing has yet been done, or seems to have any chance of being done; for it must be remembered that in the New Forest, the Forest of Dean, and elsewhere, the Government estates, though doubtless managed as well and as scientifically as present circumstances allow, are badly hampered by prescriptive rights, and by the common but erroneous idea of the public that a properly managed forest is one which has lost its beauty and its charm. If the Government wished to possess forests, such as the French and other Continental Governments possess, it would have to purchase forest estates, free of rights, as they become available, or plant up existing waste lands. And so I feel emboldened to suggest attention to what struck me very forcibly during my examination in Paris, as a member of the Forest Jury of national exhibits, and that is the excellent work done by forest societies. The members of this society, one of the oldest forest societies of Europe, will, I hope, appreciate what I say; but you are perhaps unaware that on the Continent there are societies, one or two of which have gone

beyond you, and which not only work as you do for the dissemination of correct forest principles and the discussion of improved forest methods, but actually possess and manage forests of their own. Thus the Muscovite Society in Russia, founded in 1882 with the object of preserving, improving, and replanting forests, possesses twenty properties, with a total area of 870 square miles, of which more than half are already wooded, the forest portions being carefully worked under simple working plans. I understand that there are others also in different countries; and it has occurred to me that some such society in the United Kingdom, beginning by small degrees, might gradually form a forest estate managed so as to pay financially, at any rate after a short interval, while being worked under the best and most scientific system, as an experimental area, such as your Society has long advocated.

I am given to understand that, in America, the establishment of forest societies, or perhaps it is best to say, "forest companies," is being talked of. Such companies would acquire and manage forest estates for future yield; and perhaps, in the United Kingdom also, it may some day be possible for some of those whose means allow them to be content with but a small dividend for a few years at the beginning, to invest money in forest companies, and acquire properties which, under good management, would soon become not merely a provision against dearth of timber in the future, but a good investment. At any rate the subject is one worthy of discussion, and perhaps the idea of replacing the State-managed forests of other countries by those of forest societies or forest companies may prove to be what is required in the special circumstances of the United Kingdom.

XXVI. *The Outlook of the World's Timber Supply.*¹

By Dr W. SCHLICH, C.I.E., F.R.S.

The subject with which I propose to deal to-night is not new. It has been discussed repeatedly at the meetings of this Society and outside. The interest which the Society of Arts has taken in forestry for more than a century is well known. Numerous papers on the subject have been read and discussed in this hall. Only a year ago my friend, Mr Hutchins, read a powerfully conceived paper on "National Forestry." In 1894 General Michael read an interesting paper on forestry. I had the honour of addressing the members of the Society in 1890 on "The Utility of Forests and the Study of Forestry." In 1884 Mr P. L. Simmonds read a paper entitled, "On the Past, Present, and Future Sources of the Timber Supply of Great Britain." As regards the special aspect of the question with which I am about to deal, Mr Simmonds's paper is, no doubt, the most important of those enumerated, because he reviews the imports and demonstrates the uncertainty of future supplies. Mr Simmonds's paper is full of interesting statistics. Since then, however, great changes have taken place, owing to the increase of population and the development of industries all around us.

As for myself, I took up the subject soon after my return from India in 1885, and in December of that year I discussed, in a pamphlet written at the invitation of the late Earl of Carnarvon, then Viceroy of Ireland, the needs of the country in this respect. In the first volume of my "Manual of Forestry," I brought the data up to the year 1889, and I enlarged the information in the second edition of that volume in 1896. Again, in March 1897, I lectured at the Imperial Institute on "The Timber Supply of the British Empire." The substance of that lecture was translated into French and published in the *Revue des Eaux et Forêts* and in the *Belgian Forestry Journal*.

So far the results of my efforts had been very small, and I determined to make a last effort of rousing the public to the importance and urgency of the cause. Hence I offered, about sixteen months ago, to prepare the paper now to be read, but

¹ Being a reprint of a paper read before the Society of Arts, London, on 27th February 1901.

as Mr Hutchins's paper had already been accepted, the Council considered that two papers on forestry in one session would be too much for the members. Since then, that is to say in June 1900, Monsieur Mélard, Inspector of Forests at Paris, has published a pamphlet on the "Insufficiency of the Production of Timber in the World." This pamphlet is drawn up on lines similar to those of my lecture given at the Imperial Institute in 1897, but Monsieur Mélard brings in a number of non-European countries with which I had not dealt, as not directly affecting the British Empire. Some of Monsieur Mélard's data referring to non-European countries and to France I have utilised ; but as regards the principal sources of supply I shall give my own figures, which in many cases differ considerably from those given by Monsieur Mélard.

In order to do justice to my task, I must give a considerable amount of statistics. For simplicity's sake I have arranged them into numerous small Tables, each of which presents a particular point. I have rounded off the figures to full thousands, a departure from accuracy which is quite inappreciable.

In some cases I could give the quantities and values of the imports and exports ; in others, unfortunately, only the one or the other.

I shall begin with Europe, and then deal with non-European countries. My data referring to the former are fairly complete, which, however, cannot be said of those referring to the latter.

I need scarcely point out that, within the space of one hour, I can only touch very lightly on many points, on which I should have liked to go into details.

The first Table to which I desire to invite your attention, is that which shows the areas classed as forests in the several European countries.

TABLE I.—*Showing the Area of the Forests of Europe.*

Countries.	Area of Forests, in acres.	Per-centage of Total Area of Country under Forest.	Per-centage of Forest Area be-longing to the State.	Forest per head of Popula-tion, in acres.
1. Sweden,	48,000,000	44	27	<u>8·9</u>
2. Norway,	17,000,000	21	12	<u>8·4</u>
3. Russia, including Finland,	516,000,000	40	61	<u>5·9</u>
4. Bosnia and Herzegovina, .	6,790,000	53	70	<u>4·9</u>
5. Bulgaria,	10,650,000	45	...	<u>3·2</u>
6. Spain,	20,960,000	17	84	1·3
7. Hungary,	22,420,000	28	16	<u>1·3</u>
8. Austria proper,	23,990,000	32	7	<u>1·0</u>
9. Servia,	2,390,000	20	...	<u>1·0</u>
10. Roumania,	5,030,000	17	47	1·0
11. Greece,	2,030,000	16	80	<u>·9</u>
12. Luxembourg,	190,000	30	...	<u>·9</u>
13. Switzerland,	2,100,000	20	4	<u>·7</u>
14. Germany,	34,490,000	26	33	<u>·7</u>
15. France,	23,530,000	18	12	<u>·6</u>
16. Italy,	10,110,000	14	4	<u>·3</u>
17. Denmark,	600,000	6	24	<u>·2</u>
18. Great Britain,	3,030,000	4	3	<u>·1</u>
19. Belgium,	1,250,000	17	5	<u>·1</u>
20. Portugal,	770,000	3	8	<u>·1</u>
21. Holland,	570,000	7	...	<u>·1</u>
22. Turkey,	6,180,000	8	...	...
	<u>758,080,000</u>	<u>31</u>	...	<u>2</u>

This Table at once introduces us to some very useful information, the main points of which may be summarised as follows:—

1. Not quite one-third of the area of Europe is classed as forest.

2. The average forest area per head of population ranges from 9 acres to one-tenth of an acre, the average being about 2 acres.

3. By way of anticipation I have underlined the areas referring to the exporting countries. Of these, only Austria-Hungary and Roumania have less than 2 acres per head of population; all other exporting countries have from 5 to 9 acres of forest per head of population.

I shall now place before you the next Table.

TABLE II.—*Showing the Net Imports and Exports of European Countries.*
(Average data, calculated from the returns of the last five years,
whenever available.)

Countries.	Quantities in Tons.		Values in £ sterling.	
	Imports.	Exports.	Imports.	Exports.
	Tons.	Tons.	£	£
Great Britain and Ireland,	9,290,000	...	22,190,000	...
Germany,	4,600,000	...	14,820,000	...
France,	1,230,000	...	3,050,000	...
Belgium,	1,020,000	...	4,100,000	...
Denmark,	470,000	...	1,250,000	...
Italy,	420,000	...	1,250,000	...
Spain,	210,000	...	1,180,000	...
Holland,	180,000	...	720,000	...
Switzerland,	170,000	...	590,000	...
Portugal,	60,000	...	200,000	...
Bulgaria,	50,000	...	50,000	...
Greece,	35,000	...	130,000	...
Servia,	15,000	...	15,000	...
Roumania, . . . . .	...	60,000	...	180,000
Norway, . . . . .	...	1,040,000	...	1,870,000
Austria-Hungary, with Bosnia and Herze- govina, . . . . .	...	3,670,000	...	10,800,000
Sweden, . . . . .	...	4,460,000	...	7,930,000
Russia, with Finland, . . . . .	...	5,900,000	...	8,900,000
Total,	17,750,000	15,130,000	50,445,000	29,680,000
Net Imports,	2,620,000	...	20,765,000	..

It will be observed that the following countries import (net) timber in a descending scale:—Great Britain and Ireland, Germany, France, Belgium, Denmark, Italy, Spain, Holland, Switzerland, Portugal, Bulgaria, Greece, and Servia. The exporting countries are Russia (with Finland), Sweden, Austria-Hungary (with Bosnia and Herzegovina), Norway, and Roumania. There is a deficiency of 2,620,000 tons for the whole of Europe.

Of the importing countries, the first four demand our special attention.

GREAT BRITAIN AND IRELAND.

Table III. will no doubt interest you.

TABLE III.—*Showing the Mean Annual Imports of Timber into Great Britain and Ireland.*

Period.	Mean Annual Imports in Tons.	Period.	Mean Annual Imports in Tons.
1864,	3,396,000	1879-83,	5,789,000
1864-68,	3,528,000	1890-94,	7,628,000
1869-73,	4,459,000	1895-99,	9,290,000
1874-78,	5,844,000	1899 only,	10,008,000

Mean annual increase of imports during 35 years, 189,000 tons. Large and continuous as this increase is, it must be pointed out that the imports have risen very rapidly of late years, as the following figures will show :—

	Tons.	Value.
Mean annual net imports, 1895-99,	9,290,000	£22,190,000
Mean annual net imports, 1890-94,	7,628,000	17,595,000
	<hr/>	<hr/>
Mean annual increase,	332,000	£919,000
	<hr/>	<hr/>
Mean annual increase in per cent. of imports,	4·4 %	5·2 %

These percentages show that the value has risen more rapidly than the tonnage ; in other words, that the mean price per ton has increased by 18 per cent. in the course of five years. In order to probe this question further, I have calculated the average prices of all coniferous timber imported during the years 1895-99, obtaining the following results :—

Average Price per Ton of Coniferous Timber Imported.

	£ s. d.		£ s. d.
1895,	1 17 7	1898,	2 2 7
1896,	1 19 10	1899,	2 3 2
1897,	2 2 2		

These data indicate a slow but steady rise in prices, equal to 15 per cent. in five years.

For the purpose of showing where all this timber comes from, I attach the following Table. (See Table IV., p. 360.)

TABLE V.—*Showing the Amount of Timber Imported in 1899.*

	Per cent. of the Total Quantity.
Coniferous Timber,	87
Oak,	3
Teak,	·5
Mahogany,	·7
Other Furniture Woods,	2·4
House and Door Frames, etc.,	3·6
Miscellaneous Timber,	2·8
	<hr/>
Total,	100·0

GERMANY.

TABLE VI.—*Showing the Mean Annual Net Imports of Timber into Germany.*

Period.	Mean Annual Net Imports in Tons.	Period.	Mean Annual Net Imports in Tons.
1842-64,	13,000	1885-89,	2,075,000
1865-69,	913,000	1890-94,	2,796,000
1870-74,	1,992,000	1895-99,	3,200,000
1875-79,	1,692,000	1899 only,	4,600,000
1880-84,	1,186,000		
Mean annual increase during thirty-five years,			131,000 tons.
Mean annual increase during the last ten years,			167,000 tons.
Value of the net imports in 1899,			£14,820,000.

The gross imports of timber into Germany in 1898 came from the following countries:—

From Austria-Hungary,	1,883,000 tons.
„ Russia,	1,831,000 „
„ Sweden and Norway,	570,000 „
„ North America,	262,000 „
Total gross imports,	<u>4,546,000 tons.</u>

Of these quantities, about 13 per cent. were hardwoods and 87 per cent. coniferous timbers.

The following additional information may prove interesting:—

Annual production of timber in the German forests,	15,000,000 tons.
Annual production of firewood in the German forests,	23,000,000 „
Total timber and firewood,	<u>38,000,000 tons.</u>
Annual gross receipts from forests,	£21,500,000
Annual costs for staff, labour, etc,	8,600,000
Annual net receipts,	<u>£12,900,000</u>

About 1,000,000 people live by work done in the forests, and about 3,000,000 people by work connected with forest industries.

FRANCE.

The following data show the mean annual net imports of timber into France:—

TABLE VII.—*Showing the Net Imports of Timber into France.*

Period.	Value of Net Imports in £.	Period.	Value of Net Imports in £.
1865,	4,640,000	1885-89,	5,189,000
1865-69,	5,584,000	1890-94,	4,493,000
1870-74,	4,249,000	1895-99,	4,032,000
1875-79,	6,588,000	1899 only,	4,053,000
1880-84,	7,828,000		

The net imports have fluctuated, but there has practically been no increase during the last thirty-five years. The mean annual quantity imported during the last five years amounts to 1,230,000 tons. The imports come from Austria-Hungary, Sweden, Norway, Germany, Russia, North America, and Switzerland. The production of the French forests is given as follows:—

Timber,	4,200,000 tons.
Firewood,	14,000,000 ,,
Total production,	<u>18,200,000 tons.</u>

The excessive proportion of firewood is due to the preponderance of coppice-woods, and coppice with standards.

BELGIUM.

	Tons.	Value.
Net imports in 1898,	1,020,000	£4,100,000
Mean annual increase in net imports since 1865,	22,000	
Mean annual increase during the last ten years, .	44,000	
Mean annual increase in 1899,	80,000	

OTHER IMPORTING COUNTRIES.

The increase in other European countries is comparatively small. The net imports of Switzerland have, during the last ten years, increased by about 17,000 tons a year, and those of Denmark by 20,000 tons. In all other countries together, the net increase may be placed at about 20,000 tons a year, or a total of 57,000 tons.

SUMMARY OF ALL IMPORTING COUNTRIES.

The total annual increase in net imports of all European countries of late years stands as follows:—

	Tons.
Great Britain and Ireland,	332,000
Germany,	167,000
Belgium,	44,000
Other European countries, say	<u>57,000</u>
Total annual increase,	<u>600,000</u>

If the same rate of increase lasts for another ten years, an additional 6,000,000 tons will be required in 1910.

It will be useful to see what the present total consumption in the four principal importing countries is. The following statement shows this:—

TABLE VIII.—*Showing the Annual Consumption of Timber in the Four Principal Importing Countries of Europe.*

Countries.	Home Production of Timber, in tons.	Net Imports, in tons.	Total Consumption in tons.	Number of Cubic Feet consumed per head of Population.
Great Britain and Ireland,	2,000,000	9,290,000	11,290,000	14
Germany,	15,000,000	4,600,000	19,600,000	18
Belgium,	600,000	1,020,000	1,620,000	12
France,	4,200,000	1,230,000	5,430,000	7
Total,	21,800,000	16,140,000	37,940,000	13

These data are based on reliable information, with the exception of the home production in Great Britain and Ireland, which has been estimated from the area of the forests and the yield of hedgerows, parks, etc. Considering that the consumption of timber in Britain has during the last twenty years increased at more than twice the rate of the increase in population, and that a similar process is going on in Germany and Belgium, I do not doubt for a moment that the consumption in the above four countries will in a few years have risen to 20 cubic feet per head of population.

I shall now proceed to deal with the exporting European countries:—

ROUMANIA.

Roumania has only about 1 acre of forest for every head of population. It has exported lately about 60,000 tons of timber annually. Even if this quantity should in the immediate future be somewhat increased, the rise, if any, will be so small that we can neglect it.

NORWAY.

	Tons.	Value.
Present annual net exports,	1,040,000	£1,870,000

Of late the major part of the exports went to Britain, France, Belgium, Holland, and to Germany.

The exports have not increased during the last ten years; on the contrary, they have slightly fallen. Of the total forest area, 17,000,000 acres, only 12 per cent., or 2,040,000 acres, are State forests, and 500,000 acres Corporation forests. The remaining 14,460,000 acres are private forests, which are worked without any legal interference on the part of the State. The manufacture of paper-pulp has assumed great dimensions, requiring annually already 1,400,000 tons of timber. A considerable portion of the forests is situated at a high altitude, where growth is slow. All authorities are agreed that the Norwegian forests as a whole have been considerably overworked, and that a decided falling-off in the export must set in almost immediately.

AUSTRIA-HUNGARY, INCLUDING BOSNIA AND HERZEGOVINA.

	Tons.	Value.
Present annual net exports, . . .	3,670,000	£10,800,000

The exports have been developed since the year 1855; they have increased during the last ten years by 158,000 tons a year, which is equal to about 7 per cent. Of the exports,—

	Per cent.
Germany received in 1897,	56
Italy received in 1897,	18
Russia and the Balkan received in 1897,	10
France received in 1897,	6
Switzerland received in 1897,	3
Other countries received in 1897,	7
Total,	100

The following data show the distribution of the forest area according to proprietorship:—

	State Forests.	Other Forests.	Total.
	Acres.	Acres.	Acres.
Bosnia and Herzegovina,	4,753,000	2,037,000	6,790,000
Hungary,	3,587,009	18,833,000	22,420,000
Austria proper,	1,679,000	22,311,000	23,990,000
Total,	10,019,000	43,181,000	53,200,000

Taking the three countries together, the average forest area per head of population comes to 1·6 acres. Of this, ·3 of an acre is State forest, and 1·3 acres private forest. The annual production of timber in these forests, of the class now exported, has been estimated at 16,000,000 tons, which is equal to 18 cubic feet per head of population, or just about the annual consumption in Germany. Taking into consideration the increase of population and the development of industries which has lately set in, the time does not seem far off when the Austrian Empire will require all the timber which her forests produce. But this is not all. Bosnia and Herzegovina, no doubt, have still considerable surplus stocks, but the forests of Hungary have been considerably overworked. Even as regards the State forests in that part of the monarchy, the Director-General of the Forests has publicly stated that the standing crop of timber is some 30 per cent. below the normal quantity, or the amount which should be present to permit of a permanent supply like that lately taken out of the forests. The condition in the private forests is still worse, so that Hungary, at any rate, must reduce its cuttings. Again, of the forests in Austria proper more than half the area is situated above an elevation of 3000 feet, so that their annual growth is small. Even now an agitation is going on in Austria for the imposition of an export duty on raw timber, so as to check it. More than half the quantity of timber exported goes to Germany, and the opinion has been expressed that that country will soon have to look elsewhere for sources of supply to meet the increasing demand for timber in its industries. In short, Austria-Hungary is not likely to remain an exporting country for more than a limited number of years. This means that Germany must more and more compete with Britain in the Baltic timber trade, thus not only reducing the supplies available for Britain and other countries, but also considerably raising prices.

SWEDEN.

	Tons.	Value.
Present annual net exports,	4,460,000	£7,930,000

The exports have just about doubled during the last thirty years; the average annual increase during the last ten years has been equal to 76,000 tons, or about at the rate of 2 per cent. The timber goes mostly to Britain, and next to France, Germany, Holland, Denmark, Belgium, Spain, and elsewhere. Sweden has

a forest area of 48,000,000 acres, of which 12,000,000 are State forests. The latter have been taken fairly under systematic management. A considerable portion of the Swedish forests are situated far north, and their growth is very slow, giving only a small annual increment. In the more accessible areas it has already been necessary to prohibit the cutting of trees of less than 8 inches in diameter at 5 feet from the ground, and a similar prohibition may soon become necessary in other areas. The manufacture of paper-pulp and cellulose is rapidly increasing, and it is estimated that at present about 1,000,000 tons of coniferous timber are annually consumed by this industry, which is rapidly growing. Nevertheless, it is probable that the present outturn may be maintained, and even somewhat increased, but by no means to such an extent as to make up for the prospective falling-away of the exports from Norway and Austria-Hungary.

RUSSIA, INCLUDING FINLAND.

	Tons.	Value.
Present annual net exports, .	5,900,000	£8,900,000

Thirty-five years ago the net exports amounted to about one-fourth, so that the mean annual increase comes to about 126,000 tons. About two-fifths of the exports come from Finland, and three-fifths from Russia proper. Of the timber, 38 per cent. goes to Britain, 32 per cent. to Germany, and the remaining 30 per cent. to France, Belgium, Holland, and other countries.

The distribution of the forest area, according to proprietorship, appears to be as follows :—

	State Forests.	Private Forests.	Total.
	Acres.	Acres.	Acres.
Finland,	20,000,000	30,000,000	50,000,000
Russia proper,	294,000,000	172,000,000	466,000,000
Total,	314,000,000	202,000,000	516,000,000

The average area of forest land per head of population is just under 6 acres.

These are large areas, and at first sight it would appear that they are sufficient to supply any deficit that may appear elsewhere. In

reality, however, matters are far less roseate. In the first place, the forest area includes enormous swampy tracts which produce little or no timber; then there are very extensive areas which are thinly stocked with alder, birch, poplar, hornbeam, etc.; so that the area of really important forests is only a fraction of that given above. Moreover, it is very unevenly distributed over the empire. There are enormous tracts with no forests at all. In and about the Caucasus we find considerable forests, but the bulk of the important areas are in the north of the empire, that is to say, in Finland, and in the adjoining provinces eastwards. It is from these parts that the coniferous timber is exported, and for all practical purposes these forests are of special interest to us. Unfortunately, information regarding their yield-capacity in the future differs very considerably, and it is not easy to arrive at a final conclusion on the question. There can be no doubt about a few points. The population of European Russia, including Finland, is now estimated at 106,000,000, and it has, of late, been increasing very rapidly. The consumption of timber and firewood in a northern country like Russia is naturally very great; indeed, in many parts of the empire it has been estimated at three tons per head of population. If this is so, by far the greater part of the forests is required for home consumption. Monsieur Mélard, whom I mentioned in the beginning of this paper, takes a most gloomy view of the situation. He says that while the population and industries are developing rapidly, the production of the forests has fallen off in consequence of the great destruction which has been going on during the nineteenth century, and he winds up by saying: "When in the middle of the twentieth century Russia will have a population of 150,000,000, when her metallurgic and other industries have attained the full development on which one may count, her exports of timber will have ceased, and she will be only too happy, if she then has managed her forests sufficiently well to find in them the timber and firewood which she requires for her own consumption."

German experts, on the other hand, take a more hopeful view of the situation. Professor Endres, at Munich, considers Monsieur Mélard's fears as exaggerated, and is of opinion that the resources of Russia are much greater than is generally supposed. I am, however, not aware that Professor Endres has personal experience of the Russian forests. Professor Mayr, of Munich, on the other hand, has lately spent some time in Russia, and given us an esti-

mate of their yield-capacity. He divided the productive forests of Northern Russia into three regions—the western, the central, and eastern. The data which he has collected indicate that the growing stock in the western region is about 60 per cent. below the normal amount, that of the central region about 30 per cent., and that the eastern region is still normally stocked. This shows that, in the more accessible areas, production has not kept pace with utilisation. At the same time he is of opinion that, if these forests were at once taken under careful and systematic management, they could, owing to their great extent, furnish considerable quantities for export. Herein lies, however, the difficulty. It will take a long time to introduce economical management and control into these vast areas, and, in the meantime, the process of deterioration is likely to go on. Finally, I desire to give a quotation from a letter lately written by the Director-General of the Russian State Forests. He sums up his remarks as follows:—“The utilisation of the Russian State forests is considerably below the annual growth, and Russia will for a long time to come be able to keep up its production; she will maintain it in proportions as large as at present without having to fear the near devastation of her forest riches.”

This, however, refers practically only to the State forests, and it is well known that enormous areas of private forests have of late years been worked out wholesale. On the whole, I cannot find any proof that Russia will be able to keep up her present export for any length of time, not to speak of a further increase. Anyhow, there cannot be any doubt whatsoever that the rate at which the timber can be delivered on board ship must rise in the same degree as the distance of transport from the forest to the sea-coast increases.

If we now sum up what has been said about European countries, it is clear that the exports from Norway have already commenced to fall off; that those of Austria-Hungary must soon follow in the same way; that Sweden may increase her exports to a moderate extent; and that Russia is at present certainly a doubtful factor. Under these circumstances the present deficiency of 2,620,000 tons is sure to increase, because the European sources of supply are not likely to meet an additional 600,000 tons required annually. Personally, I should not be surprised if ten years hence the deficiency amounted to two or three times the present quantity. Let us see, then, what non-European countries can do for us.

I have endeavoured to bring together the data of net exports of as many non-European countries as possible, nevertheless the Table which now follows is incomplete :—

TABLE IX.—*Showing the Imports and Exports of Non-European Countries.*

Countries.	Net Imports.	Net Exports.
	Tons.	Tons.
South America,	330,000	...
Egypt,	200,000	...
Australasia,	160,000	..
Cape of Good Hope,	150,000	...
Natal,	50,000	...
China,	50,000	...
Mauritius,	20,000	...
Ceylon,	10,000	...
Japan,	5,000	...
West India, Mexico, New Guinea, Honduras, . . . . .	...	13,000
West Coast of Africa, . . . . .	...	28,000
India, . . . . .	...	55,000
United States of America, . . . . .	...	1,020,000
Dominion of Canada and Newfoundland, . . . . .	...	2,144,000
Total,	975,000	3,260,000
Net Export, . . . . .	...	2,285,000

This Table shows a surplus of exports amounting to 2,285,000 tons. Compared with the deficit of European countries (2,620,000 tons), a deficiency of 335,000 tons will be noticed. It is due to the incompleteness of Table IX., such countries as Siam, Java, Madagascar, and others not being represented. Besides, in some cases I had to estimate the tonnage from the values.

Dealing first with the importing countries, it may be said that South America is likely to continue its imports, which consist of light coniferous woods. Egypt has no timber of its own, and the imports are sure to rise with the further development of the country. As regards Australasia, it should be stated that New South Wales, Victoria, and South Australia have of late imported timber in considerable quantity, whereas Western Australia, Tasmania, Queensland, and New Zealand have exported, there being on the whole a balance of 160,000 tons annually against Australasia. The exports from Western Australia have quite lately considerably increased, and they are likely to increase further. At the same time these timbers are hardwoods, of which a certain quantity will find a market in Europe, but they will never make

up for a decrease in the light coniferous woods, apart from the fact that, up to date, it has not been possible to lay them down in European ports under £4 a ton, or about double what the coniferous woods cost us.

The imports into the Cape of Good Hope have steadily increased of late, and they are likely to increase further, owing to the political changes which have lately taken place, and the more rapid development of the mining industry, once the war has been brought to a conclusion. Natal is similarly situated.

China is a country which demands our special attention. So far her imports have been small, but she has little timber of her own, and the imports must increase in the same degree as her commerce develops. It is, perhaps, impossible to say when the great rise will commence, but all the signs of the times seem to indicate that it will be soon. Once the country has been opened to foreign commerce and industries, China will require, owing to her size, enormous quantities of timber, which will come from the western ports of North America, and perhaps from Asiatic Russia.

Japan has made great efforts to introduce systematic management into her forests, but she figures in our Table already with a small net import. With the rapid development of industries, Japan will require more and more timber, which her own forests will not be able to furnish.

Taking the importing non-European countries together, there can be no doubt whatever that their net imports will increase as time goes on.

The exporting non-European countries are those around the Caribbean Sea, the West Coast of Africa, India, the United States of America, and Canada. The first of these export mahogany and other furniture woods, but they import so much lumber that their net exports dwindle down to 13,000 tons a year. The West Coast of Africa has exported 28,000 tons, consisting also of mahogany and other hardwoods, valued at more than £9 a ton. Whether that export will continue or not, it is difficult to say, but under any circumstances these timbers are so expensive that they do not affect the question here under discussion. British India sends teak and some furniture woods; more it cannot do, having, with a forest area which may be placed at 140,000,000 acres, to supply a home population of some 250,000,000 people.

There remain, then, the United States of America and Canada.

Before dealing with these countries I propose to devote a few minutes to inquire whether other sources are available. The only countries which we need at all consider are Asiatic Russia, Central Africa, and South America. The first of these three is a big country, it contains extensive areas which are classed as woodlands; but a great part of the country is practically situated beyond the limit of profitable tree-growth, while other extensive areas are plains without forest. Supposing, however, that there is a surplus of production for export, the cost of transport would be practically prohibitive. The outlets by water are towards the North Polar Sea, involving exceedingly difficult navigation, and if transported by land towards the west, the distance would be very great. It is, however, not impossible that any surplus timber might hereafter go towards China.

Africa has a belt of wooded country along or near the west coast, which furnishes us, as already stated, with a limited quantity of valuable hardwoods; but from all I can learn the great central forest will, as regards a source of timber supply for Europe, remain without much value. A brisk trade in caoutchouc has sprung up, but the timbers are not of the kind which we require in Europe in large quantities, apart from the cost of transport to the coast. Matters are similar in South America. Vast forests are said to exist in Brazil and in parts of Argentina, but, as far as we know at present, they contain only hardwoods of any commercial value, of which we have as yet a sufficient supply at lower rates nearer home. At any rate, the cost of transport and labour seems to be so high that Argentina at any rate prefers importing its timber from North America and the Baltic rather than get it from her own forests. Possibly the forest wealth of South America may hereafter play a part in the supply of timber, but I believe that that time is far distant.

I now come to the most important part of my subject, namely, the position which the United States of America and Canada take in the timber supply of the world.

THE UNITED STATES OF AMERICA.

It will be remembered that I have put down the net export of late years as equal to 1,020,000 tons. This is an estimate derived from the values. The latest return issued by the Bureau of Statistics, Treasury Department, Washington, entitled "The

Lumber Trade of the United States," forms part of the papers published in connection with the recent census. It contains the following information :—

TABLE X.—*Imports and Exports of Wood and Manufactures of Wood compared.*

Period.	Imports. Value in £.	Exports. Value in £.	Net Exports. Value in £.
1886-88, . . .	2,662,000	4,224,000	1,562,000
1889-91, . . .	3,520,000	5,430,000	1,910,000
1892-94, . . .	4,077,000	5,345,000	1,268,000
1895-97, . . .	3,928,000	6,579,000	2,651,000
1898-1900, . . .	3,264,000	8,640,000	5,376,000
Average of 15 years, . . .	3,490,000	6,043,000	2,553,000

This Table gives the value of timber and manufactures of wood. Unfortunately, separate returns for timber only are not available. It will no doubt cause surprise to see that more than half the exports were made good again by imports, chiefly from Canada. There has been a falling off in imports during the last three years, due to customs differences between the two countries. The sudden increase in the exports during the last five or six years is said (in the "Report") to be "the consequence of the high appreciation which European communities place on their timber resources, and the increased dependence on the American lumber supply." It is added that during the last year much English and German capital has gone into American timber-lands. This explanation is correct in a way, but I should express it somewhat as follows:—The timber requirements in Europe, especially in Britain, Germany, and Belgium, have so rapidly increased of late years, that the European sources, that is to say, Russia, Sweden, and Austria-Hungary, can no longer meet them, hence the increased demand on America. This, more than anything else, proves to me that any increase in the exports from Russia and Sweden will be limited.

The question then arises, Can the United States meet this increased demand for any length of time? I am quite sure that this will not be possible, as the following data will show:—

The total wooded area is given as 700,500,000 acres, being equal to 37 per cent. of the total area, and giving an area of nine acres per head of population. The timber standing on this immense area has been estimated, and it is given by one of the foremost authorities as equal to 3,450,000,000 tons (reckoning a ton equal to 400 feet board measure), which gives not quite five tons per acre all round. In France, Germany, and Austria this would be called about one-tenth of the average full stocking: hence the United States forests would, as regards their yield-capacity, for the next half century be equal to about 70,000,000 acres in France, Germany, or Austria.

The lumber cut in 1890 is given as equal to 63,000,000 tons, and it was calculated that the existing stand of timber would last for about fifty years. For the year 1899 the cut is given as follows:—

Coniferous timber,	.	.	.	75,000,000 tons.
Oaks and other hardwoods,	.	.	.	25,000,000 „
				100,000,000 „
Total,	.	.	.	100,000,000 „

At this rate the available stand would last only about thirty-four years. If during the next ten years the annual cut increases at the same rate as in the past ten years, it will amount to 137,000,000 tons, and the remaining stand will be consumed in about twenty-five years. Again, the annual production has been estimated at 75,000,000 tons, so that the present annual consumption exceeds it by 33 per cent. It is stated that besides the cuttings, large quantities of timber are destroyed annually by fire and other sources of loss, so that it is altogether probable that the annual growth is considerably less than the annual destruction. This means that the United States consume annually not only the legitimate growth or increment, but also a portion of their capital, a process which must inevitably lead to bankruptcy if it is not stopped at an early date. The seriousness of the position has fortunately been recognised, and efforts are being made to introduce more conservative lumbering, and to protect the forests against ravages by fire and grazing.

First an enlightened man here and another there drew attention to the matter. Soon numerous people took up the cry, societies were formed, which collected information and made it available for the general public. The State Governments next took steps to prevent destruction by fire, and to save certain areas from ruin by

converting them into State parks, etc. The Federal Government established a Forestry Division, whose duty was in the first instance to collect information. Some twelve years ago a wealthy young American, Mr Gifford Pinchot, came to study forestry in Germany and France, and he has been followed by half a dozen others, all of whom have made their studies under the enlightened guidance of my old friend, Sir D. Brandis. Soon after Mr Pinchot's return to America, Mr George Vanderbilt bought a forest estate of 100,000 acres, and put it under systematic management, first by Mr Gifford Pinchot, and then by a distinguished young German forest officer, Dr Schenck, with the main object of showing that forests can be worked profitably. About two years ago Dr Schenck started a forest school in connection with Mr Vanderbilt's estate, and last summer I had the pleasure of conducting six of his pupils through some of the most interesting Bavarian forests, these young men having come to learn how forest matters are managed in the old country. But this is only one instance. At the present moment forest faculties exist at three American universities. One of these has been endowed by the State of New York, who have assigned 30,000 acres of forest for the practical instruction of the students. The State of New York has spent £450,000, since 1897, on the purchase of forest lands, the total area so far acquired being 1,000,000 acres.

At another university a faculty of forestry has been endowed by Mr Gifford Pinchot and his family, who have presented the university with the sum of £30,000 for the purpose. But over and above this, instruction in forestry is now given at about forty other educational establishments in the States.

Last, but not least, the Federal Government has inaugurated a systematic forest policy. An area of 41,000,000 acres have, by presidential proclamation, been declared "reservations," and a staff of 9 superintendents, 39 supervisors, and 350 forest rangers have been appointed. It is said that the patrolling of the reserved forests by the rangers has to a marked degree reduced the number of fires, has excluded timber trespassers, and enforced instructions regulating the subject of sheep-grazing, timber-cutting, and sales. All this is a small beginning, but it is a promising instalment; and if the Federal Government persists in its policy, great benefits for the people of the United States, the lumbering and wood-using industries, will result, while the fear of a prospective timber famine, which has laid hold of the mind of many enlightened

Americans, may yet be avoided. At any rate, it seems clear that the people of the United States are determined to preserve and adequately manage a sufficient area of forests for the benefit, not only of the present generation, but for their children and grandchildren. Surely these are facts worth pondering over!

THE DOMINION OF CANADA.

Tons.

Mean annual net export of late years, 2,144,000

The value of the exports during the last thirty years have been as follows:—

TABLE XI.—*Showing the Value of the Exports of Timber from the Dominion of Canada.*

Period.	Annual Export in £.				In Per Cent.		
	To Britain.	To the United States.	To other Countries.	Total.	To Britain.	To the United States.	To other Countries.
1870-79,	2,627,000	1,481,000	428,000	4,536,000	58	33	9
1880-89,	2,212,000	1,876,000	389,000	4,477,000	49	42	9
1890-99,	2,493,000	2,427,000	327,000	5,247,000	48	46	6

Of the exports, 94 per cent. are coniferous timbers, and 6 per cent. hardwoods. The increase during these thirty years, according to value, has been at the rate of about $\frac{1}{2}$ per cent. a year.

The price per ton has, however, risen since 1870. Taking white pine squared logs, for instance, the average prices were as follows:—

Period.	Average Price per Ton in Shillings.
1870-79,	32
1880-89,	47
1890-99,	61

The rise in the price of other timber has been much smaller, but sufficient to show that the total quantity of timber exported is now less than it was thirty years ago.

Canada has not been able to meet the increasing demand in Europe. The above figures, moreover, show that whereas the exports to Britain have fallen, those to the United States have increased, so that practically the two countries now take equal quantities. A moderate reaction has, however, taken place during

the last three years, owing to differences between Canada and the United States regarding the duty to be paid on timber. The exports are chiefly represented by raw material. On the other hand, Canada imports worked-up timber, chiefly from the United States, valued as follows:—

Period 1885-89, mean annual value, . . .	£497,000
„ 1890-94, „ „ . . .	£548,000
„ 1895-99, „ „ . . .	£639,000

These imports have steadily risen.

It is of the highest importance to inquire into the yield-capacity of the Canadian forests. The following Table shows their areas:—

TABLE XII.—*Showing the Area of Forest in the Dominion of Canada.*

Provinces.	Area of Woodlands in Acres.	Percentage of Woodlands to total Area.	Area per head of Population in Acres.
Prince Edward's Island, . . .	510,000	40	5
Nova Scotia,	4,137,000	31	9
New Brunswick,	9,450,000	53	29
Ontario,	65,356,000	46	31
Quebec,	74,573,000	51	50
Manitoba,	16,401,000	40	107
British Columbia,	182,755,000	75	1,885
Territories,	446,049,000	29	4,506
Total,	799,231,000	38	165

In round figures, Canada has 800,000,000 acres of land classed as forests, but it has been stated by the Chief Inspector of Timber and Forestry for Canada that only one-third of the area, or 266,000,000 acres, can be considered as timber-lands, the rest being covered with small growth, of some use locally, but of little, if any, merchantable value. The area of timber-lands and the quota per head of population are so great that no failing of future supplies should be possible. Nevertheless, Mr George Johnson, the Statistician of the Dominion, gives anything but a flourishing account of the state of affairs. The white pine used to be the principal item in the exports. It has now fallen to one-fifth of the amount of thirty years ago, spruce having gradually taken its place. Of the latter species, enormous quantities are said to exist, but

cutting has developed so rapidly of late, that, as regards Ontario, it is stated, "its increasing use for the manufacture of wood-pulp threatens serious inroads upon this valuable tree." The third of the most important trees, the Douglas fir, has its principal home in British Columbia; it appears in commerce as Oregon pine.

From a commercial point of view the forests of Canada must be divided into two parts—the *eastern*, which supplies chiefly the United States and Europe; and the *western*, which exports also to the United States, to Asia, Australia, and other countries. As already stated, the eastern half has not responded to the extra requirements of Europe, and I doubt whether Canada will be able to do so in the future, unless decided steps are taken at once to start thorough protection and systematic management on selected areas, or, as they may be called, reserved State forests. Mr Johnson says:—

"A large portion of the (eastern) forests has been devilled, which means that all good trees have been cut out by the lumbermen for marketable timber. The careless torch has lighted fires like the Miramichi fire, which swept with fierce energy over an area of more than three million acres, leaving blackened giant pines to be a reminder, for more than half a century, of the immense destruction there and then caused. Vast areas have suffered from fire so severely that in many places the soil has been burned off to the very rock; and a century's disintegrating force will have to act upon the rock before there can be soil enough created for practical uses."

Again, Mr Edwards said, in 1893, in the Canadian Parliament:—

"It is safe to say, and I am sure that every lumberman in this House will bear me out in that statement, that *ten* times the amount of forest wealth has been destroyed in Canada through forest fires than has been cut by the lumbermen."

The cuttings in 1893 were estimated to amount to 40,000,000 tons, and if Mr Edwards is right, the annual destruction would amount to 400,000,000 tons, or considerably more than the existing timber area produces. This is not a nice state of things to behold. Since then the forest question has attracted more and more attention. Measures have been taken to introduce a more economical system of lumbering and to check fires. But what can a small establishment do over vast areas? Taking Quebec,

for instance, each fire district comprised, three years ago, an area of three and a half million acres of wood-lands. This is not the way to proceed if real success is to be achieved. The Governments of the several provinces must make up their minds to *select and demarcate a sufficient proportion of the area as reserved State forests*, and gradually bring them under complete control, with a rational and systematic management. Considering the large areas available to choose from, there should be no difficulty in permanently reserving an area of 100,000,000 acres, which would still leave 700,000,000 acres open for more or less unrestricted lumbering, extension of cultivation, etc. The annual revenue derived from the Canadian forests amounts, at least, to some £700,000. If half that sum were devoted to the above purpose, substantial progress could at once be made to secure not only the present, but an increased outturn for any length of time, leading ultimately to a revenue tenfold, and more, the present amount, and securing a permanent supply of coniferous and other timber for the world.

As to the large stocks of timber in Columbia, any surplus over home requirements will all be taken by China, when once that immense empire has entered upon an era of development.

It has been stated in official publications that more than £20,000,000 have been invested in the Canadian lumber and saw-mill industry, and that some £5,000,000 are paid annually in wages. Surely these are sums not to be trifled with, apart from the fact that under a proper system of forest management they would be capable of developing in the course of time to two and three times the present amounts.

So far I have hardly touched upon a very important matter, the manufacture of paper stuff, or pulp and cellulose. There is some difficulty of getting at the actual quantities of timber consumed by that industry. Those used in importing countries, like Britain, Germany, France, and Belgium, are included in the data given for those countries. As regards exporting countries, it is stated that—

	Tons.
Sweden uses now annually	1,000,000
Norway ,, ,,	1,400,000
Finland, ,, ,,	200,000
Canada, ,, ,, about	1,200,000
Total,	3,800,000

As regards the United States, it should be stated that a portion of the pulp-wood comes from Canada, but over and above this the quantity derived from the State forests must be very great. For Maine alone the quantity is given as equal to 750,000 tons. I do not think that I shall be far out if I place the total annual consumption of pulp-wood at some 7,000,000 to 8,000,000 tons.

In summing up now, I may say that I tried to give an uncoloured view of the whole question. Of hardwoods I may safely say that we have as yet a large supply. If present sources of supply should fail, others, such as Central and South America and Africa, may be opened out. The rate per ton may rise, but the material will be forthcoming. It is altogether different as regards coniferous woods, the requirements of which amount to not less than 85 per cent. of the total. The only countries whence a further increase in the demand for these woods can be met are Sweden, Russia, especially Finland, and Canada. As pointed out, Austria and the United States must cease to be exporting countries within a limited number of years. Sweden is likely to yield somewhat more in future, but the amount of the possible annual increase is not likely to be more than 1,000,000 or 1,500,000 tons. Great uncertainty exists as regards Russia. If her population increases, as statisticians have lately calculated, even her export of timber may cease, or at any rate be considerably reduced. Under these circumstances, the great stand-by for coniferous timber will be Canada, if the Government does not lose time in introducing a rational management of her forests.

The second part of my paper will be short. In it I propose to draw attention to a few lessons which may be learned from what I have said, as regards the British Empire as a whole, and these islands in particular. The following Table shows the average annual net imports and exports of the principal parts of the Empire :—

TABLE XIII.—*Showing the Net Imports and Exports of Timber into and from the British Empire.*¹

Countries	Annual Average during the Years 1890-94.		Annual Average during the Years 1895-99.	
	Imports. Value in £.	Exports. Value in £.	Imports. Value in £.	Exports. Value in £.
Great Britain and Ireland,	17,595,000	...	22,190,000	...
New South Wales, . . .	467,000	...	311,000	...
Victoria,	831,000	...	231,000	...
South Australia, . . .	250,000	...	198,000	...
Ceylon, . . . . .	...	22,000	21,000	...
Mauritius,	41,000	...	37,000	...
Natal,	99,000	...	176,000	...
Cape of Good Hope, . .	160,000	...	416,000	...
Jamaica,	57,000	...	55,000	...
Barbadoes,	65,000	...	33,000	...
Trinidad,	41,000	...	40,000	...
British Guiana,	41,000	...	27,000	...
Queensland, . . . . .	...	11,000	...	5,000
Tasmania, . . . . .	...	39,000	...	29,000
Western Australia, . . .	...	114,000	...	77,000
New Zealand, . . . . .	...	151,000	...	146,000
British India, . . . . .	...	682,000	...	593,000
West Coast of Africa, . .	...	22,000	...	70,000
British Honduras, . . . .	...	142,000	...	130,000
Dominion of Canada, . .	...	4,470,000	...	4,835,000
Total,	19,647,000	5,653,000	23,735,000	5,885,000
Net Imports,	13,994,000	...	17,850,000	...
Increase in 5 years, . . . . .	...	...	3,856,000	...
Average Annual Increase, . . . . .	...	...	771,000	...
Average Annual Increase during previous 5 Years (period 1885-89 compared with period 1890-94),	...	...	382,000	...

It will be observed that the value of the annual net imports into the empire amounted during the

Period 1895-99 to	£17,850,000
Period 1890-94 to	£13,994,000
Increase,	£3,856,000
Or an average annual increase of	£771,000
Annual increase in the previous five years,	£382,000

These data are worthy of our most serious consideration. With all the forest wealth of our colonies we import now every year timber valued at close on £18,000,000, and the sum has lately risen at the rate of £771,000 annually. Surely the time has come, or rather it came some time ago, for a more vigorous forest policy on sensible lines throughout the Empire. Let us strive to introduce systematic forest management, more particularly into

¹ A few Colonies have been omitted for want of data.

Canada and Australasia. The question is, no doubt, beset by great difficulty, but where there is the will there is also a way. Above all, let the self-governing colonies consider a little more seriously than up to date, the magnificent example which has been set to them by India, where the preservation of the State forests has now been put on a safe basis, for the everlasting benefit of the people of the country and the Indian exchequer. This is a case on which I should have liked to enlarge had time permitted it.

But should we not begin by setting our house at home in order before we go and preach abroad? The imports into the United Kingdom in 1899 are valued at £25,000,000, and they have increased of late years at the rate of 332,000 tons, valued at £919,000, annually. I think I have said enough to-night to show on how precarious a footing future supplies rest.

The price of timber is steadily, though slowly, rising, and 87 per cent. of the total imports consist of pine and fir timber, the sources of which are specially exposed to exhaustion. Whence are we to obtain the 9,000,000 or 10,000,000 tons of coniferous timber, when the countries round the Baltic, and perhaps also Canada, have commenced to fail us? These are the timbers which form the very staff of life of our building trade, and a deficiency of supply in this direction must have the most serious effect upon the population of these islands. And all the time we have sufficient, and more, surplus land at home to produce all this timber without putting a single acre out of cultivation. There are 12,000,000 acres of waste land and 13,000,000 acres of mountain and heath land to choose from the necessary 6,000,000 or 7,000,000 acres. Surely £25,000,000 going out of the country every year is money enough to take some trouble about. Only a few weeks ago *The Times* drew special attention to the fact that our imports greatly exceeded the exports, a circumstance which fills a good many people with misgivings. And here is an item valued at £25,000,000, which could be produced at home, going begging.

Whenever measures of extended afforestation have been urged, the reply has generally been that the British woodlands are maintained for other purposes, and not for economic reasons, and that woodlands in these islands do not pay. As regards the first of these two arguments, very well, let it be so. I do not want to touch a single acre of the existing woods (though they could be so managed as to give a revenue, without interfering with shoot-

ing, etc.), let them continue to serve as game preserves and adornments of the landscape. What I do urge is the creation of *additional* woods on surplus lands to be managed on economic principles, for the production of timber and other forest produce. To make such a movement a success, it is, however, necessary to dismiss, once for all, the idea that anybody can manage woodlands so that they may be financially successful. People must learn that successful forestry must be based on research, at least as much as agriculture. At Coopers Hill we educate the forest officers required for India, and we have also trained three for Cape Colony, one for Ceylon, and one for Mauritius. But the study at Coopers Hill is so arranged as to meet the requirements of India, and the expenses connected with the course are necessarily high. The college belongs to the Government of India, which cannot be expected to provide for the education of forest experts, who will either go to the colonies or be employed in the United Kingdom.

Efforts have been made towards giving instruction in forestry at other places, as in Edinburgh; but what we require is at least one well-equipped forestry faculty at a university, such equipment to include a suitable practical training ground. In addition, sylvicultural schools are wanted, where men of less pretensions may be educated to fill the posts of foresters on private estates of limited extent. Such a school has been started in connection with the Royal Botanic Garden at Edinburgh, and it would not be a difficult task to develop it, and to start others in England and Ireland. I believe that landed proprietors would pick up the men trained at such schools to carry out the plans which experts have prepared for them. It gives me real pleasure to state here that plans of operation (or working plans, as foresters call them), which I prepared three years ago for His Grace the Duke of Bedford's forests in Devonshire and at Woburn, are being followed and carried out by intelligent foresters. Once a year I visit each locality, check the work of the past twelve months, and indicate what should be done in the ensuing year. The effects of such operations are naturally slow in showing, but I am satisfied that they will lead to a considerable improvement in the yield-capacity of these forest estates. As in agriculture proper, so in forestry, His Grace is leading the way, which other proprietors will do well to follow.

The difficulty about extended afforestation in the United

Kingdom lies in the fact that the waste lands available for planting are almost entirely private property, and that most of the proprietors are either unwilling or unable to invest money in an undertaking which will commence giving a return only after the lapse of a series of years. They prefer a present small rent from shooting to an increased income from forests hereafter. Let us hope that the Government and enlightened proprietors will succeed in overcoming the difficulty. It is indeed easy to show that millions of acres, which now yield a grazing revenue of a few pence an acre, or shooting rents of perhaps eighteenpence a year, could be made to yield a net revenue, after allowing compound interest for all outlay, of ten shillings and more, if put under forest in a sensible and economic manner. With a view to inducing owners to plant, Government might help in various ways. Advances for the purpose might be given, to be recovered in the shape of a sinking fund; afforested lands might be exempt from taxation for a number of years, that is to say, until the first thinnings commence; in other words, forests should be taxed according to the income which they yield, and not the area which they occupy. In other cases, as in the congested districts of Ireland, and probably also in Scotland and Wales, if not in England, surplus lands might be acquired by the State and put under forest. Under the existing land laws, the Congested Districts Board of Ireland purchases estates. After settling all occupied parts with the tenants, considerable areas of waste land remain over, which should be converted into State forests. This is a matter which I pressed upon the Government of Ireland fifteen years ago. There are at least two million acres of such land available in Ireland, and still larger areas in Scotland, not to speak of Wales and even England. By afforestation, additional labour would be required in rural districts, and help to reduce the eagerness with which the younger part of the rural population now flock into the great cities, where only too many are destined to swell the large army of the unemployed.

This brings my review of the outlook of the world's timber supply to an end. It is a question which has occupied me ever since I came back from India sixteen years ago. So far not much progress has been made in impressing the importance of the subject upon the people and the Government of this country. I can only hope that this, my last appeal, will be more fruitful in its effect than has been the case with my previous efforts.

XXVII. *Insufficiency of the World's Timber Supply.*¹

Mons. Mélard, Inspector of Forests in the service of the French Republic, thus concludes his recent work on the above subject:—

This long review of the forest resources of our globe leaves a feeling of sadness almost amounting to anguish. It is sad to think of so much wealth gone for ever, dissipated by the carelessness and greed of men, when care and due protection would have preserved and improved it. These riches have profited little to those who have squandered them. Forest destruction, however profitable to contractors, dealers, and carriers, seldom leaves much profit to the landowner. The price of wood sold in distant markets consists of 90 or 95 per cent. for costs of felling, transport, wages, etc., and 10 per cent., or only 5 per cent. or less, for the owner.

There is cause for serious anxiety in the fact that 215 millions of people—the most advanced and powerful nations of Europe in commerce and industry—cannot find timber to meet their needs within their territories. Outside Europe, ancient empires like China, equally with young and unlicked cubs like South Africa, Argentina, Australia, etc., have alike to face a serious and growing deficit of wood-production.

There are but seven countries at present able to supply large quantities of timber. Five are in Europe, viz., Austria-Hungary, Sweden, Norway, Finland, and Russia; two are in North America, viz., Canada and the United States.

It has been shown that the available surplus of Austria-Hungary, of Russia, and of the United States is seriously threatened by increase of population and by industrial development, and that of Norway by the abuse of the axe. There remain only three sources of supply in which confidence can be placed for yet a little time. These are Sweden, Finland, and Canada.

They are absolutely and hopelessly insufficient.

If Sweden, Finland, and Canada were to attempt to supply all the countries which reach out their hands for timber,

¹ Translation by F. Gleadow, I.F.S., F.R.M.S., of "L'insuffisance de la production des bois d'œuvre dans le Monde," par A. Mélard, Inspecteur des Eaux et Forêts (from the *Indian Forester*, September 1901).

their normal production, and their forests too, would be disposed of completely in a very short time, revenue and capital alike.

A timber famine is thus within sight.

The rise in forest produce, especially high-class produce, which must be expected, will only serve to hasten the evil day. Wood-production, in which *time* is the principal factor, indeed obeys economic laws other than those which govern industrial or agricultural production. As a general rule, any increase of price paid by the consumer has the effect of stimulating production. But in the case of wood-produce, an increase of price incites thoughtless owners to realise the capital slowly accumulated by preceding generations. Hence an increased demand means increased destruction of capital, and consequent diminution of permanent revenue (or legitimate output) in timber.

The situation is therefore full of peril, and the need of instructing public opinion is urgent.

Wherever it is not too late, the destruction of forest must be stopped, either by legislation firmly and strictly applied, or by persuading landowners that their true interest lies in safe-guarding their capital or timber-producing (revenue-producing) stock, and in cutting no more than the annual production of the soil, which is the revenue or (timber) interest on the (timber) capital. The pleasant and evil fiction, that a new country should be "developed" by destroying its forests, must be reprovod. The production of timber should be the aim of every cultural operation and working plan whenever possible. Formerly it was held that private owners could not undertake the production of timber, because of the low rate of interest returned by a capital invested in high forest. Now that the customary interest on stable securities has got below 3 per cent., and is likely to go still lower, the conditions are changed. It seems probable that a private owner can now keep standards over coppice at a profit at least equal to what he would get from other securities. He can also in his fir woods grow sawyer's timber returning him 2 or 3 per cent. on the capital involved, without reckoning anything for the very certain rise that must take place in the price of timber. These ideas are not generally received, and should be as widely spread abroad as possible.

The increase in the value of timber will also doubtless contribute to diminish waste and induce care in the disposal of the

material, so that nothing is used as firewood that can possibly be utilised as timber.

Forest property should also not be burdened with taxes inflicted on the pretext that forest-owners are rich, for such an idea is inaccurate. There are in France forests taxed up to 25 per cent. and 20 per cent. of the gross revenue, and yet, notwithstanding this heavy contribution towards public expenses, these properties receive no kind of public protection, and the owners are obliged to pay private guards. This undue taxation of forest property seems to be the custom in other countries also, for Gifford Pinchot attributes to this cause the rapid destruction of certain forests in the United States. "These taxes are very heavy, for in many cases they annually amount to 5 per cent. or 6 per cent. of the sale value of the forest, so that owners are unable to both pay the taxes and keep the forests. Consequently they are driven to cut or sell their forests as soon as may be, without care for the future. When the wood has been removed, the owners refuse to pay any more taxes, and the ruined lands are resumed by the State.¹ Many thousand square miles of forest have been devastated by unbridled fellings, because the heavy taxes obliged the owners to make a clear sweep of their woods instead of managing them so as to maintain a perpetual income." ("Primer of Forestry," by Gifford Pinchot.)

There is not a country in Western or Southern Europe which has not thousands, or perhaps millions of hectares of waste land, or land whose agricultural possibilities have come to an end. All these lands should be afforested.

The State ought to be very liberal indeed to forest-owners, by exempting them from taxation, by free distribution of seeds and seedlings, and by offering them gratuitously the advice of its technical officers.

It should not hesitate to acquire parts of such lands.² Purchases of hilly tracts where torrents exist are certainly very

¹ Compare the cases of Oudh and elsewhere, where Government granted large areas of excellent forest to individuals on condition of their bringing it under cultivation. These astute gentry at once cleared the land bare of forest, put the proceeds into their pockets, and sat smiling contentment, till it pleased Government to pass orders that, as the experiment had failed, the land might be resumed.—*Translator*.

² Compare the action of the Bombay Government in disforestry by indirect means vast areas just where forest is most needed by the people.—*Translator*.

useful, and should be persisted in because they fulfil an important public object. But such purchases are rather works of defence against the forces of nature than investments in timber forests. Occasionally, no doubt, rich forests may be found on the borders of a torrent or on precipitous country, but their proper and natural place is in the plains, on the plateaux, or on mountains of moderate character. It is there that oak or fir forests should be maintained. Formerly the idea was to clear the plains and plant the mountains. It was a mistake. Forests are no less needed in the plains than in the hills. The plains furnish timber that cannot be obtained from the hills, and all plains are not good for agriculture.

There is not a moment to be lost. Forest produce cannot be procured at a moment's notice like a loan of cash. It requires a century or a century and a half to produce sawyer's timber, and the famine will begin ere fifty years are past.

XXVIII. *The Arboricultural Adornment of Towns.*

By R. C. MUNRO FERGUSON, M.P.

Opinions differ as to the progress of Arboriculture in our landward districts, but all agree that in the burghs it is an infant art. A book was once written comparing the parks and pleasure-gardens of Paris with those of London; another might compare those of Edinburgh and Carlisle, Dundee and Glasgow, with those of Weisbaden and Munich, Copenhagen and Nancy. Weisbaden is a good example of how even an industrial town may have attractive surroundings. Edinburgh is justly famous for its beautiful site, which is incomparably finer than that of any of these, but its climate is not in such high repute. Has not Miss Ferrier truly observed that "an east wind on the east coast of Scotland is a thing which may have been felt, but which has never been described"? Yet, even in Scotland, it is evident from what can be seen in the Royal Botanical Garden—a site by no means favourable to the growth either of trees or shrubs—that many of the varieties that flourish there form a striking contrast to the stunted, grimy, withered Scots elms which are the standard adornment of our streets and public places. In London, where dirt and smoke certainly exceed anything of the kind in Edinburgh, we find the poplar and some *Acers* flourishing as luxuriantly as in the country, and the English elm, lime, chestnut, and thorn do fairly well. Even in London we cannot have *Acacia* or *Paulownia* avenues as in Paris, yet it is certain that several varieties of trees will do better in our towns than the elm and such like scarecrows with which we are too familiar.

That some shade is needed in our streets and public places is shown by the fact that though the heat of Edinburgh is less appreciable than that of London, the glare of Princes Street or of Leith Walk is as depressing as that of any other of the world's thoroughfares. Nor would our architecture, infinite in variety as it is, suffer from the relief which the foliage and outlines of trees would afford to the exuberance of our masonry. Much of the beautiful work already accomplished in the parks and botanical gardens around London and Dublin could be successfully reproduced in Scotland. It is true that the State is more generous in financing the pleasure-gardens of the other capitals, but were the Scottish people sufficiently appreciative and demonstrative, we need not despair of local effort being better supported.

What is possible in the town becomes comparatively easy in the surrounding district. The expanding city clears away the trees and gardens which constituted its early environment; and whilst many of the old trees which might be left standing are not spared, little effort is made to curb the devastation of the building speculator, or to replace those trees that are inevitably removed. If half the zeal were habitually shown in this direction that was once exhibited when the Caledonian Railway Company proposed to extend its line along Princes Street, to the possible loss of a few arboricultural deformities, our streets would present a different appearance. With rare exceptions, the lack of any attempt on the part of municipal authorities to adorn our suburban areas is enough to depress the most enthusiastic of collectivists, because whatever attempts at planting we find in such districts are the result of private rather than of municipal effort.

Again, there is no reason why the approaches to towns, along the main roads, should not run through close avenues, or through open ones bordered with hedges, a system which Lord Mansfield has recently put into practice along the high road as it enters Perth. Abroad, roads are often lined with fruit-trees, which bear their fruit without molestation from the passer-by. Our own youth are at present little better than a horde of Huns on the highway; for when a tree is planted at the cost of two or three pence, it takes two or three shillings to afford it a necessary protection, which, whatever its form, detracts from the beauty of all planting. In no respect do the suburbs of American towns more surpass our own than in the absence of railings and other similar monstrosities. A remedy for the destructive tendencies of the British barbarian is to teach botany in the schools, coupled with botanical excursions on the foreign system, and to extend gardens and pleasure-grounds, which teach people to care for and to safeguard plants and flowers. The approaches to towns have, owing to the increase of bicycles and motors, become once more frequented highways; and nothing would be better calculated to break up the monotonous effect of the "dambrod" pattern into which our cultivated area is divided, than the planting of good beech and other hedges, with oak standards, to border the roads.

The divorce of the Scottish population from the soil could be mitigated by some adequate system of allotments and small holdings round the towns, a feature which is so characteristic of most Continental and of some English cities. In France especially, a

large proportion of the townspeople own their gardens or small holdings, and there enjoy Sundays and holidays.

Even here the well-to-do city man often spends the week-end in a country home, which adds not a little to the amenity of the district he frequents. But what makes the difference so marked between life in a Continental and a British city is the exodus—in the one case, on high days and holidays, of so many inhabitants to the country, where they are absorbed in healthy and civilising pursuits; and, in the other, the aimless, shiftless drifting of the crowds which throng our pavements when the inhabitants are without their daily toil. The Scottish people are comparatively well off as regards holidays—what they lack is opportunity for making good use of them; whilst as to the beautifying of our towns, which have been built on a series of sites that cannot be surpassed, the inhabitants have themselves added little by planting or by gardening to enhance the beauty of the natural scenery.

After I began this paper I wrote to Professor Bayley Balfour, asking him his opinion as to the varieties of plants and trees which could be employed for urban decoration. Professor Balfour good-naturedly sent me an ample list, which, coming as it did from so high an authority, I asked leave to send in for publication. With his kind consent I send his letter, with its most valuable list of trees and shrubs found hardy at the Royal Botanic Garden, Edinburgh, to the Editor of the *Transactions*, as the most practical contribution that could be made to the subject.

ROYAL BOTANIC GARDEN, EDINBURGH,
16th November 1901.

DEAR MUNRO FERGUSON,—You ask me a large question, and I shall perhaps best answer you by telling you of some of the trees and shrubs that do well in the Garden here, although I do not know that the conditions are exactly those of a town; perhaps they are rapidly approaching them.

I am quite satisfied that we are far too shy in our planting of shrubs and trees in and about towns. Many more would thrive were they only cultivated.

I shall go systematically through the natural orders.

RANUNCULACEÆ.—*Clematis*. Many of these do extremely well. *C. alpina*, *flammula*, *montana*, *orientalis*, *virginiana*, and so on, are all good climbers, and thrive beautifully with us.

MAGNOLIACEÆ.—*Magnolia acuminata* is a good hardy tree, and a beautiful flowering low shrub is *M. stellata*. *M. conspicua* and *M. grandiflora* do very well on walls. The tulip tree (*Liriodendron tulipifera*) is also quite hardy, and its autumn colouring is very bright.

BERBERIDEÆ.—Of climbing plants in this family, *Akebia quinata* is a charming one, and quite hardy. *Holboellia latifolia* is also good, but is not, I think, quite so hardy. A very choice plant, which requires a wall, is *Berberidopsis corallina*. It has flowered magnificently with us this year. Then of shrubs there are all the Barberries—*Berberis angulosa*, *Aquifolium*, *buxifolia* (a beautiful dwarf), *Darwinii*, *Fortunei*, *stenophylla*, *Thunbergi*, *Wallichiana*, and the several forms of *vulgaris*.

BIXINEÆ.—A thoroughly hardy and beautiful evergreen is *Azara microphylla*. There are other species of the same genus which I believe would be not less hardy.

TAMARISCINEÆ.—Many of the forms of *Tamarix* are quite hardy with us, and flower beautifully.

HYPERICINEÆ.—Some of the larger hypericums, like *H. chinense*, are very pretty flowering shrubs.

TILIACEÆ.—The bulk of the tilia do very well here. The drawback of the ordinary lime for a town is that so much secretion is formed by the aphides upon it, and this drops and makes the pavement beneath it in towns unsightly. A very charming shrub of the same family is *Aristotelia Macqui*, which we have found quite hardy.

RUTACEÆ.—A very pretty small shrub, with glossy foliage and white flowers, is *Choisya ternata*. Then the different kinds of *Skimmia* are good plants, and of trees *Ptelea trifoliata* is quite hardy, and an elegant plant.

SIMARUBEÆ.—*Ailantus glandulosa*, although it does not grow to a great height with us, yet forms a very nice small tree.

ILICINEÆ.—There are a great number of very beautiful forms of *Ilex*, some of them quite brightly coloured, and they are all thoroughly hardy.

CELASTRINEÆ.—There are several species of *Euonymus* which are nice shrubs, and which, like *Euonymus europæus* and *E. japonicus*, have variegated forms, and are extremely bright.

RHAMNEÆ.—Several species of *Rhamnus* form nice small trees, and are quite hardy, like *Rhamnus catharticus* and *R. Frangula*. *R. californicus* has a beautiful foliage, and has lived with us out-

side for some years. Then there are species of *Ceanothus*—*Ceanothus americanus* and *C. azureus* are hardy. They may get nipped a little in a bad winter perhaps. So also *C. Veitchianus*. Their flowers are beautiful. On a wall *Ceanothus* is splendid. I believe that *C. americanus* is, as a plant in the open, best grown when cut back yearly.

AMPELIDÆ.—Of the species of *Vitis* a great number do well. Many of them, however, do not show the fine colour in their leaves that you get in more southern regions. In this case, as in others, the want of colour is due to our want of summer heat. Of vines that I can guarantee to be quite hardy, there is *Vitis amurensis*, *Coignetia*, *cordifolia*, *capreolata*, *quinquefolia*, *riparia*, and *inconstans*.

SAPINDACEÆ.—In this family we have the different species of *Æsculus*, several of which are quite hardy and flower freely. Besides *Æsculus Hippocastanum* there is *carnea*, and *flava*, and *glabra*, and *Pavia*. A very large number of *Acers* do well. Amongst them, the Norway maple, of which we have large trees, and its colour in the autumn is beautiful; and we have also the cut-leaved English maple and the sycamore. There is *circinatum*, most gorgeously coloured in autumn; *glabrum*, *dasycarpum*, *Negundo*, which in its variegated form is a very pretty plant, *rubrum*, and so forth. The Japanese maple (*A. palmatum*) grows quite well in the open here, but we have not had trial of many of the highly-coloured and variegated forms of it for sufficiently long to enable me to say how far they will succeed well. That they will live I have no doubt. To the same family belong the staphyleas, of which *Staphylea pinnata*, *trifolia*, and *Colchica* are quite hardy.

ANACARDIACEÆ.—Here we have a number of species of *Rhus*, and they thrive beautifully and give splendid colouring in autumn—*Rhus Cotinus*, *glabra*, and so forth.

LEGUMINOSÆ.—In this family *Piptanthus nepalensis* is a very charming flowering shrub, quite hardy. And then there are the several species of *Laburnum*, of *Genista*, of *Ulex*, and of *Cytisus*, many of which are quite hardy, and are beautiful both in their foliage and flower. *Wistaria* grows quite well on walls here, but it does not flower very freely. *Robinias* are quite noted town-plants. *Coluteas* and *caraganas* are handsome hardy shrubs, and *Gleditschia*, as well as *Cercis*, gives us beautiful small trees.

ROSACEÆ.—*Prunus* supplies a wealth of quite hardy flowering trees, which are also, many of them, beautiful by their foliage in

winter. And then there is *Nutallia cerasiformis*, and several forms of *Spiræa* and *Neillia*. *Stephanandra* is a beautiful little shrub, and so is *Kerria* and *Rhodotypos*. Many species of *Rubus*, like *Rubus nutkanus*, *deliciosus*, *leucodermis*, and *spectabilis*, are lovely flowering shrubs, and nothing can be more beautiful than the forms of *Potentilla fruticosa*. *Rosa rugosa* is a very fine shrubby plant. In this same family are all the species of *Pyrus*, which give us foliage of the most various kinds and colours, many of them changing to distinct and conspicuous tints in the autumn. There are also many forms of *Crategeus*, but few of which are commonly grown about towns. There are also such lovely shrubs as *Cotonæaster bacillaris* and *frigida*, *microphylla*, *horizontalis*, etc. And then for a wall *Photinia serrulata* is one of the handsomest of plants. *Raphiolepis japonica* is a slow-growing but densely-clad evergreen. Further, there is the genus *Amelanchier*, which contains some beautiful shrubs.

SAXIFRAGEÆ.—In this family there are numbers of beautiful and hardy shrubs. *Hydrangea*, for instance, gives us *Hydrangea paniculata* and its forms, as well as the climbing *H. petiolaris*. *Deutzia crenata* and other forms are good hardy deciduous plants; and then in *Philadelphus* there is *Philadelphus coronarius*, *Gordonianus*, *grandiflorus*, and others. *Jamesia americana* is a nice small and hardy shrub.

The *Escallonias*, many of them, do very well, especially upon a wall, and being evergreen as well as good flowerers, they should be far more planted than they are.

Of the different species of *Ribes*, there is *Ribes sanguineum*, which is now to be got in a great number of horticultural varieties. There is also *R. aureum*, *Gordonianum*, and many other pretty shrubs.

HAMAMELIDÆÆ.—The plants of this order are by many considered somewhat delicate. They are not so, although they are slow growers. The best of them, perhaps, are the species of *Hamamelis* itself, and then the *Liquidambar* is a tree which in a good season shows most effective autumn tints.

ONAGRARIÆÆ.—*Fuchsia Riccartoni* is a very nice small shrub.

ARALIACEÆ.—Here we have the different forms of ivy, and, besides that, interesting plants like *Aralia spinosa* and *Acanthopanax spinosum*, which are quite hardy and very striking plants, though they are deciduous.

CORNACEÆ.—Of the *Cornaceæ* we have *Aucuba* as a good ever-

green, and also *Garrya elliptica* and the species of *Griselinia*, as well as *Nyssa sylvatica*. And then, besides these, there are several species of *Cornus*, some of which, in their coloured twigs, are extremely effective in winter, and about the time of leaf-fall the leaves show very conspicuous change of colour.

CAPRIFOLIACEÆ.—Of this family we have the various forms of *Sambucus*, both fine foliage and fruit plants; also the different species of *Viburnum*. There are many viburnums which are not much grown, but which are beautiful shrubs and quite hardy. Perhaps the best are *Viburnum cotinifolium*, *Lantana*, *Opulus*, *Tinus*, and *tomentosum*. *Symphoricarpus* is pretty in fruit, and is very common. Then we have the several *Loniceras* as woody climbers—far more deserving of cultivation than their scarceness indicates—*Lonicera fragrantissima*, *Standishii*, *Periclymenum*, *tartarica*, and so forth. *Leycesteria formosa* is a charming hardy shrub, very striking in the flower, and not much grown. In addition, there are the different forms of *Diervilla*; many of the new varieties of the nurserymen are brilliant in colour.

COMPOSITÆ.—Here we have the olearias, which have not only the advantage of being evergreen, but have also very bright and conspicuous flowers. *Baccharis patagonica* is a good and hardy shrub, with glistening leaves. *Cassinia fulvida* is a splendid hardy resistant evergreen; and of smaller forms the New Zealand *senecios*, *Senecio laxifolius*, for example, are very pretty.

VACCINIACEÆ.—*Gaylussacia*. The species of this genus are amongst the most beautiful foliage shrubs in autumn. We have only tried them for a year or two outside, and they have not had a good chance, but seem to me to be quite hardy. Some of the *vacciniums* are useful small shrubs, but the majority of them are better in a border.

ERICACEÆ.—*Arbutus Unedo* is far hardier than many people suppose. *Pernettya mucronata* has a great number of garden forms, and is valuable not only for its perennial foliage, but also for its beautiful fruit. Then there is *Gaultheria Shallon*, which neither cold nor drought seems to kill. *Oxydendron arboreum* is also a fine shrub, whose flowers, however, come out too late to get much of a chance. The genus *Pieris* has several hardy species with evergreen foliage—*Pieris floribunda*, for example. One of the most beautiful of the genera in this family is *Enkianthus*, which is quite hardy.

The different kinds of heaths are perhaps too small to be in-

cluded in a list of trees and shrubs, but forms like *Erica mediterranea*, and *scoparia* and *stricta*, form pretty large under-shrubs. Then the same may be said of *Bryanthus empetrifomis*. *Kalmia angustifolia* and *latifolia* are both good evergreen flowering shrubs. And then *Ledum latifolium* and *palustre* are excellent hardy small shrubs. I do not require to mention the different kinds of *Rhododendron* and *Azalea*. Lastly in the family I may mention *Clethra alnifolia*, which is a good hardy plant.

OLEACEÆ.—Here we have the different kinds of Jasmine—some climbers, some not. *Jasminum floridum*, *nudiflorum*, and *officinale* are all kinds which grow well here. *Forsythia* is one of our most brilliant flowering shrubs in spring. Of *Syringa* there are any number of garden forms of different species. *Syringa chinensis*, *Emodi*, *japonica*, *Josikæa*, *persica*, as well as *vulgaris*, are all shrubs that thrive well here. The different kinds of *Fraxinus* come into this family, and the hardy forms are in great number. In this same family you have the hardy evergreen *Phillyrea*, *P. decora* and *latifolia*; and then there are forms of *Osmanthus Aquifolium* which live well in the open, but only thrive in a somewhat sheltered place. The genus *Ligustrum* I need only mention as containing many beautiful and hardy forms.

APOCYNACEÆ.—The vincas belong here, and are, of course, common trailing shrubby plants.

LOGANIACEÆ.—*Buddleia globosa* is a plant that is surprisingly hardy. Most people think it is a delicate thing; we find it quite the opposite. *Desfontainea spinosa* wants a sheltered spot to flower.

SOLONACEÆ.—*Lycium europæum* and *barbarum* are both hardy climbers, and *Fabiana imbricata* is a plant that grows well upon a wall.

SCROPHULARINEÆ.—The different forms of New Zealand veronicas fall in here, and their name is legion. The largest is perhaps *Veronica Traversii*, but besides it there are some others which are nearly as big, and which are thoroughly hardy.

BIGNONIACEÆ.—The catalpas do not do well with us, but in this family *Eccremocarpus scaber* is a climber which grows very rapidly. I have seen it in several parts of Scotland, covering houses in the villages.

LABIATEÆ.—The different forms of *Lavandula* and *Rosmarinus* are small but good shrubby plants

PHYTOLACCACEÆ.—*Ercilla volubilis* is a woody climber of this

family, clinging like the ivy, and, like it, forming an evergreen screen.

ARISTOLOCHIACEÆ.—*Aristolochia Siphon* is a thoroughly hardy climber, but deciduous, and stands smoke well.

LAURINEÆ.—*Umbellularia californica* is a scented-leaved small shrub here, and has proved hardy, though it was badly nipped in this last wind; and *Laurus nobilis* gets on very well also.

THYMELÆACEÆ.—In this family there are the several species of *Daphne*, which are small, hardy, and very pretty shrubs.

ELEAGNACEÆ.—There are no more beautiful evergreens than the species of *Eleagnus*, *E. argentea*, *pungens*, and so forth, and they pass through many varieties. We have them growing well upon a wall, but I am sure they would do equally well planted out. Then the sea-buckthorn is a good hardy plant, and it is very pretty alike in leaf and fruit, and its ally, *Shepherdia*, is nearly as pretty.

EUPHORBIACEÆ.—Here we have all the different kinds of box; and of low-creeping shrubs *Pachysandra* is amongst the best.

URTICACEÆ.—*Ulmus*, in all its forms, grows well. *Zelkova* is also a good small tree: it does not get very high with us; and there are several species of *Celtis* which do well. The mulberry thrives, but it does not, as a standard, grow to any size with us; on the walls it grows much better. The oriental plane does fairly well with us, the occidental not at all.

JUGLANDÆÆ.—The caryas grow into small trees with us, and so do the walnuts, and also *Pterocarya*.

MYRICACEÆ.—Two or three of the myricas are quite hardy, and very pretty small shrubs they are.

CUPULIFERÆ.—Of *Betula* and *Alnus* there are many species thoroughly hardy and resistant. *Carpinus* in two or three species also does well, and so does *Corylus*. *Ostryopsis* and *Ostrya* also thrive.

Of oaks there are plenty good species for our climate. Many of these in our Garden have not had a fair chance. Where they have, almost the whole of them have done well. The oak to which you refer is probably the Hungarian oak, *Quercus conferta*. *Castanea* forms a good tree here, and so does *Fagus*.

SALICINEÆ.—A horde of willows, as well as of poplars, romp with us. The latter particularly form big trees in a very few years.

GRAMINEÆ.—Several of the bamboos thrive particularly well.

CONIFERÆ.—Given shelter, there are few of the Conifers that would not do well with us, which shows that we do not suffer so very much from smoke.

I am thoroughly convinced that the cold to which we are liable is not nearly so great an element of danger to trees and shrubs as is commonly supposed. The fatal thing is wind in cold weather, and the wind is so fatal because it increases the loss of water by transpiration from the plant, and this cannot be replaced from the soil in sufficient quantity. Given shelter, we could grow here a large number of trees and shrubs. The want of sun-heat has no doubt an influence in preventing the fine changes of colour in the leaves, and it also leaves the young wood often unripened, and thus there is a want of free flowering in many of our trees. And further, the shoots are more liable to be injured by loss of water through the influence of wind. I do not think that the want of sun-heat is directly a cause of our not being able to grow well many temperate trees.

I do not know whether I have been definite enough in the information I have given you, but it is extremely difficult to select individuals where so many are available, and I know I have omitted in this *currente calamo* story a number of plants that I might have mentioned to you. I quite agree with you that elms—especially the wych elm, so abundantly planted—are not always elegant objects.

If you think I can give you more detailed information upon any individual point, I shall be very pleased to do so.

Believe me to be,

Yours very truly,

ISAAC BAYLEY BALFOUR.

XXIX. *The Valuation of Woods or Plantations for the Purpose of Transfer.* By JAMES PEARSON, Strabane, Brodick.

The valuation of growing timber for the purpose of transfer is an art for the practice of which no fixed rules can be set down. We can only consider the principles on which such valuations are based, and the considerations which will weigh with the valuer in the application of these principles when making his valuation. All woods under the age of full-grown timber, with the exception of young plantations recently planted and not yet thinned or yielding a return, are valued on the basis of their prospective value when felled; and to gauge this accurately the valuer must be possessed of an intimate and thorough knowledge of the habits of the different species, and of the influence which climate, soil, etc., may have on their annual growth. Before entering on any valuation, the valuer should make himself acquainted with the prices of wood prevailing in the locality in which the crop is growing, and with the extent of the local demand. This latter should be particularly noted, as in many inland districts there is no local demand for the wood, and the expense of transport to a more distant market may absorb all profit. In a mining or hop-growing district again, the market may be at the very door, and there is comparatively little expense of this nature. The position of the wood and the facilities it affords for the removal of the produce should also be noted in this connection.

Before taking up in detail the methods of valuing various classes of wood-crop, I should like to mention the fact that in many cases of the transfer of landed property, not only are plantation *crops* not taken into account, but very often the *land* upon which they are growing is left out of calculation unless it yields a yearly rent. A case of this kind came under my notice some time ago. A large sporting property, with a free rental of over £3000, came into the market and was sold at twenty-five years' purchase of the free rental. Some little time before the sale, the growing timber on the estate had been valued at £40,000, and this timber was thrown in along with the land, for what reason it is difficult to say. It may have been for reasons of amenity, or the exposers may have thought that the sporting, agricultural, and grazing rents could not be maintained without the maintenance of the woods, and were thus dependent on them. No doubt allowance must be made for such

considerations; but hardly to the extent of leaving the whole of the woods, with the land on which they stand, out of the account. Both should be valued—the wood at its commercial value, and the land at the rent which it would bring in if not covered with timber. The valuer can then consider what deductions from the amount so obtained should be made on the grounds of amenity, whether it be of landscape or shelter; and also what allowance should be made in consideration of the fact that the agricultural and grazing rents are maintained by means of the shelter afforded by the woods, and that they would not be realised but for the presence of the trees. On sporting estates the woods may be an important factor in the let, and a like deduction may have to be made under this head.

We will now take up in detail the valuation of the various classes of wood-crops.

1. MATURED WOODS.

Here the question before the valuer is to define the money value of the crop of full-sized marketable timber, plus the value of the land on which the crop stands; and the first step is to find the contents in cubic feet of the marketable timber. The methods in practice among wood-valuers in calculating the cubic contents of growing timber may be stated as follows:—(1) The trees being counted, the valuer simply estimates by the eye the number of cubic feet that each tree contains. This requires considerable experience on his part. (2) He actually measures the height and girth of each tree, and finds the contents by the usual method of measuring round timber. By both these methods the valuer can arrive at the cubic contents of the wood; but the process involves considerable time and expense, and where the crop is at all regular, many valuers proceed somewhat on the following lines. All the trees are first counted. A sample area, of say $\frac{1}{10}$ part of an acre, is then marked off, and the contents of each tree thereon are estimated. A second acre is taken, another $\frac{1}{10}$ part is marked off, and the contents of each tree thereon are estimated, and so on throughout the whole wood. Taking the trees on the areas measured off as samples, the valuer then strikes an average, and calculates therefrom the contents of the remaining trees. Where the crop is regular a fairly correct estimate can be arrived at by the above method; but, of course, in many woods it cannot be adopted, on account of the irregularity of the stock. Having

calculated the cubic contents, the valuer should then acquaint himself with the prices per cubic foot for the different classes of timber which obtain in the neighbourhood, if there be a local demand ; or, failing this, at the nearest market where a fair price can be realised. A sum to cover cost of cutting, removal, transport, etc., will then be deducted from the gross value.

The valuer will now have completed his valuation so far as the timber is concerned, and has then to consider what value, if any, should be put on the land on which the timber stands. Some valuers are of opinion that if a full price be paid for the timber, the land on which it stands should not be taken into account in the valuation, the reason given being that the rents of the adjoining agricultural and grazing lands are enhanced and maintained by the shelter afforded by the woods. This, no doubt, applies in cases where the plantations and woods, being old enough and of sufficient extent, are so situated as to benefit the adjoining land by their shelter ; and if these conditions are fulfilled, an amount equivalent to that by which the rent of the adjoining fields is increased through the presence of the trees should be deducted from the value per acre which the ground on which the timber stands would possess were it not covered with timber. But against this course must be set the fact that where the woods border on land cultivated for potatoes, turnips, or other green crops, the shade of the trees detracts considerably from the letting value of the fields ; and this must be taken into consideration. In cases, however, where the forest crop is such that the adjoining lands are neither benefited nor injured by the woods to any appreciable extent, the value per acre should be that which the land would have if not covered with timber and if let for agricultural or grazing purposes, and this would be based on the value of neighbouring land of like quality.

Then, the capitalised value of the estimated yearly rental, at say twenty-five years' purchase, added to the value of the growing timber, will give a fair transferable value for the plantation. On shooting estates many valuers do not take into account the land upon which the timber is growing, their contention being that the rent is covered by the yearly sum received for the shootings.

Although the above are the general principles on which woods of this class are valued, yet in practice it will be found that they frequently have to be modified, in order to adapt them to the

particular circumstances of each estate. Such modifications must be left to the judgment and experience of the valuer.

2. MIDDLE-AGED WOODS.

This is a class of woods in which the valuer will experience some difficulty when estimating the transferable value. The trees have not reached maturity, and the valuation must be based on the prospective value of the trees. The method adopted is usually on the following lines, modified, of course, to adapt it to the peculiar circumstances of each case:—(1) Estimate the number of years the wood will take to reach maturity, and the ultimate value of all the trees likely to be found in the final crop. (2) Estimate the value of all thinnings likely to be taken from the wood before the trees reach maturity. (3) To obtain the present transferable value from the sum of these two (*viz.*, the value of the trees at maturity and of the intermediate thinnings to be taken), deduct compound interest at say $7\frac{1}{2}$ per cent., to cover interest on capital outlay, taxes, supervision, etc., for the number of years the trees take to reach maturity.

If to the amount thus obtained be added the capitalised rents of the ground on which the timber stands, a fair valuation will have been arrived at of the present value of the plantation. But here a point must be noted in regard to the capitalising of the rents of the land. In the prospective value, the purchaser has already paid for the annual increment (growth) up to the period of maturity of the timber; and the interest which he is entitled to receive on the capital sum paid down for the land will be deferred until the period of maturity. This is a case of calculating the present value of the reversion of say £1 per acre (which we will assume the land is worth as agricultural or grazing land) deferred twenty years, when the wood will reach maturity. This can easily be found from tables prepared for the valuation and purchasing of estates, and which every valuer should possess. Thus at 4 per cent.—a fair interest on money invested—the present value at twenty-five years' purchase of a perpetuity twenty years deferred is only 11·409 years' purchase. The estimated yearly rental should therefore only be multiplied by 11·409, and the amount added to the value of the growing timber, to find the transferable value. The considerations mentioned in the case of matured woods as to the valuing of the land on which the crop stands apply to this class of crops also, and the

valuer will take them into account in fixing the yearly rental per acre for the land on which the plantation stands.

In estimating the prospective value, the valuer must bear in mind the purposes for which the different kinds of wood are adapted, the position of the wood as affording facilities for removal, the expense of transport if the wood is far from a railway station, the existence or otherwise of a local demand, and the prices likely to be realised. He will also take into consideration the influence which shelter and other favourable conditions may have on the growth of trees which enjoy these advantages. It is evident that a thorough knowledge of the different varieties of trees, combined with practical experience on the part of the valuer, is necessary for computing the total number of trees which will reach maturity in a saleable condition, and for estimating the prospective value of these trees. In fixing the value of the thinnings which may be taken, consideration must be given to the purposes for which they may be adapted, and to the local demand. The thinnings of wood, grown in a mining district and suitable for pit-props, must evidently be of more value than those growing miles away from a railway station, and which can only be used for fencing and other estate purposes. In many such cases the thinnings do not much more than pay the cost of their cutting and removal.

3. PARK TREES AND ORNAMENTAL TIMBER

The value of an estate in the country, as a residential property, is dependent to a great extent on the arrangement and extent of the policies, pleasure-grounds, etc. The planting of park trees and ornamental timber in the policies and round the mansion-house, if carried out in a judicious manner, undoubtedly improves the amenity and enhances the value of the estate. A well laid-out flower-garden or kitchen-garden contributes to the same purpose. For valuation purposes, park trees and ornamental timber in the policies are looked upon as an appendage to the mansion-house in the same way as is the flower-garden; and these considerations having been taken into account in fixing the yearly rental of the mansion-house, no valuation should be made of the park trees and ornamental timber, these being already included in the valuation of the dwelling-house. It may be, however, in the case of the park trees, that a much larger number

has been planted than is necessary for the purposes mentioned; and in this case the excess number should be valued according to the class to which they may belong as timber, and by the methods previously described. The amount should then be added to the capitalised current agricultural or grazing rental of the land, at say, twenty-five years' purchase. This looks at first sight as if the purchaser were paying the full value of the land as agricultural land over and above the value of the trees. But this is not the case, the capitalised rental of the parks as agricultural land being reduced on account of the presence of the trees. Clear of timber, the land would probably fetch a much increased rental. To illustrate this, I may mention the case of a property which was lately in the market. Several parks were rather heavily wooded. The trees were counted, and it was found that on an average about one-fifth of each acre was covered or affected by timber. The surrounding land clear of trees was rented at £1, 10s. per acre, and the land offered for sale was also estimated to be worth this sum. It was accordingly offered at twenty-five years' purchase of the estimated rental of £1, 10s., or £37, 10s. per acre, but no purchaser was forthcoming. It was then offered at twenty-five years' purchase of the current rental of 24s., or £30 per acre, plus the value of the trees to be ascertained by arbitration, and it then found a purchaser. The trees were valued at £7, 10s. per acre, and this, added to the capitalised sum of £30, brought out the sum at which they were first offered, viz., £37, 10s.

Ornamental timber growing in ordinary plantations outside the policies is valued in the same way as other timber of the same bulk and quality.

4. YOUNG WOODS.

In valuing young plantations—those not yet thinned and which have not begun to yield a return—the valuer usually proceeds as follows:—He first finds out the cost of planting per acre, either from the estate books or by estimating the cost approximately; and to this he adds the expenditure on drainage and fencing, with a sum to cover taxes and the cost of management from the date of planting to date of valuation. He then proceeds to fix the value per acre of the land covered by the plantation, on the basis of the rental at which similar neighbouring land is let for agricultural or grazing purposes, but making allowance for unproductive heights and hollows, if any,

He will, of course, satisfy himself that the land, if not covered with the young plantation, would let for the same rental as the surrounding fields; but if the soil, situation, or other circumstances are such that a like rent could not be got, then a proportionate deduction must be made. If, then, to the estimated cost of planting, drainage, fencing, taxes and management, be added the yearly rents of the land from planting to date of valuation, plus compound interest, a fair valuation should have been arrived at of the value of the growing crop to date of valuation. There now only remains to be added the capitalised value of the estimated yearly rental of the land, at from twenty-two to twenty-five years' purchase, as may be decided on, and the transferable value of the plantation will have been ascertained.

In the application of this method to woods of this class, the valuer must keep in view that, in cases where the work has not been judiciously planned and properly executed, or where the plantation has subsequently been neglected, a suitable deduction must be made from the capital value arrived at. Plantations of the same age may also differ greatly in value, on account perhaps of improper selection of species, mismanagement, or other reasons, and in these cases also a proportionate deduction must be made, to provide for the resulting reduction in rate of growth of the plantation. As a rule, the experienced valuer is able to estimate with accuracy the value of the plantation by its general appearance and by its rate of growth.

5. COPPICE-WOODS.

With the exception of oak coppice, this class of wood crop is not much cultivated in Scotland, although on many estates a growth of coppice-wood, composed of trees indigenous to the soil, has sprung up on uncultivated or waste ground. In England, however, the case is different, as in many counties a large proportion of the forest crops cultivated consists of coppice plantations and coppice mixed with standards. The purposes for which coppice is grown are many and varied, but they may be grouped generally under one of the following heads, viz., coopers' ware and bobbin wood, charcoal wood, bark for tanners, basket ware, hop poles, fencing and general estate purposes, firewood.

The transferable value of this class of crop is based on its prospective value, and in estimating this the valuer should consider—(1) the purposes for which the coppice-wood may be suitable,

the demand for it which may exist in the neighbourhood or at a more distant market, and the prices likely to be realised ; (2) the age at which the coppice should be cut for the purposes intended. This depends greatly on the nature of the climate, soil, situation, and shelter. For instance, in the Midlands of England, oak coppice is as bulky at twelve or fourteen years as it is in Argyllshire at twenty-five years. Then again, much will depend upon the extent of the demand for the produce. In some parts of England, where coppice is used for hampers, crates, and coopers' stuff, it is cut over at two or three years of age. In the hop districts it is cut over at from five to six years old ; and in other districts, where it is used for fencing and general estate purposes, it is cut at from ten to fifteen years of age. In Scotland, again, where oak coppice is chiefly grown for bark and spoke-wood, it is left till the shoots are from 5 inches to 7 inches in diameter at the base.

Having ascertained the purposes for which the coppice is saleable, the demand, and the prices likely to be realised, and having fixed the age at which it should be cut, the valuer will be able to estimate the prospective value of the crop. In some instances, by ascertaining the amount realised at previous cuttings, he may form a fair idea of what it will again be worth when ready for the axe. This estimate is, however, often very misleading, and at most it can only be looked upon as the prospective value subject to modifications. This will be evident when it is stated that coppice, which used to sell at from £10 to £15 per acre, is now realising only from £4 to £5 per acre. Great caution is therefore needed when using the prices realised by cuttings in the past as the basis of the value of future cuttings. Having estimated the prospective value, that sum, subject to the general allowance of 5 per cent. to cover outlay, taxes, and supervision, will be the present transferable value of the coppice-wood. To this must be added the capitalised rental of the land ; and the prospective value of the wood forms the basis for determining this. But as future cuttings, in addition to the present crop, have to be considered, the valuer will have other matters than those already mentioned to take into account. In this connection it will be necessary to consider the condition of the stools, the prospect of their deteriorating, and the annual cost of filling vacancies. Account will also have to be taken of the nature and condition of the soil in regard to future cuttings, the state of the fences and drainage, and the parochial and other burdens on the

land. To ascertain the yearly value per acre, the valuer deducts from the prospective value, as already obtained, the cost of refilling vacancies, plus 5 per cent. interest on such outlay, together with the expense of repairing fences, drainage, and a sum to cover taxes. The balance, subject to the same rate of interest, is then divided by the number of years representing the age of the wood when saleable, and the result will be the yearly value of the land per acre. This, multiplied by twenty-five or other number of years' purchase, as agreed on, will give the capitalised rental per acre, which, added to the present value of the coppice already found, will give the transferable value per acre of the plantation. In many coppice plantations, standard trees are found mixed with the coppice, and their value must be taken into account in the valuation. This will be ascertained by valuing them according to the class to which they belong, and by the methods already described.

CONCLUSION.

In the foregoing paper I have endeavoured to describe briefly the methods used for computing the transferable value of different classes of woods and plantations. That crops are frequently not in the good condition they might be is a fact which the landowners in this country are awakening to, and with proper management a much better return might be got for the capital represented by the soil and growing timber. Already, I am glad to note, Mr Munro Ferguson, the Duke of Bedford, the Earl of Selborne, and other landowners, have had the wooded portions of their estates surveyed by competent experts, and carefully prepared Working Plans have been drawn up for their future management. The economic advantages to be derived from a well-conceived Working Plan have been ably set forth by Dr Nisbet and other well-known writers. But from the valuer's standpoint the valuation of woods planted and managed under a Working Plan will be much simplified, the data on which his valuation is based being easily arrived at from the records which must be maintained under such a Plan. It is to be hoped that the advantages of a Working Plan will soon commend themselves to other estate owners who have not yet realised them, and who are at present inclined to look upon such Plans with some suspicion.

XXX. *Further Notes on Tree Seed-Testing*, 1900-01. By
JOHANNES RAFN, Skovfrökantoret, Copenhagen, Denmark.

In last year's issue of the *Transactions* of this Society, I had the honour to publish a series of experiments with the germination of tree seeds; and, as I have reason to believe that these have attracted some attention in interested circles, I have thought that the results of some further experiments might possibly be kindly received this year. I am the more anxious that they should appear, because the germination tests of the past season on one point, viz., the quickness with which the seed germinates when it is good, and the consequent promptitude with which the testing establishments are able to give reliable figures for the valuation of the seed in question, have been exceptionally instructive.

Looking at *Larix*, for instance, it will be clear to everyone that it is possible, even in ten days, to make a sure estimate of the value of the seed; for no professional man will for a moment doubt that *L. leptolepis*, which has only germinated 1 per cent. in ten days, is quite worthless.

It is very disheartening to those engaged in experimenting with foreign trees, a subject which at the present moment is receiving much attention in Europe, that we year after year receive shipments of seed from Japan which, after being paid for at a high rate on receipt, afterwards turn out to be quite worthless. It is by no means pleasant to have to throw some sacks of seed on the rubbish-heap, when the value is 10s. per lb. if it was sold.

According to information received from the Swiss seed-testing establishment at Zürich, they have in the season 1900-01 had eight samples of Japanese larch for testing, and they have germinated 12, 2, 9, 2, 1, 2, 27, and 11 per cent. respectively—only one of them, the 27 per cent. one, being good; and that sample germinated 11 per cent. in ten days and 25 per cent. in fifteen days, while the 12 per cent. sample had not germinated 10 per cent. till the twentieth day.

Also the Japanese seed of *Chamaecyparis obtusa* was perfectly worthless last season, germinating only 1 per cent. in thirty days. This seed germinated, in the season 1899-1900, 19.35 per cent., as stated by me in last year's Part of the *Transactions*, at page 281 of this volume. What remained of this was again tested this

year, germinating 7 per cent., and was accordingly considerably better than the so-called new-crop seed with which the Japanese supplied us last spring.

Chamaecyparis pisifera, received from Japan in the spring of 1900, germinated then 10·67 per cent., and what remained was tested last spring but failed to germinate at all. This makes it clear that when we receive from Japan seed that fails to germinate, it must have been kept over some years before it was shipped to Europe.

The Japanese must certainly learn that this will not do, and by and by they must make improvements in this respect. For who but the exporter has got to bear the cost of these failures? In the long run the European seedsmen cannot be expected to do so; the nurserymen will certainly decline to do it, and the Japanese seedsmen, who have got to pay for the collecting of the cones, will finally have to bear the loss until they can supply better seed.

The rapidity with which the seed of the different species lose their germinative power is very different. The small-grained *Picea ajanensis*, which in the season 1899-1900 germinated 52 per cent., has, as appears from the Table, gone down to 9 per cent.; while the hard and coarse-grained seed of *Picea polita*, which in 1899-1900 germinated about 59 per cent., has, in the course of a year, only gone down to 22 per cent.

This year, however, I specially wish to draw attention to the very great difference in the germinative capacity of the different American species, as this is of very great importance for judging of the value of the seed.

The following four species are taken from the list—

	Of the pure seed there germinated in—		
	10 days.	15 days.	30 days.
	Per cent.	Per cent.	Per cent.
<i>Picea Engelmanni</i> , from Colorado, . . .	91·67	93·17	95·00
„ <i>sitchensis</i> , from the Cascade Mountains,	14·00	45·00	53·00
„ (<i>Pseudotsuga</i>) <i>Douglasii</i> , from Colorado,	82·50	92·66	94·00
„ „ from Oregon, . . .	2·33	7·50	36·00

This *Douglasii* seed from Oregon had, further, after the thirty days' test, 37.02 per cent. of sound but not germinated seeds.

When comparing the figures, it will at once be clear to every expert that after a ten days' test the Colorado seed appeared to be exceptionally good, whereas the seed of Sitka spruce and Douglas fir from Oregon was nearly worthless. If hot and dry weather happens to set in after sowing in the nursery, the two species with a germinative capacity so great that nearly all the seed has grown in the course of ten days will pull through, whereas the others will certainly fail. But still seed like that of *Douglasii* from Oregon may possibly not be refused when considered as an article of commerce, for when the sound seeds that have not germinated in the course of thirty days are added to the 36 per cent. germinated seed, the sample contains 73 per cent. of sound seeds which, given time and plenty of moisture, will be brought to germinate, as is indicated in the last column of the Table on p. 412. The results noted there are not gained in the usual way, namely, by means of a high temperature, but by slow germination in an unheated verandah. The test of the *Douglasii* seed here was commenced at the end of February, and after a hundred days 67 per cent. of the seed had germinated. As an article of commerce such seed need not, as before mentioned, be rejected; but for use in the nurseries it is certainly better to be without it, except it be possible, during three months, to give the seed an even moisture in the seed-beds. If this cannot be done, the result of the sowing will certainly not be satisfactory. The *Douglasii* seed from Oregon was accordingly refused by me, and not distributed to the nurseries; but, acting under instructions from my American consigner, it was passed on to a German firm.

In the past season (autumn 1900) no seed of the Douglas fir was saved in Oregon—the native home of the quick-growing, green variety that is so well suited for the milder parts of Central Europe and the British Isles,—and the many hundredweights of seed that were exported from there to Europe in the spring of 1901 must have been at least one year old, and are sure to have brought many disappointments when sown in the nurseries.

Also amongst seed of hardwoods the different germinative capacity has appeared very strikingly. Taking *Alnus glutinosa* and *A. incana*, for instance, there is already, after a five days' test, a very distinct difference between old and new seed. *A. incana* of the crop of 1899 germinated only 9 per cent. in five days,

while at the same time the fresh new seed of the 1900 crop germinated 26 per cent. The 1899 seed of *A. incana* tested this year, and germinating 9 per cent., is the remainder of that which in last year's Part of the *Transactions*, page 285 of this volume, was noted as germinating 20 per cent. in five days. It has thus lost more than half its germinative capacity in a year.

In the case of *Betula* there is a very marked difference in the seed of the different species and in samples from different localities. That which has done best is the Scandinavian seed of *Betula odorata*, which germinated 51 per cent. in five days; then comes Sample 1 of *B. verrucosa*, with 26 per cent. in the same time. The American species are far behind, the two samples of *B. lutea* having only reached 17 and 24 per cent. in fifteen days, while the two samples of *B. lenta* are practically worthless, having only germinated 1 and 5 per cent. respectively in thirty days.

Although these tests are undeniably reliable, most of my consigners absolutely refuse to take any notice of the figures. As a rule they maintain that germinative tests of *Alnus* and *Betula* are quite misleading and without importance. The consigner of the two lots of *B. verrucosa*, which I received at the end of September (Lot 1) and the end of November (Lot 2), urged, and still urges, in spite of the tests, and notwithstanding the fact that the first lot was of exceptionally fine light colour, while the second was dark and old looking, that both consignments were taken from the same stock of seed. He takes up the same ground as the collector of *B. lenta* that germinated 1 per cent., and maintains that the seed was new and good and of the very best quality, and says that the fact that the testing establishments have failed to induce the seed to germinate is a matter that does not in the least concern him. To found a claim for abatement of price on even the most careful tests of *Alnus* and *Betula* is to run the head against a Chinese wall of prejudice behind which the collectors guard themselves.

Finally, I shall add a few lines on the before-mentioned series of tests carried out without artificial heat, the results of which will be found in the last column of the Table. Taking *Abies Nordmanniana*, *Pinus Cembra sibirica*, and *Pinus Strobus*, what immediately strikes one is the fact that the slow germination commenced in February and March in a cold verandah has given considerably better results than the tests carried out during

the same time at a temperature of 82° F. *P. Strobilus*, for instance, when kept at that temperature, had only germinated 34 per cent. in 175 days, whereas 98 per cent. had germinated during the same period when the seed was kept in the cold verandah. *P. Cembra sibirica* had in 45 days germinated respectively 48 per cent. and 82 per cent.; *Nordmanniana* respectively 6 per cent. and 28 per cent.; whereas Danish seed of *Thuja gigantea* germinated 85 per cent. in the heat but only 49 per cent. in the cold.

These last tests have not been carried out nor suggested by me, but were started by the Danish Government, at their seed-testing establishment in Copenhagen, with seed which I placed at the disposal of the establishment at the request of the director.

CONIFERS.	Weight of 1000 Fresh Seeds.	The Samples contained per cent.						Of the Pure Seeds there Germinated:			In a cold Verandah.
		Refuse (Sand, Soil, Scales, etc.	Pure Seeds.	Dead Seeds.	Sound but not Germinating ("hard") Seeds.	Real Value. ¹	In an avrg. temp. of 77°-82° F.				
							10 days.	15 days.	30 days.		
<i>Abies balsamea</i> , Mill., Danish seed, . . .	0.32	5.00	95.00	47.50	...	47.50	20.00	33.66	50.00	45.00	...
<i>cephalonica</i> , Lk., . . .	...	...	...	...	...	...	...	...	...	10.00	44.00
<i>cephalonica</i> , var. <i>Reginæ Amalix</i> , from Arcadia, . . .	1.71	13.00	87.00	48.72	5.22	33.06	2.50	19.00	38.00	34.00	...
<i>concolor</i> , Lindl., Colorado seed, . . .	1.10	1.00	99.00	30.60	...	68.31	31.63	65.33	69.00	68.00	...
<i>gracilis</i> , Lindl., " " . . .	0.40	1.90	98.10	45.45	...	52.65	26.50	35.50	53.67	...	...
<i>nobilis</i> , Lindl., Scotch " " . . .	...	...	...	...	...	...	...	6.00	14.00	6.00	...
<i>glauca</i> , Hort. Scotch seed, . . .	1.43	4.00	96.00	54.72	...	41.28	5.00	...	43.00	22.00	...
<i>Nordmanniana</i> , Lk., . . .	2.36	14.50	85.50	77.33	...	8.12	...	...	9.50	28.00	...
<i>Pinsapo</i> , Biss., . . .	1.65	6.90	93.10	60.52	...	32.58	5.00	12.33	35.00	...	...
<i>sibirica</i> , Ledeb., Seed from Ural, . . .	0.34	9.50	90.50	62.90	...	27.60	18.00	30.50	...	24.00	...
<i>subalpina</i> , Engelm., . . .	0.41	6.50	93.50	83.68	...	9.82	2.33	6.66	10.50	...	...
<i>Chamaecyparis lawsoniana</i> , Parl., Danish seed, . . .	0.08	6.00	94.00	38.70	...	55.93	42.67	...	59.50	43.00	...
<i>obtusa</i> , S. and Z., 1899 crop, Japan, . . .	...	...	...	...	...	...	...	6.00	7.00	7.00	...
<i>obtusa</i> , S. and Z., 1900 crop, Japan, . . .	...	...	...	...	...	...	...	1.00	...	0	...
<i>pisifera</i> , S. and Z., 1899 crop, Japan, . . .	...	...	...	...	...	...	...	0	...	0	...
<i>Larix europæa</i> , D.C., Alpine seed, . . .	...	13.20	86.80	...	...	39.90	36.00	...	46.00	34.00	...
<i>leptolepis</i> , Murr., 1900 crop, Japan, . . .	0.13	34.00	66.00	63.60	...	2.31	1.17	...	3.50	1.00	...
<i>sibirica</i> , Ledeb., Lot 1, Seed from Ural, . . .	0.41	3.50	96.50	62.73	5.79	27.98	6.00	20.30	...	...	...
<i>sibirica</i> , Ledeb., Lot 2, Seed from Ural, . . .	0.36	0.10	99.90	78.90	...	...	...	...	21.00	...	...
<i>Libocedrus decurrens</i> , Torr., . . .	0.80	20.00	80.00	68.40	...	11.60	7.00	...	14.50	24.00	...

¹ For definition of "Real Value," see p. 278 of this volume.

DECIDUOUS TREES.

	Weight of 1000 Fresh Seeds.	The Samples contained per cent.					Of the Pure Seeds there Germinated :				In a cold Vermont.
		Refuse (Sand, Soil, Scales, etc.)	Pure Seeds.	Dead Seeds.	Sound but not Germinating ("hard") Seeds.	Real Value.	In an average temp. of 77°-82° F.				
							5 days.	10 days.	15 days.	30 days.	
<i>Alnus glutinosa</i> , Willd., German seed, crop 1900,	...	30.50	69.50	...	...	18.10	20.00	25.00	23.00	...	24.00
,, <i>glutinosa</i> , Willd., German seed, crop 1899,	11.00	...	...	13.00	...
,, <i>incana</i> , Willd., crop 1900,	...	56.50	43.50	...	...	16.10	26.00	36.00	...	37.00	48.00
,, " " " 1899,	9.00	...	...	10.00	...
<i>Betula lenta</i> , L., Philadelphia,	1.00	.0
,, " " " Massachusetts,	5.00	.0
,, <i>lutea</i> , Mchx., Philadelphia,	17.00	23.00	2.00
,, " " " Massachusetts,	24.00	...	1.00
,, <i>odorata</i> , Bechst., Swedish seed,	51.00	64.00	...	68.00	71.00
,, <i>verrucosa</i> , Ehrh., Central European seed, Lot 1,	...	63.10	36.90	...	...	21.80	23.00	53.00	...	59.00	46.00
,, <i>verrucosa</i> , Ehrh., Central European seed, Lot 2,	...	71.40	28.60	...	...	8.30	15.00	25.00	...	29.00	...
<i>Caragana arborescens</i> , Lam,	72.00	98.00	100.00	...	92.00
<i>Spartium scoparium</i> , L.,	0.23	7.30	92.70	22.00	23.17	47.44	...	21.83	37.17	51.50	71.00
<i>Ulex europæus</i> , L.,	0.24	1.20	98.80	4.44	16.31	78.05	...	71.83	74.33	79.00	58.00

XXXI. *Forestry in Kent and Sussex.* By DAVID A. GLEN,
Forester, Bedgebury Park, Goudhurst, Kent.

Somebody has called Kent the "Garden of England." Assuming the accuracy of the simile, it may be permissible to state that it is a garden which, in some respects, reflects little credit upon many of those who are responsible for its good management. Some of the hop-gardens are worked in a manner that leaves nothing to be desired; but, as a rule, little attention is given to land that is not devoted to the apparently lucrative industry of growing the seductive climber. In the economy of agriculture Kent is practically a one-crop county; and it is to be hoped it may never experience such a calamity as befell Ireland in 1845, when disease attacked the homely potato, the staple crop of "the tight little island," and brought ruin upon the land.

However, if Kentish agriculture is open to adverse criticism, the management of the majority of woodland areas in Kent, and also in the adjoining county of Sussex, is probably more so. Areas of woodland, more or less extensive, are sometimes let along with the farms, so that the tenants may grow their own hop poles. From this fact it will be readily inferred that the woods in these counties are not very valuable property. The system on which they are generally managed is one of spoliation and robbery, which it is the purpose of this paper to criticise and condemn.

The impressions most forcibly thrust upon the mind of the student of forestry during a residence in these southern counties are—first, the great natural advantages of soil and climate they possess for the production of first-class timber; and, second, the meagre extent to which these favourable conditions have been utilised. Like some pictures, the average wood of these parts looks best from a distance. Viewed from the summit of a distant hill, it may form a pleasant feature in the landscape, but a nearer view would probably be disappointing to the practical forester, who loves to see good timber or the promise of it. A walk through the wood would very likely show that it contained a few starved-looking standard trees of various sorts and ages, dotted amongst underwood or coppice, whichever it might happen to be, with occasional bare patches by way of variety, and the value of the whole perhaps not exceeding £25 or £30

per acre on land which could very easily carry a crop worth over £200 per acre.

There are some particularly fine timber trees in Kent and Sussex, but there are not many of them in the woods. It is on lawns and in pleasure-grounds, in fields, on roadsides, and in hedgerows, that the finest specimens are to be seen, because, in such situations, they are beyond the blighting influence of a defective system of woodcraft, and can grow and flourish as Nature intended that they should. Such trees strikingly demonstrate, to those who have eyes to see, the great capabilities of the soil, and the folly which prevents the multiplication of their number. The prevalence of field and hedgerow timber in those parts of the counties which the writer has visited, and the undulating and picturesque configuration of the landscape, which shows the trees to advantage, give the country an appearance of being much more heavily wooded than it really is. This appearance of density is favoured by another circumstance, namely, the utilisation of conifers as landscape trees. Beautiful specimens of the less hardy kinds are frequently to be met with growing openly in the most exposed situations—convincing proof of the mildness of the climate.

Nearly all the soils that have come under the observation of the writer in the counties of Kent and Sussex have been of the nature of rich clayey loams. Everywhere he has found the soil of sufficient quality and depth for the production of first-class timber. Nowhere has he heard of land being let for agricultural purposes at rents against which intelligent forestry could not successfully compete. The poverty of the woods is neither due to a barren soil nor to unfavourable climatic conditions. It is their management that is at fault.

At the annual dinner of the English Arboricultural Society, held at Manchester in August 1900, the Lord Mayor of Manchester, who was the guest of the Society, after confessing to an ignorance of matters arboricultural, suggested, in the course of a clever and interesting speech, that arboriculturists might profitably use chemical fertilisers to promote the growth of trees. Replying to this suggestion later in the evening, Professor Fisher said: "There were some remarks in the Lord Mayor's speech which attracted my attention. His lordship spoke of the use of fertilisers in agriculture, and suggested the possible use of such things in the production of forest trees. In regard to that, I have

to say that the real fertilisers are the dead leaves which fall from the trees. If you grow your trees dense enough and have plenty of dead leaves, they want no fertilisers at all, and that is the great point we have to do with in arboriculture. The agriculturist has to buy manure at a great cost, and supply it constantly to the land, whereas, if arboriculturists grew their forests sufficiently dense, the trees would supply their own manure."

We can imagine with what dismay the eloquent Lord Mayor and the popular professor would learn that in many of the woods in Kent and Sussex, not only the dead leaves, but every bit of herbage and vegetable undergrowth, is carefully raked together and carted away to make litter, which, after it has been well rotted in the cattle-sheds, is utilised as manure for the hop-gardens. The trees are expected to grow without the aid of any fertiliser, either natural or artificial. The writer cannot speak from experience of other southern counties, but he has been informed by natives of Hampshire that the same practice is carried out in some districts of that county.

A detailed description of the principal operations of southern woodcraft, if not instructive, will probably be interesting to northern foresters. We will take the case of the average wood already referred to. At some remote period it has been surveyed and divided into blocks, locally termed "cants," varying generally from two to three acres in extent. The dividing line between these "cants" is generally a narrow, shallow ditch, and not unfrequently these dividing lines are all that a wood can show in the way of a drainage system. The rotation for the underwood and coppice is from ten to twelve years, and on most estates it is sold as a standing crop to be cleared by the purchaser. Previous to a wood sale, the forester, or wood-reeve as he is locally termed, goes through the "cants" that are to be sold, and marks with a daub of paint a young oak here and there to indicate that they are to be left as standards. As a rule he is very sparing with his paint, and does not mark more than a tenth part of the standards that should be reserved. The immediate object he has in view is to get as high a price as possible for each "cant" of wood, and as they are sold by auction, he knows that a lavish display of red paint would have an unfavourable effect upon the bidding. The result very often leaves a doubt as to whether not only his paint but his time has not been wasted. The few isolated standards he may consider worthy of decoration with his paint-

brush, being suddenly deprived of the shelter afforded by the coppice with which they have been surrounded, receive such a check that they seldom do much good. If circumstances should favour their survival, they are apt to develop into short-boled, heavy-headed trees of little commercial value. A keen local demand for small timber suitable for hop-growers' purposes is another circumstance which influences the wood-reeve in the manipulation of the paint-brush. Pure copse, as a rule, furnishes more hop-poles per acre than copse that is dotted with over-shadowing standards, and many promising young saplings are sacrificed in consideration of this fact.

The purchasers at a sale of standing coppice and underwood are chiefly cottagers, who find in the cutting of the wood, and the preparation of the hop-poles, a profitable means of employment during the winter months. The prohibitive price of coal—1s. 8d. per cwt. at the time of writing—puts that commodity beyond the reach of this class, who, consequently, find it necessary to utilise brush-faggots and waste pieces of wood as fuel. In view of these facts, it is not surprising that the majority of labouring men in these parts are experts in the use of the axe and the faggoting-hook.

The prices realised at a recent sale, when nearly 200 acres of coppice and underwood were disposed of, do not constitute a very flattering recommendation of the system. The highest price obtained was £4, the lowest 5s., and the average was probably a little over £2 per acre. Assuming that the average was £2, 10s. per acre, and that a period of only ten years has elapsed since the last clearing of the same ground, we get a return of 5s. per annum per acre, from which must be deducted taxes, the cost of maintaining roads and fences, besides the expenses in connection with the sale. The foregoing is surely a miserable return for land situated in the "Garden of England," and carrying very few, and, in some cases, no standard trees at all. In face of such results, it is not surprising that the question should be sometimes asked, Does forestry pay? The only apparent advantage a proprietor of woodland areas derives from this easy-going system is that he is not obliged to keep a permanent staff of woodmen. How much he loses by the system it would be difficult to correctly estimate.

The wood-buyer begins operations at the close of the game shooting, or earlier if he is allowed. With his faggoting-hook he

lops off all the branches on each tree as high up as he can conveniently reach. These he ties together with a birch, willow, or hazel wand into good-sized bundles. These bundles are designated brush-faggots, and they realise from three shillings to four shillings per hundred. While proceeding with this operation, he also clears the ground of all the smaller stems, sorting out as he goes on pea-sticks, stakes, and binders, the latter being utilised for the construction of the wicker-work fences so common in the south. The next operation is the objectionable one already referred to of scraping the leaf-mould, etc., into heaps. The thorough manner in which he does this part of his business is apt to make one sigh for legislation that would make such robbery of the soil a punishable crime. Having literally cleared the ground, the next job is the felling of the trees. Although an expert axeman, the wood-buyer's work with that implement is decidedly unscientific. With right and left downward strokes of his broad-faced tool he fells his tree, throws it aside, and goes on to the next. There is no such item in his programme as the dressing of the stool, in which is frequently left a V-shaped cavity, splendidly adapted for holding water to rot the stock. After cutting a number of trees, he proceeds to dress them and sort them out in lots according to their sizes, thus:—11 feet, 12 feet, 14 feet, and 16 feet long. The tops, thick branches, and smaller stems that are unsuitable for hop-poles, fencing stakes, binders, or barrel hoops, are cut into lengths of from 3 to 4 feet, and are tied into bundles for fuel. These are termed house-faggots, and realise from twenty-four to twenty-six shillings per hundred. When the bark has been shaved off the poles—a work which is frequently done by women and children with rough draw-knives—they are ready for sale. Some proprietors, however, have the wood-cutting done by their own men, the prepared poles being afterwards sold by auction in convenient lots. This is a decidedly better arrangement, as it gives the proprietor who adopts it complete control of the work, it enables him to sell his poles direct to the hop-grower, and it keeps irresponsible plunderers out of the woods.

At two recent sales of hop-poles which the writer attended, the following were the average prices of the poles he saw disposed of:—

On Lord C——'s Estate.

12 feet poles realised about . . .	8s. 10½d.	per 100.
13 " " " " . . .	10s. 2d.	" 100.
14 " " " " . . .	13s. 7d.	" 100.

On Lord G——'s Estate.

11 feet poles realised about . . .	4s. 10d.	per 100.
12 " " " " . . .	10s. 2d.	" 100.
14 " " " " . . .	12s. 7d.	" 100.
16 " " " " . . .	13s. 8d.	" 100.

Poles of Spanish chestnut are the most highly esteemed and realise the best price, if 3d. per cubic foot—which is about the amount it works out to—can be reckoned a good price for sound timber of any kind. At the sales referred to, some of the poles had their bark on, other lots had their bark off; some had been shaved and sharpened, while the sharpened points of some other lots had made the acquaintance of the creosoting-tank.

The preference shown for chestnut poles is a contributing cause to the general poverty of the woods. When the wood-reeve undertakes planting operations, he is unduly influenced by the immediate local demand, and plants principally, if not entirely, Spanish chestnut. His whole policy is, in fact, dominated by a desire to cater for the requirements of the hop-grower, and the result of his policy can hardly be called satisfactory. Spanish chestnut undoubtedly makes an excellent copse-wood, and, under favourable conditions, is a rapid grower; but it is a light-demanding tree, and therefore not a good under-wood. Realising this fact, the wood-reeve views with more satisfaction than concern the diminishing number of standard trees in his woods, as each removal provides more head-room for his beloved chestnut poles. Young larch is much appreciated by the hop-grower when he can obtain it, and this species might with advantage be planted in many situations in place of chestnut; but it has this disadvantage in the eyes of the wood-reeve, that it does not cut and come again like the latter, and he has more love for the axe than for the spade. Probably there are estates in Kent and Sussex where a better system may obtain; but the foregoing is a pretty accurate description of the main features of forestry as it is practised in these southern counties.

The inevitable result of such mismanagement will be at once apparent to all who have given serious consideration to the subject of practical forestry. The forester working upon intelligent lines has the satisfaction of knowing that every passing year makes his woods more valuable, but here every succeeding year is making them more worthless. The timber trees are few, of poor quality, and are steadily decreasing in number. The soil they grow in is sun-baked, wind-dried, deficient in humus, and infertile. Another unfavourable circumstance is that the demand for poles for the hop-gardens is slackening off in favour of permanent wirework fixtures. As the use of such permanent fixtures becomes more general, the demand for small timber will correspondingly decrease, and it is conceivable that a few years hence even the poor prices it at present realises will not be obtainable. The foolish policy of removing the leaf-mould and herbage is responsible for the following results, viz.:—The starving of the standard trees by depriving them of their natural food; the deterioration of the soil by sun and wind, consequent upon the removal of this protecting layer; and the prevention of the natural regeneration of the woods, as the sprouting seed and tender seedling are ruthlessly swept away and doomed to rot ingloriously in the manure-heap.

In view of Monsieur Mélard's recent prediction that we are within measurable distance of a timber famine, the continuance of the methods described is not only a national reproach, but also a national danger. The convincing data on which M. Mélard bases his calculations precludes the idea that he was aiming at a cheap notoriety by playing the rôle of the prophetic alarmist, while his painstaking labours have brought into prominence a problem that demands the immediate and serious consideration of political economists throughout the civilised world, and particularly that of the British Government. His conclusions emphasise the necessity not only for an extension of our woodland areas, but also for the adoption of a better system of management in some of our existing woodlands.

That there is room in Kent and Sussex for an extension of the areas under timber, and also for an improvement in the system of their management, there is not the slightest doubt. Good forestry aims at making the earth yield her best: it is bad forestry that, with every facility for the production of the best, is content with an inferior product. The following measurements of vigorous

trees at present growing in typical Kentish soil will give a fair idea of the suitability of the land for the production of timber. When it is stated that the land on which they are growing only realises about ten shillings per acre, and that the current price of oak ranges from two shillings to half-a-crown per cubic foot, it will not seem a rash assertion to say that here, if anywhere, forestry ought to pay. The measurements given below are exact over-bark measurements, and were taken, in every case, at about the height of 5 feet from the ground. Any estimate of the probable ages of the trees could only be conjectural.

No. 1, Oak, girth, 11 feet 2 inches.	No. 9, Oak, girth, 11 feet 10 inches.
„ 2, „ „ 14 „ 6 „	„ 10, „ „ 10 „ 9 „
„ 3, „ „ 11 „ 0 „	„ 11, „ „ 12 „ 10 „
„ 4, „ „ 12 „ 0 „	„ 12, „ „ 11 „ 0 „
„ 5, „ „ 13 „ 2 „	„ 13, „ „ 13 „ 1 „
„ 6, „ „ 15 „ 4 „	„ 14, „ „ 11 „ 0 „
„ 7, „ „ 11 „ 4 „	„ 15, „ „ 11 „ 0 „
„ 8, „ „ 11 „ 0 „	

Here we have a group of fifteen oaks, not specially selected, growing within a radius of a hundred yards, and giving an average girth of over 12 feet. It seems preposterous that land which can produce such timber should be mainly utilised for the raising of an unprofitable by-product.

Thanks to the apathetic attitude of successive British Governments with regard to forestry, we are, as a nation, largely dependent upon foreign countries for a supply of timber. The chief recommendations of this foreign timber are that it is of clean growth, free from knots, and more easily worked than home-grown timber. There is, however, one class of British timber with which the foreign substitute is not, in point of quality, comparable, and that is *oak*. This fact is not so well known as it ought to be. Lancashire is the dumping-ground of a considerable quantity of foreign oak, and there are few people better qualified than the Lancashire farmer to pronounce upon its wearing qualities, and to assess its value as compared with English oak. Given his choice of two farm waggons, both of equal price, and precisely similar in every way, with the exception that one was built with English and the other with foreign oak, he would unhesitatingly choose the former. If the waggons were put up for auction, he would bid pounds more for the one built with English timber than he would for the other. He knows by experience the superior value of English oak, and

it is a pity he does not always get it when he asks for and pays for it. As all the trees represented by the foregoing measurements are healthy and vigorous, the measurements prove that Kentish soil is congenial to the oak, our most valuable timber tree. Nature, if she were not frustrated in her efforts, would in time effect the re-afforestation of the woods, and oak would be a principal factor in her working plan.

The idea entertained by most people with regard to the late W. E. Gladstone's knowledge of trees was that it was confined to the cutting of them down. That this was a wrong impression the following incident will serve to show. When courteously and proudly pointing out the beauties of some of the fine old trees at Hawarden to the members of the English Arboricultural Society a few years ago, the venerable statesman rather surprised his auditors by the statement that it is unusual to find a birch tree whose quarter-girth measurement is greater than 16 inches, and that he had never, to his knowledge, seen one larger that was also quite sound. Bedgebury Park, in Kent, the property of Isaac Lewis, Esq., contains a sound, healthy specimen of the silver birch, the quarter-girth of which, at the height of 5 feet, is $20\frac{3}{4}$ inches. Another, which is, however, showing symptoms of decay, gives, at the same height, a quarter-girth of 25 inches. On the same property there are two splendid larches, nearly a hundred feet high, which girth respectively at breast-height 7 feet 6 inches and 8 feet 7 inches, while the following measurements were also noted:—

Austrian pine,	.	.	8 feet 9 inches at 5 feet high.
Silver fir,	.	.	8 „ 3 „ „ „
<i>Wellingtonia gigantea</i> ,	.	.	8 „ 9 „ „ „
English yew,	.	.	11 „ 1 „ „ „
Scots fir,	.	.	9 „ 9 „ „ „
<i>Cedrus Libani</i> ,	.	.	8 „ 1 „ „ „

The cedar above referred to is growing by itself in a very exposed situation, and is a magnificent landscape tree. The foregoing measurements, which are by no means phenomenal, are recorded merely in support of the writer's contention that, at present prices, it would be much more profitable to grow high forest trees on land which can produce such timber than to grow coppice.

As already stated, the soils which have come under notice do not show very wide variations, being chiefly clayey loams resting

upon a free subsoil. Ash, for the production of which such land seems well adapted, and the market value of which is about equal to that of oak, is not much in evidence unless in the form of coppice.

After what has already been said, it will seem almost superfluous to repeat that the woods referred to are in a bad way. They are possessions of which the proprietors have little reason to be proud. On the contrary, taking into consideration the capabilities of the soil and the favourable nature of the climate, their condition is something rather to be ashamed of. Their past management has indeed been a continual outrage upon the laws of nature; for while it has effected the deterioration of the soil and robbed the trees of their nutriment, it has not enriched the owners of the land. Whether or not the owners realise that the poverty of their woods is due to mismanagement is doubtful. If they do not, it is time, both in their own interests and in those of the nation at large, that they should learn the truth.

It is to be hoped that the near future will witness the adoption, in Kent and Sussex, of a more rational system of woodcraft than that at present generally practised; but this cannot be brought about unless the management be placed in the hands of trained foresters.

XXXII. *A Visit to German Forests.* By FRASER STORY,
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It has been suggested to me that some notes on a visit which I recently made to Germany may prove helpful to those who contemplate a similar tour.

The reputation which German forestry enjoys in Scotland and throughout the world happily frees me from the necessity of explaining why I elected to visit Germany. The forest management of that country is characterised by scientific knowledge, and by skill and economy; and my object was to learn some of the many lessons which it teaches. During my stay I had the advantage of Professor Schwappach's friendship. In Eberswalde he extended to me his personal guidance and instruction, and all my subsequent journeys were taken under his advice. My course of study was thus directed by Prof. Schwappach, whose good name also secured for me, wherever I went, the most perfect courtesy. Owing to his able direction, I saw what was best and most typical in German forestry, and this fact gives me some confidence in penning the following notes. The journeys were undertaken in the order in which they are here set down; and to aid in locating the different places mentioned, I have arranged them under the names of the States in which they are situated.

BRANDENBURG.

The district of Eberswalde, in the province of Brandenburg, naturally falls to be described first, because it was there that I spent the first four months of my visit. It may be that the Forest Academy of Eberswalde is more famous than its woods, but for me the latter had the greater interest. I did not go to Germany to study in the lecture-room, and it was with no serious thoughts of class-work that I matriculated at the Academy, and even enrolled myself as a member of two classes. To go to these classes, however, and to inspect the rich collections of the Academy, were pleasures of which I could not too often avail myself. Being entered as a student of the Academy, one is able with the better grace to attend the College excursions. These take place regularly several times a week, and embrace studies in botany, entomology, geology, and land surveying; but the most important excursions are those connected with the practical

management of forest lands. During the summer, one of the professors drew up a working plan which will regulate operations, in the woods specified in the report, for a period of twenty years. When forest treatment is the theme of the excursion, the students have explained to them on the ground the manner of the wood's formation, its subsequent management, the lessons to be gained from its present condition, and the plans which are laid for its future control. To listen to class-room lectures in the hot sunny afternoons of June and July would have been intolerable, quite apart from the fact that practical demonstration is only possible within the forest. Such a method of teaching is undoubtedly the more perfect, because, in addition to its other advantages, it is so pleasing.

These excursions are not so frequent as to seriously interfere with the time of a student who wishes to privately investigate the surrounding forests. That work occupied the most of my time, for it will be admitted that to attempt to familiarise oneself with the 40,000 acres of State woods round Eberswalde is no light task.

The beginning of April, when I arrived in Eberswalde, is a busy season in Germany, for a commencement is then made with planting and sowing operations. Much of the forest soil near Eberswalde being of medium quality and free from a rank growth of weeds, is well suited to the direct sowing of coniferous seeds; but the planting of nursery stock obtains quite as commonly, being largely employed on the poorer soils. In the case of Scots pine, which is the prevailing tree of the district, seedlings are used in preference to older transplants, the latter coming in more for purposes of "beating up." To see the various methods of planting, which are widely different from those in vogue in Britain, and to handle the tools, is in itself an education. The large nurseries are very fine, and well repay a study of their detailed working; they are especially interesting during April and May. A seed-kiln of recent design, and a fish-hatchery, may be mentioned as adding to the instructive features of Eberswalde.

Closely surrounding the town are woods managed on the so-called Selection System. By this system individual stems or groups of trees are "selected" when mature, felled, and their places filled by planting or sowing. The method adopted in Eberswalde is to clear small areas not exceeding 120 feet in diameter, and to restock with the species indicated by the soil and situa-

tion. As soon as a group of young trees begins to suffer from shade, the older crop which immediately surrounds it is cut into towards the south and west. This allows of an extension of the young growth, and light is admitted to the existing plants. Professor Schwappach finds, in his experience of this system, that it is not advisable to make more than the one addition to the original size of the patch. One finds, therefore, scattered throughout the forest, many small plantations, and these are of varying ages and species. For the better regulation of the work, the area is divided into fifteen compartments, three of which are



SCOTS PINE REGENERATED IN STRIPS, SHOWING THE STANDARDS, EBERSWALDE.

treated each year; thus it follows that there are operations in every compartment once in five years. Careful investigation is at present being made throughout Prussia into the qualities as forest trees of many exotic species, and the group system affords excellent opportunities for a comparative study of them. The beauty of the Eberswalde woods is a quality not to be overlooked. To have regard to æsthetic effect is part of the scheme of management, as during summer thousands of visitors are there-by attracted from Berlin.

There are four forest ranges, or *reviers*, in the neighbourhood of Eberswalde, each being about 10,000 acres in extent. The town is so centrally situated that the most outlying forests may be readily reached on foot; but cycling, even through the woods, is everywhere possible, and is a great saving of time and energy. Scots pine is the most frequently occurring tree; one finds it both in pure woods and with beech, or with beech and oak, in mixture of even or of uneven age. The most common system of management is High Forest of pure pine; next is the Two-storied High Forest, where the pine is the upper, and beech, forty or fifty years younger, the lower story. Pine of even age with beech is found not to do well, but where the former has the lead, and the latter covers the ground with its shade and its litter of leaves, better pine timber is produced than under any other system. Soil and situation, however, do not always allow of such a mixture, and on the vast sandy tracts of north-east Prussia the Scots pine is found alone. The American species, *Pinus banksiana*, is showing wonderful powers of endurance upon arid, drifting sand; but whether it will ultimately supplant the common pine on the poorest land is as yet uncertain.

At Freienwalde, a few miles from Eberswalde, the occurrence of clay and heavy marly soils allows of oak being grown; while at Chorin there are pure woods of beech, so that the district is not without variety of species. Spruce and silver fir are not suitable to the locality, and are seldom met with. A memorial stone at Freienwalde, bearing the words, "*Zur Erinnerung an die Excursion der Royal Scottish Arboricultural Society*," marks the spot near the picturesque "Baa See" visited by members of the Society in August 1895. The pamphlet, "A Short Account of the State Forests of Prussia," which Dr Somerville prepared for that year's excursion, contains the most valuable information regarding the districts inspected by the Society.

THURINGIA.

In the end of May my companion (Mr Nobbs) and I accompanied Professor Schwappach in a tour through the *Thüringer Wald*. Thuringia is a mountainous district in Central Germany, lying to the east of the river Werra. Its forests are essentially coniferous, spruce largely predominating; but, especially in the vicinity of Eisenach, beech also occurs. Naturally regenerated

pure woods of beech may there be seen in all stages, from the youngest crops with the sheltering parent trees still on the ground to mature woods where fellings to bring about a full production of mast have taken place. The forestry school at Eisenach, with the able Director Dr Stoetzer at its head, is less pretentious than the Eberswalde institution, but is complete in all respects.



SPRUCE EIGHTY YEARS OLD, THURINGIA.

Professor Schwappach's work led us through the seven Prussian *reviers* of Thuringia. Throughout these ranges the High Forest system is the rule. Spruce and silver fir, which are indigenous to the district, form much the greater part of the forests, recurring to some extent in mixture together, but chiefly in pure woods. For spruce, on better quality soils, the first thinning takes place at about thirty years; but where the situation is not so good, it

is delayed until about the fortieth year. The woods are clear-felled at 100 to 120 years, the cuttings proceeding in a more or less westerly direction. Adjoining felling areas are not taken in hand in consecutive years, but an interval of five or six years is allowed to supervene, on account of the presence of the pine weevil (*Hyllobius abietis*). In many parts of Germany this insect, which causes so much damage to young conifers, is combated by digging trenches of about 9 inches deep by 6 inches broad round the area to be planted. The weevils on their way to the young crop fall into these trenches, and are later on picked out by persons sent round to destroy them. But in Thuringia this method is not practicable, owing to the stony nature of the soil. Spruce there extends to the tops of hills exceeding 3000 feet in altitude, but at the upper levels it is impossible to obtain the close canopy and clean boles that are found lower down the slopes. Silver fir grows nearly as high up as the spruce, but beech finds its limit at a height over sea-level of 2000 feet.

POMERANIA.

The tour through the Thuringian forests was the first of several excursions which I took part in during my stay in Eberswalde. Some of the places visited may be mentioned, together with their special features.

The island of Wollin, in the Baltic, showed examples of the fixation of shifting sand. On much land that was previously worse than useless excellent forests now exist: present operations are confined to maintaining these, and to keeping the margin directly along the sea-coast intact. In settling the drift on the seaward side, *Elymus arenarius* and sea buckthorn (*Rhamnus*) play an important part. Towards the crowns of the sand-dunes are rows of wattle hurdles which arrest the progress of the shifting sand; under lee of them Scots pine seed is sown and lightly covered with branches.

In the woods bordering on the sea, the Shelter-wood System is in operation. It keeps a constant cover of trees upon the ground, and so prevents the formation of sand-drift.

Not far from Wollin is Mühlenbeck, a *revier* famous for its magnificent beeches. The pure beech woods are treated under a system of natural regeneration by seed. The final fellings take place at 180 to 200 years, and consist of two preparatory fell-

ings and one seed-felling, after which, the area being then restocked, some trees are left to provide shelter against frost and drought. These old trees are removed gradually, so that when the young beech reaches a height of about 5 feet, none of the former are left. The young crop grows up in a dense thicket, which gets its first thinning at about the thirtieth year on soils of average quality. At first the thinnings are light and frequent, their recurrence being every two or three years. Later, once in ten years is often enough, when the timber removed at each thinning may average about 700 (quarter-girth) cubic feet per acre. Slopes having a north-easterly aspect are those most easy to regenerate naturally; parts which fail are usually planted with four-year-old transplants of spruce, but on the best soils sapling oaks are used. Hornbeam is indigenous in Müblenbeck, and being more frost-hardy than the beech, it takes the place of that species in low "frost-hollows." In this *revier* occurs the very uncommon mixture of oak and spruce. The species are arranged in strips, a line of oak alternating with one (in some parts three) of spruce. The usual result of such a mixture is that the spreading, surface-lying roots of the spruce deprive the oak of the soil-moisture which it demands; but here, the soil being damp and clayey, the two species do quite well together. The conditions are, however, exceptional.

North-west from Stettin, and reaching to the bay at the mouth of the Oder, is the interesting forest district of Eggesin, where natural regeneration of Scots pine can probably be seen better than in any other part of Germany. From an ordinarily treated crop of Scots pine about ninety years old, rather more than two-thirds are thinned out. This allows of the sowing of the ground by the remaining trees, and gives light enough for the development of the subsequent young crop. The final removal of the old trees is effected within ten years from the time of the seed-felling. Preparatory fellings, such as are necessary with beech regenerated in this way, are not required, owing to the thin crown which the pine carries. Blanks in the regeneration are filled up by bringing plants with the earth attached to their roots from places in the young crop whence they can be spared. While the crop is in its early stages, it has a rather ragged appearance, but older woods become more even. The soil upon which most of the forests at Eggesin are growing is simply sand blown from the sea. This overlies clay, which is found at a depth of about 3 feet.

Peat occurs only in patches of inconsiderable size, but the district forest-officer has given much attention to its treatment, and the results of his investigations are amongst the most instructive features of the *revier*.

In coniferous forests, especially before their first thinning, danger from fire is very real in Germany; and one cannot go far without seeing the damage it has caused. In Eggesin I saw an area of fully 400 acres that had just been burnt over. The charred and leafless trees stood out from the still smoking ground, a sorry spectacle. When a forest fire has fairly taken hold in a dense young wood, the saving of that wood is generally impossible, and efforts are concentrated upon limiting the destruction within certain bounds. The sections or compartments into which the forests are divided greatly facilitate this work. The size of a section is about 40 acres, and it is isolated from neighbouring parts by rides about 6 yards broad, which are frequently kept ploughed and bordered by birch or oak. When the fire is confined to the forest floor, it is encircled as quickly as possible by a strip about a yard broad being cleared of all litter and humus down to the mineral soil. The fire, running along the surface, comes to a stop upon reaching this barrier. Most of the workers, who are villagers required by law to lend their assistance in time of fire, are disposed along the dividing lines; and whenever ground-fire tries to force its way across, it is at once extinguished by a spadeful of sand.

THE HARZ.

Of the Harz mountains, the highest is the Brocken (3747 feet). It is a vast, round, broad-topped hill of no especial beauty, but interesting because of its immensity, its "spectre," and its spruce woods. The last-mentioned show what can be done in the afforestation of mountain-land under severe climatic conditions. Winter in the Upper Harz is extremely rigorous, with much snowfall, and the climate generally is said to resemble that of Central Norway. The spruce is the tree of the district; on the Brocken it reaches almost to the summit, and the other hills are entirely clothed with it. Woods grown at high altitudes in Germany are always subject to damage by snow-break; weak trees are bent to a bow-like shape, stronger stems are snapped through the middle; while in some parts whole stretches of

forest have scarcely a tree that has not suffered from the loss of its leading shoot. Here, in the Harz, the loss from this cause has been especially severe. The sylvicultural systems, etc., of the district have been ably described by Professor Somerville in the pamphlet previously referred to. Clear-fellings at 120 years are general, only the highest and most exposed parts being raised under a shelter-wood. There is an interval of three or four years between felling and restocking, which latter is effected by "bunch planting" of seedling spruce, or, as is the better practice, by using single plants of four years old.

HANOVER AND BRUNSWICK.

Each year, at the end of the summer session of the colleges, the students of the two Prussian forest academies, Eberswalde and Münden, engage in a joint excursion which lasts about a fortnight. Last autumn the tour, under the leadership of Professor Weise, was through some of the State forests of Hanover and Brunswick. To see the progress that has been made in the formation of forests upon the heath-lands of Lüneburg was one of the aims of the excursion. For this the district of Oerrel, near Lintzel, was visited. The poor, heathery moorland has been converted into capital young woods, the first planted of which are now twenty-three years old. Scots pine and spruce are in mixture of even age. Deep cultivation, by means of sub-soil ploughing in strips, is found to be most efficacious. Sowings and plantings have both succeeded, but the former are somewhat better than the latter. The trees composing the older woods have formed quite a dense canopy; the heather has been killed, and by its decay and the fall of needles, the poor, sandy soil is rapidly improving. It is doubtful how far the mixture of Scots pine with spruce is advisable. In many parts they grow well enough together; but again in others the pine has grown so much faster that it is quite suppressing the spruce, and yet, because of its rather stunted form and branchy crown, the pine is not benefiting itself. In places the Scots pine is being removed, and the spruce allowed to remain as the permanent crop. Owing to the cultivation being in broad strips, spruce has not here the struggle which it usually has with heather. Its surface roots are apt to get mixed up with the spreading heath, and it may become suppressed if Scots pine is not there to more quickly

shade the ground, and so hinder the development of the heather. I have seen a rank growth of heather very successfully kept back by using the Black pine (*Pinus austriaca*). This was in Schleswig-Holstein, where the tree grows very rapidly in youth, but falls off or dies out at about twenty years old; the spruces, which are interplanted and of the same age, then succeed the pine, ultimately forming pure woods of spruce. At Lintzel it was instructive to see the treatment of forest-land which had been laid waste by fire. The area had been cleared as quickly as possible, and the small timber, cut into lengths of 3 feet, was being converted into charcoal; while prisoners from the convict station at Oerrel were bundling all the lesser brushwood into faggots for firewood. There is a light railway at Lintzel, and the level ground allows of the steam-plough being used. The extensive young woods stand in such jeopardy from fire that the erection of a watch-tower with telephone connection has been considered a necessity.

One of the chief purposes of the Hanoverian legislature in acquiring and afforesting land in the heath of Lüneburg was to afford to private owners of such land an object-lesson in good forestry. It therefore interested me to see at Celle a property which, under conditions similar to those obtaining at Lintzel, was being transformed into forest. The owner is planting with Scots pine a part of the moor on which sheep used to graze. All the ground is not cultivated, strips only of 16 inches broad being skim-ploughed to remove the sparse growth of heather, and the soil is then stirred with the horse-plough to a depth of about 15 inches. Yearling plants are inserted in rows $3\frac{1}{2}$ feet apart, and 3 feet between the plants in the row. The partial ploughing costs less than 10s., and the Scots pine seedlings about 8s. per acre.

Amongst the places visited in this excursion, the *reviers* of Lüchow, Clötze, Bischofswald, and Grünwalde may be mentioned. The first of these provides an example of the wholesale damage wrought by the caterpillars of the Nun Moth (*Liparis monacha*). The visitation of this dreadful pest in the Lüchow district alone extended over an area of nearly 3000 acres, the forests on 1300 acres being utterly killed out. Pure coniferous forests, and particularly the older woods, are those most badly preyed upon. At Clötze also, where 76 per cent. of the area is under Scots pine, devastation by the Nun Moth is markedly noticeable, and as the

attack was preceded by serious damage to the Scots pine roots by *Trametes radiciperda*, and was followed by wind-storms and bark beetles, this *revier* is in rather a dilapidated condition at present.

Bischofswald, at Weferlingen, showed differences in tree-growth and species in accordance with changes in the soil. The geological formations run in long narrow belts from S.E. to N.W., and comprise lias, new red sandstone, weald clay, carboniferous sandstone, and alluvial soils. Where lime is present, the beech grows with great vigour, and other species in mixture with it have to be carefully protected against suppression. The sandy parts are occupied by the Scots pine. Of the wooded area, oak occupies 32 per cent., beech 28 per cent., conifers 40 per cent. Fellings take place in the case of oak at 160, beech at 120, and conifers at 100 years of age.

On the banks of the Elbe, directly opposite the small town of Schönebeck, lies the *revier* of Grünwalde. Formerly the system here adopted was that of Coppice with Standards; but since 1884 the forests have been undergoing conversion into High Forest. In these woods the elm occurs abundantly (about 30 per cent.), and also both the common and the American ash. Oak, which occupies about half of the area, has its rotation fixed at 140 years, while elm and ash will fall at 80, and soft woods at 40 years of age.

BAVARIA—THE SPESSART AND RHÖN.

The finest oaks in Europe are to be found in the Spessart. The great trees, many of them with a circumference at breast-height of over 10 feet, and with long, clean boles, rising without a branch for 50 and 60 feet, stand with their crowns clear of the underwood of beech. The function of the beech is, of course, to guard against the deteriorating influence which a crop of pure oak of advanced age always permits upon the soil. Properly regulated, the two species make an ideal mixed crop: there is the highly valuable oak, fostered and fed by the shade-bearing beech, whose dense foliage shelters the ground from drought caused by wind and sun, and whose fallen leaves keep the soil in excellent heart.

The object of management all over the Spessart is the same, namely, to produce oak timber, the quality of the soil being

maintained by means of beech. In the practical attainment of this purpose there are important modifications according to situation, past management, forest rights, etc.; but the general treatment may be said to be as follows:—Woods about to be exploited are gradually more and more heavily thinned, so that there may not be too much “raw humus,” whose acid properties would be



OAK IN THE SPESSART.

prejudicial to a young crop. This preparation of the soil usually takes about ten or twelve years, when, should a “seed year” of the oak occur, it is taken advantage of to get the area sown by natural means. But should the seeding fail or be incomplete, narrow parallel strips are cultivated, acorns sown, and the few trees left from the old crop are removed by degrees, until, at about the fifth year, none of them remain. A sufficiency of beech plants

from naturally-sown mast is always assured ; indeed, the difficulty is to repress the exuberance of that species. Owing to the existence of an ancient law, no thinnings may take place until the sixtieth year ; but certain "weedings" and the "heading off" of the most aggressive beeches are permitted. The nominal rotation-period for oak is about 280 years, and for beech 140 years ;



LARCH AND SCOTS PINE, WITH BEECH UNDERWOOD, AT BAMBERG.

Larch and Scots pine, 180 years old.

This is the second rotation of the beech.

but many of the oaks are 300 to 400 years old, and the present young woods will probably be felled at an age not exceeding 200 years. In the Spessart the age-classes are irregularly represented. Old oak (200-400 years) and plantations formed within the last forty years so predominate that there is a great deficiency in the middle-age classes. This has necessitated a spreading of the

fellings in the older woods over a number of years more than their state of maturity indicated, because by so doing the peasantry do not suffer from want of employment, the labour supply is upheld, and the timber output is more equally distributed. The servitudes with which the forests of the Spessart are burdened are not, as a rule, severely felt, because the region is thinly populated. Where this is not so, and particularly round the borders of the Spessart, coniferous forests now prevail, in consequence of the abstraction of leaf-litter, which has rendered the soil unfit for the growth of broad-leaved trees. The Weymouth pine (*Pinus Strobus*) has done conspicuously well in Bavaria; its yield per acre is said to be in some cases even greater than that of the spruce, and the appearance of some mature woods of 100 years old lends encouragement to a more universal adoption of this species.

Lying north-east of the Spessart is the Rhön district. At Brückenau, oak and beech are found on slopes with a southerly aspect. The mixture of trees by groups, each formed by a single species, is here preferred. But when the oak begins to thin out—usually about the sixtieth year—a soil-protecting underwood is introduced. This, as a rule, consists of beech, but silver fir and Weymouth pine have been tried with success on a small scale. Oberbach, a forest district not far from Brückenau is well known in this part of Germany for its natural regeneration of ash. Over basaltic rock this species thrives well, blanks which occur in the natural seeding being filled in with young plants of ash and sycamore. At about twenty years old, these woods are under-planted with beech, which thereafter grows up together with the ash. One wood of spruce on this *revier*, growing over a Red Sandstone formation, astonishes even German foresters: at 75 years old practically every tree is 100 feet high and of proportionate girth.

SAXONY.

From the oaks of the Spessart and the Scots pine of Northern Germany it was quite a change to come into the spruce woods of Saxony. The silvicultural system generally in vogue is that of High Forest, with a short rotation of 60 or 80 years, and with clear-felling and subsequent regeneration by planting. Bunch planting used to be practised, but is now entirely abandoned, single plants of four years old (transplanted at two years) being found

better in every respect. In Saxony a better price is obtained for spruce wood than for pine, which is quite the reverse of what obtains in Prussia. The spruce timber finds its chief outlet in the manufacture of wood-pulp, which is a large and growing industry in Germany.

At Tharandt, near Dresden, I visited the Forest Academy. This college, the first of its kind in Germany, was founded by Cotta in 1804. The forest garden, under the charge of the noted botanist, Professor Nobbe, dates back to the foundation of the academy. For the last thirty years Professor Nobbe has given his closest attention to the collection of plants and their systematic arrangement over the extensive grounds. It is without doubt the finest collection in Germany, and contains upwards of seventeen hundred distinct species of trees and shrubs.

SILESIA.

For the practical study of forest management, one cannot find a more suitable district than that of Allersdorf, in the Riesen Gebirge. There the steep hill-sides of broken porphyry rock would soon become barren "scree" land, were it not that the covering of forest binds the soil together and renders it fertile. The climate is harsh: in summer there is much rain, in winter much wind and snow. Snow-break does more or less injury every year, and sometimes serious damage is done, especially in woods that have been recently thinned. The species grown are exclusively coniferous, consisting of spruce, silver fir, larch, and Scots pine; but the two first mentioned predominate. Spruce and silver fir form woods in even-aged mixture together, and also in pure crops. Except on south slopes which are too dry, the silver fir successfully restocks the ground naturally. It is worked on a rotation of 100 years, during the last period of which severe thinnings take place which admit light to the forest floor, and allow the trees that remain to increase in diameter. Planting has always to be resorted to in the case of spruce, transplants being inserted about 4 feet apart. The woods are clear-felled; but in order to minimise the danger from erosion, only narrow strips are undertaken at a time, and the stumps that would otherwise be extracted are allowed to remain to hold the soil together. Compartments of the forest are divided into a number of cutting-sections, each of which is treated as a separate unit. As a precaution against attack by pine weevil, fellings do not take

place at closer intervals than five years in any one section. The fellings are so arranged that the oldest woods occupy the east, and the youngest the west or windward side. This method of protection against wind I found practised all over Germany, and it no doubt accounts for the wonderful absence of wind-blown trees. The timber of trees felled in the winter is removed during the following spring and summer, and the area is restocked one year later. Spruce requires to be barked as a precaution against bark beetles. The forests of Allersdorf, which are wholly upon mountain-land, bring in from their 8000 acres a net annual revenue of £11,200,—that is to say, they yield a return of 28s. per acre per annum, calculated on the whole area of the *revier*.

Farther into that corner of the German Empire which is bounded by Russia on the east and Austria to the south, lies the district of Proskau in Upper Silesia. The wide plain of which the *revier* forms a part is moderately fertile. The heavier soils bear oak, spruce, larch, and silver fir in various mixtures; poorer diluvial sands have crops of Scots pine in pure woods, and in association with spruce. The climate is that of Central Europe, with a hot summer and a correspondingly cold winter. These weather conditions, with an absence of the cold, raw spring of lands which lie towards the sea, suit the larch tree very well; and in woods here one finds that species with an average height of 130 feet, straight, clear of side branches, and with timber of the finest grain. But larch is grown sparingly in Germany; it is an uncertain tree to deal with, sometimes it succeeds, but more often it fails, and the use of the European species is decidedly declining. That the pursuance of proper sylvicultural principles is not altogether detrimental to sporting interests is well proved in Proskau. In this forest range there are shot each year an average of 50 red deer, 50 roe deer, one or two fallow deer, a dozen wild pig, and 500 hares. While I was there, the Oberförster brought down a twelve-pointer stag weighing 336 lbs. There is at Proskau a school for training the Förster, or lower-grade forest official. About fifteen young men live together in the school building, very much as in barracks. They are taught the elements of several sciences allied to forestry, and have a small museum for demonstration; but their main work lies in the forest, where each day specified duties are assigned to them by the Oberförster. These duties they carry through under the guidance of trained officials. The institution receives Government aid, but each scholar must pay some 9 marks per month

towards his maintenance, and provide himself with clothes and a rifle.

A forester's training is much more thorough in Germany than in Britain. One who proposes to become Förster must first show by certificate that he has acquitted himself well at a first-class school. He then goes either to such an institution as that at Proskau, or, as is more common, he is apprenticed to a district forest-officer for two years. At the end of this time he must pass an examination. For three years he serves in the army, and attends science classes in the evenings. Then comes another examination, after passing which he is designated a "Hilfsjäger"; he then receives further instruction, and eight or nine years later comes the final examination, which lasts for several days. When he has passed this successfully, he is entitled to the name of "Förstaufseher." After filling a secondary position for about five years, he becomes a fully qualified "Förster," but even then he, of course, acts entirely under the direction of his superiors in rank, whose scientific training is of a much higher standard than his.

SCHLESWIG-HOLSTEIN.

Winter was approaching when I visited Schleswig-Holstein; autumn cultivation of the soil was in progress, the fellings had begun, and I was able to take part in thinning operations. The weather conditions are very similar to those at home, dampness being the prevailing feature. The land is largely heath and bog. On the banks of the Kaiser Wilhelm Canal I saw an interesting piece of forestry work. At the formation of the canal, cuttings had to be made into a subsoil of heavy clay, and much of the material cast up was deposited in long, flat-topped mounds. After having lain unproductive for some years, the State acquired this, along with some adjoining land; and in 1899 the mounds were planted with the common alder, seedlings and two-year-old transplants being used. Up to the date of planting, no vegetation had appeared upon the heaps, and a few of these that at the time of my visit had not yet been dealt with, showed absolutely no plant-life except some struggling specimens of Coltsfoot (*Tussilago farfara*). Oak, beech, birch, Scots pine, and spruce, tried in several parts, had all failed utterly, as though the ground were poisonous; but the alder was flourishing in a surprising manner, plants of three summers' growth being 7 to 8 feet high, healthy, and of sturdy growth. The

stiff clay is no doubt chemically rich, but its physical qualities are so bad that the unsightly heaps were likely to remain barren, had not the alder succeeded in establishing itself. After forty years the alder will be felled, when it is hoped that, through the action of the tree roots and leaf-mould, the soil will be so far ameliorated that species yielding better timber may be grown. Alder finds quite a good market, however, in the neighbouring fish-curing works at Kiel.

One does not think of Schleswig-Holstein in connection with typical German forests; collectively the woodlands are small, and they occur in scattered plantations of inconsiderable size. But that only makes the resemblance to British conditions all the closer; and one can see clearly that for profitable forestry it is not necessary that individual forests should be of great extent.

The formation of woods upon peat-land is reduced to a science in Schleswig-Holstein; but it is pretty evident that where the peat is deeper than about 3 feet the bog is better left as such. Agriculture, however, has reclaimed much deep bog-land through a patient process of treatment that extends over many years. To the south of the province, and not far west from Hamburg, is the best wooded part of Schleswig-Holstein.

Much of the land in Schleswig-Holstein, as in other parts of Germany, is in the hands of peasant proprietors. Where woods exist on these lands, they are under the supervision of the State only to the extent of seeing that the area under trees is not allowed to be decreased; what is felled must be made good by the planting of a like area.

The work of planting is often done on these small holdings by "notching in" conifers in the manner which is common in Scotland. For the first two years or so but little difference is seen between plants thus inserted and those which have had pits dug for them; later, however, the contrast is very marked: the plants which have been placed in pits, and which have had the benefit of some cultivation, shoot away much more vigorously, and form better young trees. Under the "notching" method, the roots are inserted in a manner quite contrary to nature. When this occurs to the Scots pine, the tap-root is lost, and its functions can never be taken by a lateral root. The later development of the root system is hindered by its cramped position, and by the soil being wholly unworked.

"Notch" planting, as practised in Britain, is never resorted to in State forests of Germany, because experience has taught that

young plants succeed best when their roots are allowed to assume their natural position in the ground, and this is not possible with "notching." The peasants are aware of the advantages of planting in prepared pits, and many of them, in spite of their poverty, employ the more thorough method; but the ease and cheapness of "notch"-planting still attract the poorest and most thoughtless among them.

It is difficult to record, in short compass, the outlines of a tour which lasted eight months, and comprised visits to upwards of forty forest ranges. Details of practical work have had to be omitted, and only the salient features of the more important districts have been briefly indicated. I have tried to give what I thought might be helpful to others who may follow in my footsteps. I was well satisfied with the journey I made, and can thoroughly recommend a like excursion to others. No amount of mere book study can enable one to realise the actual working of Continental forestry, and Germany is no doubt the first country in the world in forest organisation and management.

It is not possible, directly and without modification, to adopt for forest lands in Britain all the practices that one sees in Germany; but the suggestions are manifold, and for successful economic forestry the guiding principles must everywhere be the same. I would impress upon any who may visit the German forests the necessity of first having a knowledge of the theory upon which scientific forestry is based. Anyone going without a fair grasp of the principles underlying sylviculture would not only be unable to take full advantage of what he might see, but would be in danger of going back with a wholly warped conception of the Continental system. For myself, I never ceased to be thankful for the instruction I had received in the Class of Forestry at the Edinburgh University. It was the best possible preparation for the right understanding of what I saw.

An acquaintance with the German language is also a desideratum, as otherwise one is bereft of speech for a month or two, and consequently is benefited by so much the less. As to the length of time which it is well to stay, I found that by leaving Scotland in the last days of March, and returning at the end of November, I saw the year's operations very well. In Germany, spring work cannot generally begin before April, and for "lumbering" operations November and onwards is the time. The cost of living is not high; about 25s. per week will be found sufficient for board and

lodging in a village or small town, and staying at a country inn one is usually charged even less. Travelling is never cheap, however, and I found that my total expenses always ran to quite £10 per month.

Throughout my tour I received every possible help and guidance. To Professor Schwappach especially my warmest thanks are due, for he made my visit the success it was. But absolutely without exception I met with the greatest kindness at the hands of the forest officers in all parts, and it gives me pleasure to be able here to record the deep sense of indebtedness which I feel to them. During the greater part of my stay I was fortunate in having the companionship of a Scotsman and fellow-student, Mr Eric A. Nobbs, B.Sc. Mr Nobbs's enthusiasm, inquiring bent of mind, and scientific knowledge, made him the best associate I could have had; and to him is attributable much of the pleasure and instruction which I have derived from my tour.

XXXIII. *Hints on the Training of Foresters.*

By R. C. MUNRO FERGUSON, M.P.

A concise little pamphlet, giving clear instructions and useful hints to huntsmen, written by Colonel Anstruther Thomson some years ago, has suggested the idea that notes on the same lines might be a helpful addition to such training as is now offered to young foresters. Experienced foresters, and especially those who are heads of families, might gather from such a paper hints useful for the education of boys intended for their own profession. Under present circumstances the best forester is likely to come out of a forester's family, for we have to depend on home rather than on technical training. Home training is of special utility in this country, because, as is often fairly urged, such training is more essential for the needs of many estates than is the most up-to-date education in a Continental forest school. Most owners want their fine trees, their effective ornamental plantations, and their good game coverts continued as they were laid down by their forefathers. At any rate, although a believer in scientific training for all purposes, I do not propose here to enter into the relative value of the scientifically educated and the self-trained forester, but simply to note the aims which should be within the reach of nearly all foresters.

The advantages of home training and early arboricultural associations are shown in the fact that a large proportion of excellent foresters come from the woodland areas of the Moray basin and of Perthshire, and that amongst this class are to be found those who most readily assimilate improved methods in the practice of forestry.

The man who intends to make a forester of his boy should turn the child's attention, and, if necessary, that of his schoolmaster, to such subjects as botany, entomology, physical geography, and geology—though he should not limit the scope of the boy's education to these subjects, for he must be trained as a citizen of the world, and be prepared, after the manner of his race, to take any post that fortune may offer him. The mind should not be confined to the technicalities of any one profession, nor the vision limited to the bounds of any one country. Even at home a forester's duties are often comprehensive, and he frequently makes an excellent ground-officer or under-factor: we probably all know

of such men who are fit to be factors, for the *perfervidum ingenium Scotorum* is well developed in this class.

On leaving school at fourteen, a boy is best suited for nursery work, which he should thoroughly master. He should accept of any good opening in a home nursery, or in one of the great commercial establishments. Besides this, he should gather experience in winter-planting, carting, and in light jobs pertaining to the upkeep of an estate. Meanwhile, he should always keep up his reading—a habit which, once dropped, is difficult to recover. Amongst the books a boy should take to, as soon as he has mastered the various primers and class books and is fit for serious reading, are—Darwin's "Elements of Botany," Schlich's "Manual of Forestry," Grigor's "Arboriculture," Michie's "Larch," Dr Ormerod's "Injurious Insects and Methods of Prevention," Cooke and Berkeley's "Fungi," "Elements of Sylviculture," by G. Bagneri, Colonel Bailey's papers on Forestry, Nicol's "Planters' Calendar," by Edward Sang, Nisbet's "Studies in Forestry," and the "Transactions of the Royal Scottish Arboricultural Society." These are some of the works, at any rate, to which many foresters readily give their attention when they come within their reach.

To stimulate a desire for reading and study, the lad's mind should be directed, by his employers and parents alike, towards finding out the reasons of things—why the Scots firs are liable to lose some of their newest shoots, and why these firs, when freshly planted, are gnawed, or, a few years later, are peeled? why larch blister and bleed, whilst ash and beech break out into lumps? and why poplars break over? He should notice the provisions of nature for the reproduction of plants, and the opportunities for co-operation open to man; what the different forest products are used for, and what they are worth. Should he leave home, let him lodge with a forester's family. Wages should be a secondary object, for the great thing at this stage is to *learn*. As the lad progresses, he should take evening classes in engineering, because, as he gets on in life, he may have to deal with traction engines, sawing benches, steam cranes, and other mechanical appliances. He should know something of architecture and carpentry, and he should work steadily at his botany, entomology, physical geography, and geology. Towards the end of his teens he should get into a bothy on the best managed estate on which he can find employment; again not troubling about pay, but weighing care-

fully the facilities that this or that estate may offer for his improvement. Where there is no bothy, he should continue to lodge with a forester, and he should spend the following few years on at least three or four of the most practically managed woodland estates. During this period he should form his opinions and perfect his proficiency in every branch of his profession. He should study economy and efficiency, especially with regard to fencing and gates (generally an extravagant item), to outbuildings, transport and marketing of wood, and the selection of the right species for the various qualities of land. He should give as much time as he has in spare evenings to assisting the estate office in keeping accounts, and in making calculations and estimates for work. He should acquire the habit of looking many years ahead in regard to the requirements of plantations, studying always the kinds and mixtures of plants that suit the different soils and exposures. The chance may come to him of taking a course at the Botanical Gardens, or of attending the University lectures; but from these he can only derive full advantage if he has received a sound elementary education.

An experiment was tried in Fife, under which a working forester attended the Edinburgh University lectures, and though he had to travel twenty-five miles each way, he could, by working near the station, and doing overtime at bookkeeping, both prosecute his studies and almost accomplish his ordinary share of work.

When it is recognised by the young forester himself, and by his employers, that he is fit to assume responsibility, he should marry, and get a section of woods to look after, or a charge of his own. For, once competent, there is no object to be gained in merely going from place to place, like a rolling stone; indeed, the shorter the period of changes the better, because, if he is fit to direct, he cannot too soon assume responsibility. Then comes the moment to think of wages, and to get the highest possible. Once established as a foreman or head forester, he should get into touch with the leading men of his profession; the Royal Scottish Arboricultural Society offers opportunities for this, and many employers help their foresters, by giving them time or money to go on the Society's excursions, which, especially those conducted abroad, are of real benefit to even the oldest and most experienced amongst us. Moreover, the owner of an estate who has a thoroughly trained forester is the more disposed to main-

tain a good forest establishment, with machinery, bothies, books, collections, or experimental areas.

Throughout the forester's training, whether it be scientific or empirical, it should always be kept in view that when he becomes a head man he must be fit to give instruction in every detail of his work—for he will have to teach his men how to keep their saws, their working tools, and machinery; he will have to train his nurserymen, pruners, drainers, hedgers, and fencers; whilst, for the general management of his woodlands, he must be able to draft a rough scheme for their systematic working, if he is to use his own powers effectively, and to make the best of his plantations.

It is all the more necessary to discuss the forester's training, because we have no regular scientific teaching open to him. Some day, perhaps, a little book of homely precepts may be written and amplified from these suggestions, and, meanwhile, the subject might be further ventilated in future numbers of our *Transactions*.

XXXIV. *Manufacturing Timber.* By JOHN M'PHERSON,
Manufacturing Forester, Novar.

To help to make the *Transactions of the Royal Scottish Arboricultural Society* the medium of exchanging views and of gaining information helpful to its members, I venture to occupy a paragraph or two in the current year's issue on the subject of Manufacturing Timber.

Timber in the remote portions of the Highland counties has to submit to very keen competition from foreign supplies landed near the places of consumption; and, unless the strictest economy is practised in the transport and manufacture of home-grown goods, there is a very narrow margin of profit left for the owner. Hence the great necessity of cheapening the various operations to be undertaken in marketing the goods. First of all, then, the question of transport from the woods to the saw-mills, and thence to the railway station or nearest seaport, has to be considered; and at the present high price of manual and horse labour one has to adopt cheap methods of transport if a revenue is to be obtained from the woods on an estate. Here traction-engine traffic has been the method usually adopted, where the position of the woods and the state of the roads made it at all practicable. By means of a traction engine and good waggons, a forester can, on a small schooner's cargo—of, say, 1800 or 2000 sleepers—even with a distance of five or six miles' carriage, effect a saving of some £16 as compared with the cost of horse-labour. The wages of a staff sufficient to work the traction engine and to load and discharge the waggons, would be 16s. 2d. per day; coal, oil, etc., would cost 6s.; upkeep of traction and waggons, say 5s.; amounting in all to 27s. 2d. per day. At this cost 500 sleepers can be carried the above distance in one day; whereas it would be necessary to employ 16 horses and carts at 7s. per day, which would amount to £5, 12s., to do the same amount of work. The above example applies to manufactured goods only; but by using the traction engine during the summer season in the woods, an equal or even a greater saving can be effected in the transport of round timber.

In the wet season, the engine is again very profitably employed in sawing up the timber. The cheapest and best class of benches for round wood will be found to be home-made wooden benches,

40 feet in length, one on each side of a part of the saw-shed. Both the saws can be driven by one good engine standing in the middle of the shed; that on the left-hand side is engaged in slabbing, while that on the right-hand side is sawing logs by piece work. Beyond the engine, and driven by its spare fly-wheel, benches 16 feet long face one another on either side of the shed, and a cross-cut saw is driven by the same shafting; these are used for cutting pit-wood, staves, and heading; so that the cross-cutting, slabbing, and sawing of these small sizes can be carried on simultaneously with the operations on the larger timber at the long benches. A mill of this kind would fully employ ten men. This is probably the cheapest and most expeditious method of cutting up timber that has yet been employed in country districts. The ordinary $9' \times 10'' \times 5''$ sleeper can be sawn in this manner at a cost of $1\frac{1}{4}$ d., plus the wages of the fireman, oil, etc., which would amount to one-eighth of a penny per sleeper. Of course, where water can be employed instead of steam power, the latter items will be saved, and many of our Scottish streams are admirably adapted for this purpose.

Creosoting Scots fir, and using it for estate purposes, such as fencing, cattle courts and stables on farm steadings, will be found a very profitable way of employing the ordinary Scots fir. By it the durability of this timber is increased at least three-fold; and the larch-wood, which has hitherto been used largely for these purposes, can be disposed of at very remunerative prices. A very handy creosoting plant can be erected for between £200 and £300, including an engine to drive it; and the great advantages derived from using creosoted timber on the estate very soon handsomely repay the first outlay. Then, the sale of creosoted fencing material should, as farmers and landowners get familiar with its use, form a very extensive industry in home-grown timber. Unfortunately, the consumers of these goods in this country are very reluctant to change their methods; and they go on using larch which costs more money, and will last less than half the time of creosoted Scots fir. This aptly illustrates what a visitor to the United States remarked lately, viz., that in that country you find everybody striving to adopt the newest ideas; whereas, in this country, people continue to practise the old ones, in spite of the clearly defined advantages of many of those which are new.

The forester in charge of the appliances which I have described

must be a keen, active, business-like man, thoroughly competent to give instructions as to how the timber is to be sawn in order to obtain the greatest quantity of marketable goods, and to cause the least waste. He must disabuse his mind of the idea that the estate exists simply for the purpose of giving employment to a certain number of men ; and also of the idea that workmen are not supposed to exert themselves so fully in the service of a proprietor as in that of a merchant or a mill-owner. The work of superintending the manufacture of from 50,000 to 100,000 cubic feet of wood in an economical and profitable way will generally be found to be quite enough for one man's capacity, apart altogether from the supervision and management of planting and growing timber. Where such a quantity of timber is annually manufactured by owners, they will find that the work is far more profitably conducted by a man set apart exclusively for these operations.

The benefit of managing timber-works economically and profitably, will be a mutual one for both employer and employees. The workpeople will have a healthy, agreeable industry, which will do a great deal more than many of the present-day schemes to keep them in the country and on the land ; and the owner will have the satisfaction of being able to derive from the soil, in remote places, a rent which it has become extremely difficult to obtain from grazing and agriculture.

XXXV. *Notes on Forest Work.* By GEORGE U. MACDONALD,
Forester, Raith.

In these days, when the annual labour-bill on a landed property amounts of necessity to a large sum, and when the price of wood and other products is relatively small, it behoves us, who are to a large extent responsible for the control and the distribution of work on an estate, and particularly on its wooded areas, to be constantly alive to the great importance of adopting the most economical methods of work.

If woods are to pay, the maximum of work in connection with their upkeep must be accomplished at the minimum of cost; and on this assumption I venture to make the following remarks, in the hope that other foresters, whose knowledge of such matters is greater than my own, may, through the pages of the *Transactions*, or otherwise, give us the benefit of their experience, and offer a few hints as to what, in their opinion, would tend to lessen the ever-increasing expenditure on the upkeep of woods and other contingent works.

FENCING.

A very important and by no means the least costly item in the forester's annual estimate of expenditure, is the erection and maintenance of fences and gates. These may be required either for the protection of woods and plantations or for agricultural purposes. In either case, the point to be aimed at is to afford sufficient protection at the least possible expense.

It is evident, I think, that on many estates the important question of fencing has not always received the attention it deserves. In erecting a fence, too many foresters cling to the old and apparently stereotyped fashion of placing stobs at 6 feet intervals, regardless of the nature of the danger against which protection is required. This, in many instances, leads to unnecessary expense. Where, for instance, a plantation or field has to be protected against the inroads of cattle and horses, and where the line of fence is more or less straight, a sufficiently efficient protection would be provided by placing stobs, or standards, 18 feet apart, and by attaching thereto three plain and two

barbed wires—the two barbs forming the topmost lines. If these are kept thoroughly strained, neither cattle nor horses will ever attempt to break through them. This will effect an enormous saving in material and labour as compared with the old custom of invariably placing the stobs 6 feet apart, while the result will be equally satisfactory. If sheep have to be reckoned with, then add another line of plain wire, and, between the stobs, fix two wooden droppers to prevent the wires from yielding when pressure is brought to bear against them. Even with the addition of droppers, this style of fence is cheap in comparison with that usually erected, for droppers can be bought for 1½d. each, while stobs cost 6d.

Another method of fencing, on a much too elaborate scale as regards the number of stobs used, is often seen. This is where one or two wires have to be erected above a wall or dry stone dyke. To place stobs, in a case of this kind, 6 feet apart is not only wasteful extravagance, but it is also most unsightly. In many instances, where dykes run fairly straight, 15 yards is not too great a distance at which to place the stobs, especially if barbed wire is used; and in no case should they be nearer than 8 yards, except at curves, where closer stobbing is unavoidable.

Other instances could be enumerated where a large reduction in material could be made without in the least degree destroying the effectiveness of the fence; but for our present purpose enough has been stated to prove that, in some instances at least, a considerable saving in money might be effected by using the minimum number of stobs and wires actually required for a given line of fence.

My experience is that the most economical wire to use is No. 8 galvanised steel wire, with four-point barbs fixed 3 inches apart.

GATES.

With regard to the question of gates, I am convinced that here too a considerable saving in material can with safety be effected. In most cases the gates used are much too heavy. This not only occasions a waste of material but is a constant source of trouble and expense in connection with the hanging of them. Unless the posts to which the gates are hung, and the necessary mount-

ings, are exceptionally strong—and this again adds considerably to the cost—they are soon borne down by their own weight, so that the end touches the ground and prevents them from swinging. From this cause they soon get knocked about and so much damaged that in a very short time new gates are required to replace them.

A very suitable gate, which is extensively used on this estate, is made out of creosoted Scotch fir rails, cut $3\frac{1}{2}$ inches wide by $1\frac{1}{4}$ inches thick. The gate consists of four bars, 10 feet long, securely nailed to ends cut out of the same material, with two angular pieces for supports, and two pieces of double rail to support the hinge-plates. The ends are 3 feet 9 inches in height, and, along with the angular pieces, are left 3 inches above the topmost bar. Across these ends is firmly stretched a barbed wire, which prevents stock from rubbing or leaning against the gate.

A gate of this description can be made and fully mounted for about twelve shillings, while those in general use cost nearly double that amount. It has the advantage, too, of being light and easily supported on its own hinges, while the post on which it is hung need not be more than 8 inches in diameter.

TOOLS.

Whatever be the nature of the work on which foresters or their labourers are employed, it is of the utmost importance that the tools used should be of the handiest description, and that they should be made from the most reliable material. There is no economy in purchasing cheap tools if the material from which they are made is not of the highest quality, for there is more time lost in sharpening and trying to work with bad tools than many people care to admit. Axes, spades, saws, and other tools, which constantly require grinding or sharpening, are best relegated to the waste iron heap. When purchasing tools, it is therefore necessary that the forester should insist upon getting them from those makers only who, experience shows, can be relied upon to supply the best possible material and make.

Another point which deserves special attention from the forester, is that his men should use the tools for the exact purpose for which they were made. It is no uncommon thing to see a man using a spade when a shovel would be more to the

purpose, or a saw when a stroke from a knife would do all that is required.

Mention of these things may seem trivial, but we must remember that they all mean money. The more efficiently a man is equipped with suitable tools—if he knows how to use them—the more work can he accomplish in a given time, and that with the greater ease to himself. Not only should men be taught how to handle tools, but what is equally important, each man should be able to sharpen and keep them in the best possible condition. A keen edge goes a long way to help forward the work. Where much felling is done on an estate, it is desirable to have a light grinding-stone, which can be conveniently carried about to the different woods where the men are at work. This saves time, and renders it unnecessary to go to the toolhouse or some other centre whenever an axe gets damaged. Another good plan is to have a few spare axes and saws always kept in readiness to replace blunt ones; in this case all grinding and sharpening would be best done by a man and a boy specially told off for the purpose—which they could accomplish in a short time once a day—the men engaged in the actual cutting being saved loss of time and anxiety in connection with their tools.

PRUNING.

There is perhaps a greater variety of tools in the market for pruning than for any other part of a forester's work. On most estates, where the invariable practice has been to mix many species of trees in a plantation, pruning—or, more correctly, relieving one species of tree from the overlapping and dominating influence of its neighbour—is too often unavoidable. I say too often advisedly; for, as a forester, I hold that this operation should not cost a tenth part of the money it commonly does now. If more attention were paid to density and to grouping, instead of mixing the various species, pruning would form a very light charge against our woods. Pruning, correctly so called, should take place before the plants leave the nursery, unless in the case of cutting away contending leaders or exceptionally strong side branches subsequently developed. Unfortunately, however, as matters stand at present, a great deal of time and money is necessarily spent in relieving one species from the more vigorous growth of its neighbour, and it is in this operation that

the forester has to judge as to the best and cheapest method of procedure. When, for instance, one has to deal with a young plantation composed of Scots fir and spruce, where the former species in most cases outgrows the latter during the first twelve or fourteen years, and where it is necessary to lop off the lateral shoots of the Scots fir so as to keep the leaders of the spruce clear, I would unhesitatingly recommend the "Standard Tree Pruner" as being the most economical tool to use. It is very light, is easily manipulated, and can be bought at prices ranging from 4s. 6d. to 13s., according to the length of the pole required,—extra blades can be bought for 1s. 6d. each. This tool should only be used for soft woods. It can be purchased from any public nurseryman or got direct from the makers. For lopping off leaders or over-reaching side branches of hardwoods of a comparatively small size, the various kinds of hand scateurs which are now in the market are well adapted. These, when kept in good order, make a clean, smooth wound. For older and taller trees the "Parrot Beak" is the quickest and simplest tool to use; while for heavier branches or limbs the hand-saw has as yet no rival. On young mixed plantations which are already partially ruined through the uncontrolled competition of the several species of which they are composed, and which are not likely to prove remunerative, the less time and expense bestowed the better. Here the best tool to use is the ordinary hedgebill, which is easily carried, and a man can probably do all that is necessary by a skilful stroke given as he walks along.

PLANTING.

Touching on the important subject of planting—for the space at my disposal will only admit of a few remarks—it is of great advantage if for "notching" half-worn spades of good quality are supplied to the workmen, as these keep a much keener edge, and are lighter to handle than newer ones.

Where, in my opinion, a considerable saving of money could often be effected in connection with the formation of woodlands, is in the size or age of the plants used in the operation. Of course much depends on the nature of the ground to be planted. There would be no economy in putting very small plants in thick, rough herbage; for the extra cleaning which they would there

require would cost more than the price charged for another year's keep in the nursery. It is, however, evident that, in a great number of cases, Scots fir and larch, two year—two year and older, are being planted on ground where two years' seedlings would do equally well and probably better. Most foresters are aware of the fact that the smaller the plants are when put out into their permanent situation, the more chance there is of the plantation turning out a success, provided always that the surface of the ground is suitable for their reception. I refer more particularly to the family of conifers. Strong, two years' seedling plants of Scots fir, for instance, can easily be bought for 6s. per 1000, while the same plants, two years later, would cost 18s. or 20s. For this reason, among others, I am a strong advocate of immediately restocking ground which has been newly felled, particularly if the old crop were such as to leave the surface comparatively bare of herbage. A cheaper class of plants can then be used, less labour is required for planting, and they have the chance of being firmly established in the ground before weeds or grass can injure them.

On an estate where large quantities of hardwoods are planted annually, I have found it a good plan to prepare pits for these early in the autumn. This practice, I know, is condemned by the author of "The New Forestry," but in my experience it has always proved most successful. I admit that all soils are not adapted for this method, such as wet ground where the pits would get filled with water, or stony ground where the scant soil is apt to get washed away by heavy rain; but I hold that, in most cases, there is nothing to justify a forester in not following this procedure. When the planting season begins, it is an immense advantage to have the ground so prepared that the plants can be put into their places immediately they are brought on to it. Besides which, the larger number of trees which can be planted in a season under this plan forms of itself a sufficient reason for its being given a fair trial.

PIECE-WORK *versus* DAILY LABOUR.

In considering how best to lessen his annual working expenses, the forester should give his careful attention to the relative advantages derived from executing certain classes of work by the piece or by the day's pay. Some localities lend themselves to one

method better than to the other. While I do not advocate that all kinds of forest work should be done by contract, I am convinced that this system should be more generally applied on some estates than it is at present. Draining, fencing, road-making, hedge-switching, and the felling of timber, particularly if it is cut clean, are all good subjects for execution by piece-work. Where a number of young men are kept on an estate, I believe that giving them the chance of doing certain classes of work by contract encourages them to acquire active habits, and helps to train their judgment in various kinds of work.

The above are a few hints out of many which might be given, showing where, in my opinion, a greater or less saving in money could be annually effected in forest work. Such savings would tend in some small measure to solve the all-important question of how to make woods pay.

XXXVI. *Notes on the Forests of Norway.*¹

By Colonel F. BAILEY.

HISTORICAL.

Historical records, together with examinations of the soil, especially of the bogs, render it certain that in former times Norway possessed much more extensive forests than it does at present, the process of denudation having been more active on the mountain ranges and along the coast-line than elsewhere. As far north as the 62nd degree of latitude, roots and other remnants of pine forests are found in bogs at an altitude of more than 300 feet above the present highest limits of growing pine. Information regarding the conditions which prevailed in very early times is defective. Existing documents show, however, that about three hundred years ago, near the mountain town of Røros, there grew a pine forest so dense that it could be crossed only by a "blazed" track; but after the lapse of one hundred years this region became completely devoid of forest. In other localities, for example on the table-land of the Dovrefjeld, the pine has been largely supplanted by birch; while the latter tree has in its turn entirely disappeared from the highest mountain slopes.

Timber was not exported in large quantities before the fourteenth century; the wood trade, however, increased considerably during the sixteenth century, by transactions with the Dutch, and it was further developed during the seventeenth century, when dealings with Great Britain were opened. It seems probable that the coast forests of the south and west, including the splendid oak forests which formerly flourished there, disappeared at about this period; so that, about the middle of the seventeenth century, the felling of forests lying farther inland had to be commenced. At the same time the mining industry was rapidly developing, and led to the consumption of vast quantities of timber.

These circumstances, together with forest fires, attack by insects, the increase of population and development of general trade, have led to the gradual disappearance of a large proportion of the ancient forests; while reckless cutting, excessive grazing, and other injurious practices have interfered with natural regeneration. The consequence is that the weather-beaten coasts and mountain

¹ Compiled chiefly from *Norway*, an official publication prepared by the Norwegian Government for the Paris Exhibition of 1900.

plateaus are now barren and desolate, while vast tracts of the country within the Arctic circle have become desert wastes. The mountain plateau of Finmarken, and to some extent the islands also, have for a long time been almost devoid of trees; but some two hundred years ago, when the settlement of these regions commenced in earnest, dense forests of birch, with some pine, flourished in many of the open, gently-sloping valleys, and at the heads of the larger fjords. Farming in the south, and the breeding of reindeer in the north, still continue the process of denudation.

The total area which remains covered by forest is believed to amount to 26,324 square miles, which represents 21 per cent. of the entire surface of the country. Of this area only about 4000 square miles are under control by the State.

About the middle of the seventeenth century, attempts were made to check the destruction of forests by means of legal enactments directed especially against the multiplication of saw-mills and the export of excessive quantities of timber. Most of the restrictions then imposed were, however, withdrawn in 1795; and since 1860 the wood-industry has been unfettered, private owners being practically free to treat their forests as they please. This freedom, coupled with the improvement of communications and a rise in the price of timber, has led to the destruction of many mountain forests, and to serious deterioration in the condition of numbers of others situated on lower ground.

The Forest Act of 1863, however, prevented the accrual of ruinous rights of user, while the continued ill-treatment of private forests compelled the State authorities to take further steps for their protection; and by the Act of 1893, municipalities have now the power to exercise control over such private forests as may be considered necessary for shelter, or which seem likely to disappear through mismanagement. That at the present time so many forests remain in the mountainous regions and in the far north, is due to the fact that the State has from time immemorial owned these remote tracts, which, though half a century ago they were practically worthless, have now acquired a high value through improved communications and the rise in prices.

When these mountain and forest regions began to become inhabited, certain parts of them which were not State property did not fall into the individual possession of private owners, and these remain as "Commons." In the ninth century the Commons were declared to be the property of the king; but they continued subject to the

rights of the neighbouring population in the way of timber, grazing, hunting and fishing. During the eighteenth and the first half of the nineteenth centuries, the State sold the best of the Commons, which thus passed into private ownership; and a part of the remainder became the property of the districts in which they were situated, being thereafter known as District Commons.

SPECIES AND DISTRIBUTION.

In southern Norway are found a few very small and scattered forests of deciduous species which cannot stand severe cold, such as beech, oak (especially *Q. pedunculata*) and wych elm. But the chief constituents of the forests crops are the Scots pine, the spruce and the birch (*B. verrucosa* and *B. odorata*). Spruce rarely forms compact forests north of the Arctic circle; but with this exception the three trees are found all over the country:—sometimes in “pure” forest covering large continuous stretches of ground, but more commonly intermixed, and with the addition of a small proportion of other species.

It is believed that about three-fourths of the total forest area are occupied by conifers, and the remaining one-fourth by deciduous trees. The pine is the chief constituent of the crop throughout the great forests of the south, and on the slopes of the Dovrefjeld up to about 62° N. lat.; but between this latitude and the Arctic circle, as well as in the extreme south-east of the country, the forests are composed principally of spruce. As regards altitude, the upper limit of pine forest is as a rule about 330 feet higher than that of spruce; but in some localities the spruce maintains itself up to the same altitude as the pine. The Mountain birch grows everywhere, spreading up to the extreme north of the country. Its limit of altitude is about 650 feet above that of the pine. In the south, the Mountain and the Lowland or White birch are found together, usually in mixture with other trees; but the birches form “pure” forest only where conifers cease to flourish, that is, on the higher mountains and in the most northerly districts.

Three distinct regions of forest growth may be discerned, viz. :—

1. *That within the Arctic Circle.*—The forests here consist principally of birch; but there are considerable tracts of pine and a few scattered spruce.

2. *The West Coast Region.*—The actual coasts, including the portion within the Arctic circle, is almost devoid of forests, except

on comparatively small areas, which are sheltered from sea-winds. More extensive and valuable forests occur, however, at the heads of the fjords and in the valleys leading down to them. Here the pine is the principal tree on the lower ground, while birch succeeds it at higher elevations.

3. *The Inland Region.*—In the eastern and southern parts of the country, conifers (pine and spruce) cover the mountain slopes from the margin of the cultivation in the valleys up to an altitude of about 2600 feet, where they are replaced by birch (*B. verrucosa* or *B. odorata*), which also often occurs as a forest tree on the outskirts of cultivation and pasture, below the belt of conifers. These last-named species in their turn give way to the dwarf birch (*B. nana*) and the willow, at altitudes of from 3200 to 3600 feet above sea-level.

SEEDING.

Forest trees in Norway produce mature seed at an earlier age than they do in more southern countries. Seed of pine and of spruce is relatively small and light, this characteristic being more marked in higher than in lower latitudes; but it is said to produce plants of a particularly hardy nature. The germinating power of the seed is also very high; it often runs to over 90 per cent. of the whole sample. Natural reproduction and development are more favourable than might be expected in a mountainous country extending considerably north of the Arctic circle. Seed-years occur at intervals of from three to five years; the intervals being shorter in the south and longer in the north.

RATE OF GROWTH AND DIMENSIONS.

In a country extending over some thirteen degrees of latitude, with considerable changes of elevation, it is to be expected that the rate of growth and the dimensions attained would vary greatly. In southern Norway the pine, when from seventy-five to one hundred years old, will, as a rule, yield logs from 23 to 25 feet in length, and from 9 to 10 inches in diameter at the smaller end. The spruce will yield logs of similar dimensions in from seventy to eighty years. But taking the country as a whole, the felling-age may be put at one hundred and fifty years for pine, and at one hundred and thirty to one hundred and fifty years for spruce; and in the more mountainous and more northerly districts a period of fifty years may be added to these ages. The height of conifers

rarely exceeds 100 feet, while in the northernmost forests 60 or 65 feet is rarely exceeded. Birch, which is for the most part reproduced by coppice, requires from eighty to one hundred years to complete its most useful development, when it may attain a height of 80 feet, with a diameter at breast-height of 5 feet.

YIELD.

The compilation of forest statistics is still far from being completed, and accurate information on all points of interest and importance is not available; but it is stated that of the thirteen counties or districts into which Norway is divided, one-fourth have a surplus of wood to dispose of, one-fourth have not more than suffices for their own use, while the remaining half of the districts are obliged to supplement their own timber resources by purchasing from others which enjoy a surplus. The annual outturn of the whole country is estimated to be about 344 millions of cubic feet, of which amount about one-fifth part is consumed at home, the remaining four-fifths being exported. This outturn, which represents only about 21 cubic feet per acre per annum over the entire forest area, is believed to exceed that which is annually produced by the growth of the forest crops.

The coniferous trees suffice, generally speaking, to provide for the wants of the country in the way of building-timber, fencing material and fuel. The timber exported is either in the round (spars, pit-props, etc.), or in the form of balks, boards, or cask-staves. Of late years a good market has been found abroad for made-up doors, windows and other builders' requisites. The Norwegian spruce, when young, is relatively free from resin, and is on this account much used for the manufacture of wood-pulp, an industry which in some localities is carried on to such excess as to threaten the very existence of the neighbouring forest crops. Spruce bark is used for tanning leather. In many parts of the country pine roots are used for the manufacture of wood-tar. Birch-wood is used as fuel and for making many kinds of tools and utensils; the inner bark of this tree is employed for the tanning of leather, while the outer bark serves for the roofing of houses; the leaves are given to cattle as fodder.

The total value of forest produce exported in 1897, together with that of the forest industries for the same year, is said to have amounted to something short of £3,500,000.

FOREST WORK AND THE TRANSPORT OF TIMBER.

According to the census of 1891, there were then 19,451 persons earning their living by working in the forests. The felling of timber is commenced about the middle of September, and is continued throughout the autumn and winter, by men who find temporary accommodation in log-huts built in the woods for the purpose. The timber is barked and collected at convenient points. When the snow is sufficiently deep and the bogs are frozen, it is dragged or otherwise conveyed to the banks of the nearest stream suitable for floating; timber shoots, dry or wet, being employed to convey the logs down mountain slopes or over rugged ground, where the use of horses would be impracticable or unduly expensive. Arrived on the bank of the stream down which it is to float, the timber is piled, and it is usually thus taken over by the purchaser, who affixes his mark to each log. In the spring, when the ice has broken up, the logs are cast into the stream, and are worked down it into one of the larger rivers, in which hundreds of thousands of loose logs may perhaps be found floating.

The log-drivers must be both skilful and experienced, and they must be thoroughly familiar with the water-way. They must regulate the amount of timber cast into the stream so as to avoid congestion; they must push off logs that go ashore, are arrested in back-waters, or caught on rocks or in narrow gorges. If a log has been stopped in such a place, increasing quantities, to the number of many thousands, may become piled up, arresting the further progress of the timber, and even perhaps closing the channel to the passage of water. Should this occur, a serious disaster may ensue; for when the barrier thus formed ultimately gives way, much of the timber forming it becomes split and broken, and the flood carries destruction to the country below. Should the commencement of such an accumulation of timber be observed, the log-drivers must deal with it promptly. Stepping out on to the logs, they loosen one after another of them by means of their hooked levers, until the remaining mass is put in motion, when they must make good their escape as best they can. This business is of a dangerous kind, demanding both skill and courage for its successful performance.

Floating work on the larger rivers is carried on jointly by the forest owners and the merchants, who act in concert; the expenses of floating the timber are divided, and control is exercised by a

body of elected managers. It is a matter of great importance to pass the timber down without any undue delay, as if it be left too long in the water, or exposed on the banks, it may become either saturated to the sinking point, or dry and cracked. Hence many of the principal water-ways have been cleared of obstructions, dams have been built in order to accumulate a reserve of water in neighbouring lakes, shoots have been constructed to pass the timber over waterfalls, or other works of improvement have been executed by the managing body for the joint benefit of all interested.

PEAT.

In parts of the country where wood-fuel is unobtainable or very scarce, the people burn peat in their houses. This practice is very prevalent in the western and northern regions. Peat-bogs, which are found almost everywhere, are estimated to cover 4600 square miles, or 3·7 per cent. of the total area of Norway. Indeed, some suppose their extent to be even larger. The peat industry is of considerable and of increasing importance. The peat is usually dug out in square pieces, which are stacked and dried in the open air; but it is sometimes either moulded in boxes and dried in the open air, or prepared by means of a specially constructed machine. The peat harvest is commenced in spring, as soon as injury by night frosts is no longer anticipated. In 1897 a peat-master, with assistants, was appointed for Finmarken; and in some other districts officials have been engaged to instruct the inhabitants in the exploitation of peat-bogs.

THE STATE FORESTS.

The following areas are under State control, viz. :—

	Sq. Miles.
1. State forests,	2241
2. State Commons, burdened by rights of the people residing in the district in which each is situated,	840
3. Attached to State farms, and the property of the "Fund for the Advancement of Education,"	254
4. District Commons,	722
	<hr/>
Total, .	<u>4057</u>

The above figures do not include 50 square miles belonging to the Kongsberg silver-mines, or 77 square miles the property of the Angell Charities.

Of the State forests, covering 2241 square miles, 1293 square miles, or more than one-half of the whole area, lie in the districts of Tromsö and Finmarken, which northern tracts, as well as many of the State forests in the mountains of the south, with many of the State Commons also, are not very productive. It follows that the really productive area under control is by no means extensive.

Since the year 1860 money has been annually granted for the purchase by the State of forests, or of land suitable for forest, especially in the most denuded districts, or where the want of shelter to farms and villages is much felt. The sum annually allotted to this purpose during the past few years has been £3500, but this amount has been augmented from time to time by special grants. The greater part of the standing forests thus purchased by the State are still suffering from past mismanagement.

During the course of the last thirty to forty years, however, planting and the rational management of forests have been undertaken in the treeless districts of Jøderen, near Stavanger, where an area of about four square miles has been planted up, as well as in other similar localities. Work of this kind has also been done by private owners acting with State aid.

The aggregate gross yield of the forests under State control for the thirty-one years running from 1859 to 1890 amounted to about £505,000, and the net yield to about £183,000. It is not quite clear to what precise areas these figures relate, but they cannot, apparently, represent more than a penny per acre per annum! As the condition of the State forests improves, their revenue will of course increase; but the numerous and troublesome privileges with which they are burdened will always entail a costly management. The capital value of these forests, without deduction for rights of user, is estimated at somewhat over £1,000,000.

It was not until the year 1857 that effective control over the State forests was established, the attempts in this direction, made about the middle of the eighteenth century, having soon been abandoned. Forest Administration is now a branch of the Agricultural Department. It is controlled by a Director, who has under his orders a staff of 41 superior officers, with 358 overseers and rangers. Valuation surveys and regular working plans have been commenced, and commercial nurseries have been formed in several places.

Establishments have also been organised for the collection and sale of the seeds of forest trees, the two largest of them being at Hamar and Voss.

FOREST SCHOOLS.

Elementary instruction in forest management is given at three forest schools, and an advanced class has been formed at the Agricultural College. The teaching of forest planting is being gradually introduced into primary schools.

NATIONAL FORESTRY SOCIETY.

During the past three or four years, interest in the management of private forests has grown rapidly, and this has led to the foundation, in 1898, of a National Forestry Society, which is managed by a State official.

CONCLUSION.

The writer of these notes has, during a recent residence in Norway, himself observed the process of forest destruction proceeding in full activity. A farmer-proprietor of his acquaintance is engaged in buying up wooded estates, from which he cuts all saleable timber and then sells the land. On completion of these transactions in connection with one estate, he buys another, and treats it similarly. The river which drains his valley was a short time ago seen to be completely blocked with the results of his operations. But, so far as could be gathered, measures will not be taken to secure the protection or regeneration of these forests.

XXXVII. *Report on the Effects of a Hailstorm to Growing Timber Crops.* By HUGH C. SAMPSON, B.Sc.

On June 12, 1900, at Holmes Chapel, Cheshire, a very violent thunderstorm, accompanied by hail, occurred, and did a considerable amount of damage both to property and to vegetation generally. This happened at about three o'clock in the afternoon, when we could see and almost feel the approaching storm. The sky became so overcast that it was impossible to read in the house. The rumbling of the thunder gradually became louder, and the flashes of lightning more vivid. The threatening clouds came from the S.E., and seemed to be beating up against wind. All Nature was hushed, and the cattle had taken shelter beneath the trees.

The storm burst with a deafening peal of thunder directly overhead, and this was almost immediately followed by the hail. In a few moments the air was full of twigs and leaves which had been cut off the trees. Many of the hailstones which worked this havoc were $1\frac{1}{2}$ inches in their longest diameter, while on an average they measured fully 1 inch. I have been told on good authority that some measured $1\frac{3}{4}$ inches in diameter. The structure of these hailstones was curious. They were all more or less flat in shape, the shorter diameter being about half the length of the longer. One surface was concave and the other was convex. Most of them had an onion-like structure, being composed of successive layers of clear and of opaque ice.

The course over which the storm passed, as is usual in thunderstorms, was quite local; it embraced a width of 2 miles and a length of about 10 miles. To give some idea of the force of the storm, I may say that over 1000 square feet of plate-glass (21-ounce), representing a quarter of the whole glass area in the greenhouses here, were broken. The opposite side of the valley, however, seemed to catch the force of the storm even more fully. At one place, roofing-glass nearly $\frac{1}{2}$ inch thick was broken; and I noticed a field of early potatoes, which were nearly ready for raising, completely stripped of all their leaves, and with only a few bare haulms left standing. The main roads, which are but slightly sheltered by trees, were strewn so thickly with twigs and leaves that these latter had to be swept up into heaps about 4 feet in height, and lying at intervals of about 75 yards. Many twigs

were left hanging to the trees, which after a few days presented quite a withered appearance.

The storm, coming as it did in the middle of June, caught the trees when in their first full leaf. Thus numbers of the still tender twigs were cut clean off, and, owing to the diminution of leaves, the amount of food assimilated by the plant was considerably lessened, while the year's growth must have been correspondingly reduced.

The wounds caused on the stems of trees were observed only on young bark which was still smooth, and no damage was seen on the bark of branches more than 2 inches thick. Coppice-shoots seem to have suffered most, as the bark was necessarily tender, owing to their rapid growth. The wounds on such shoots seem also to have much more difficulty in healing. In all cases, trees with a natural tendency to throw out horizontal branches, and especially when they were grown in the open, seem to have suffered most. The branches had then to encounter the full force of the blow from the hailstones, and thus the newly-formed wood was often badly bruised. On the other hand, trees which tend to form vertical branches, and those grown in close woods, seem to have suffered less, as they had not to meet the full force of the blow; from them the hailstones glanced off, leaving a comparatively narrow and clean cut which can soon heal. This can be very well seen in the case of the apple trees standing in the gardens here. Standard trees, which are allowed to grow naturally, have not suffered nearly so severely as those grown on the espalier system, with the branches trained horizontally.

THE AMOUNT OF DAMAGE DONE TO DIFFERENT VARIETIES OF TREES.

Coniferous trees seem to have suffered the least permanent damage; owing to the narrowness of their needles, their foliage practically received no damage, and any wounds formed on the stem were soon covered by the exudation of resin. The wounds may, however, at some future time, impair the quality of the timber.

Larch appears to have suffered most, owing most likely to the sparseness of its foliage, and to the fact that the needles come off in whorls, and leave the greater part of the stem bare.

Scots Pine appears to have been damaged to a considerable

extent, though not so badly as the larch. This is most likely due to its heavier foliage, which would more or less protect the stem.

Spruce seems to have suffered the least damage, perhaps because, being a shade-bearing tree, its living needles are carried well up the branches, and thus protect the branches on which they grow as well as those lower down.

In regard to broad-leaved trees, they may be named in the following order, commencing with those which were most damaged:—(1) willows and poplars, (2) ash, (3) sycamore, (4) oak, (5) alder, (6) beech, (7) birch. Except in the case of the willows and poplars, which have exceptionally soft bark, the order is the same as that in which these trees would stand if classified according to the thickness of their twigs, those with the thickest twigs being damaged the most.

THE OCCLUSION OF WOUNDS.

As I mentioned above, the wounds on conifers soon managed to cover themselves by means of the exudation of resin, except in the case of the Douglas fir, on which tree the wounds are still quite open. The rate of occlusion on broad-leaved trees, as far as I have been able to observe, is as follows, commencing with those which healed quickest:—(1) mountain ash, (2) beech, (3) alder, (4) ash, (5) birch, (6) sycamore, (7) oak, (8) poplars and willows.

XXXVIII. *Of Damage done to Trees by the Shale Industry.*

By a CORRESPONDENT.

The shale district in Scotland is an agricultural one, and therefore the woods are, as a rule, not large; but the soil is for the most part deep and good, and therefore capable of growing very heavy timber. The writer knew of three sycamore trees, which grew in different places. They were blown down, and the cheapest of them sold for £27, 10s. There is a larch which at one time was slightly larger than the famous tree at Dunkeld. It died about twenty years ago and the stump only now remains, while the Dunkeld tree has surpassed it by a few inches.

All hardwood trees common to this country, and some conifers, used to thrive. Of conifers, larch and Scots fir only are known to the writer to have reached great size and age, the climate being probably too dry for spruce and silver to live long enough, in full vigour, to attain giant dimensions.

About 1870 shale-mines were opened; the shale was distilled and the products of distillation were refined on the spot. The products consist of paraffin, both liquid and solid, sulphate of ammonia, lubricating oil, naphtha, and tar. The refining process requires sulphuric acid, and one refinery has for some time manufactured this substance for its own use. All these works, and the refuse shale, which is thrown out hot from the retorts, produce much smoke and noxious gas. There is coal smoke from furnaces, and dust and vapour from the heaps, one might say mountains, of shale, and there is the smell of paraffin in the air. Some of the furnaces use tar, which is one of the products of shale, as fuel; and it is probable that this produces another variety of smoke or vapour. Besides all this, there is the manufacture, and in any case the use of sulphuric acid. In short, there is much poisonous gas in the air and much black smoke; so much, indeed, that everything within a radius of some miles has become filthy. Sheep soon look black. Evergreens look dingy, except where overlapping branches moving in the wind keep each other clean. The trunks of such trees as the beech show how dirty they have become, for where a twig is blown against one of them a light-

coloured mark becomes visible. Everything, even the flowers of recent growth, are dirty and blacken the hands of anyone who picks them.

The result of this is that trees have died. First in order came spruces and silvers of all ages, and other full-grown conifers of all sorts. Then oaks and beeches, and any full-grown trees which were much exposed. But, except in the case of great exposure, sycamores and limes do not appear to suffer to any great extent, while elms have survived, though they have become unhealthy and stunted in exposed situations. Some oaks, which were very much exposed to the refinery which manufactures sulphuric acid, died with extraordinary rapidity. Within five years of their being green trees, they were not only leafless, but became gaunt poles without even a vestige of bark upon them, and the small twigs had all disappeared. Young trees do not die so quickly, but oaks and beeches do not thrive, and it does not seem worth while to plant any species of conifers, though they may live for a few years; Austrians and larches probably survive longer than any other species. As one would expect from observation of the older trees, the young trees which thrive best are sycamores and limes. Black Italian poplars grow fast and seem to thrive, but they have not yet been observed to attain maturity. The trees in the neighbourhood of other shale-works do not show such results, nor are they affected so quickly; but few, if any, other works are so large as the one referred to, and it is unknown to the writer which, if any of them, manufactures the sulphuric acid used in their refineries.

It would appear, therefore, that the shale-works are of themselves deleterious, and that they become very much more so when the sulphuric acid is manufactured on the spot. So much for the general results.

With regard to particular observations of different trees, a few examples may be of interest. Full-grown oaks first show that they are affected by becoming stag-headed, and then they die downwards with varying rapidity. In those which died quickly and lost their bark, the sap-wood was quite gone, but the red heart-wood did not appear to be affected. Beeches become gradually thinner, and frequently show a sort of eruption of the bark. Sometimes the eruption occurs without the foliage of the tree showing serious diminution, at least for a time. In one instance the writer observed the lower leaves of a beech, which of

course were in shade, to be so pale in colour as to be nearly white.

The effect on the timber is probably to make it more brittle, because when an affected tree falls, the branches and even the small twigs on the upper side of the prostrate trunk are frequently all broken by the fall instead of springing back into their original position, as one would expect if the tree were sound.

Another effect, probably caused by the sulphuric acid, is that the leaves fall rather earlier in autumn than they do in neighbouring districts which are not affected by shale-works. And this is true of districts where the harvest is generally a fortnight earlier than in the shale district. Such are the effects of the shale industry upon trees. The smoke and vapours to which they are exposed are of a mixed character, and the trees which seem to stand it best are sycamores, limes, and black Italian poplars.

XXXIX. *The White American Spruce* (*Picea alba*) *as a Wind-Mantle.* By JOHN F. ANNAND, Overseer, Haystoun Estate, Peebles.

Since the introduction and extensive cultivation within the last century of what may still be called the "newer coniferæ" (the bulk of which, though very interesting and useful as ornamental trees, are quite valueless for timber crops), the American White spruce, introduced about the year 1700, seems to have been overlooked. It is nevertheless, probably without exception, the hardiest of all the spruces in our climate.

We frequently hear of the common Norway spruce being recommended for planting as shelter-trees along the exposed edges of woods. However valuable the common spruce may be for this purpose in Continental countries, there is no doubt that in many parts of Scotland, especially along exposed seaboard, and at high elevations inland, it is one of the least suitable species, since it demands shelter itself as an indispensable condition for even moderate growth. Now in fresh, moist, and even wet soils, such as peat-bog and stiff clays, and in very severe exposures, the White spruce is found to make an excellent screen against wind for the protection of more valuable timber-producing species.

A remarkable instance of its suitability for this purpose came under the writer's notice a short time ago. On an estate in the north of Scotland, in a very bleak, exposed part of the country, a plantation had been formed about ten years ago on a peaty soil with a stiff clay subsoil. The ground formed part of what had once been a very extensive peat-moss, where peats had for long been cut as fuel for the neighbourhood. The crop as it now stands is chiefly made up of Scots fir, common spruce, and White American spruce. The three kinds mentioned seem to have been distributed fairly evenly over the ground, without special regard to the question of their ability to bear exposure from severe gales of wind.

The result is interesting and instructive. On the exposed edges of the wood, the common spruces are either killed entirely or are fast being killed by the continued action of cold frosty winds in spring. For a considerable distance into the wood also the common spruces, though not killed, are very much dwarfed in growth, are practically denuded of foliage on the exposed side, and have in fact the appearance of having been trimmed on one

side with the hedge knife. Compared with this species, the American White spruces are standing boldly to the blast on the most exposed edges. They are extremely healthy, and are making strong, vigorous growth.

The Scots firs have suffered a great deal from leaf-shedding throughout the whole of the wood, but especially on the exposed sides. They are, however, gradually recovering from this, owing no doubt to the shelter afforded by the spruces, which are now growing somewhat more rapidly than the Scots firs. Towards the centre of the wood, and where they obtain some shelter, the common spruces are growing quite vigorously, and are forming wood rather more rapidly than the American species.

On the same estate, where the two species of spruce are to be found growing side by side on exposed edges of woods, the common spruce is suffering, while the hardier American species is quite vigorous and healthy. Similar instances of the hardiness of this tree are to be found in high-lying woods in Peeblesshire and in other parts in the south of Scotland.

As a timber tree, first rank is by no means claimed for the White spruce. The quality of the timber, as grown in this country, is about equal to that of the common spruce, but the quantity of produce per acre in a given period, under favourable conditions for both species, would be somewhat smaller in the case of the American species. Good representative specimens of the White spruce timber were on view in the Canadian Section of the Glasgow Exhibition.

As already pointed out, however, the chief value of the tree in this country lies, not so much in the quality of its timber, as in its hardiness when forming shelter-strips on exposed ground. As the main element of shelter in large woods, growing on poor peaty and wet soils, and for smaller shelter-belts, it is invaluable.

It is interesting to note that *Picea alba* is extensively used for shelter-strips in woods formed on the poor heaths and dunes of Jutland, in Denmark, where it has to withstand constant exposure to the severe gales of the German Ocean.

The tree can be grown quite cheaply from seed, and the nursery treatment of the seedlings is in every respect similar to that of the common Norway spruce. A considerable amount of soil-moisture is an essential for its healthy growth and development, but otherwise it is one of the least exacting amongst forest trees as to its environment.

XL. Forestry Section of the Highland and Agricultural Society's Show at Inverness, July 1901. By D. F. MACKENZIE, F.S.I., Mortonhall, Midlothian.

A new and interesting addition to the Society's shows, and one which may become one of its permanent features, was the Forestry Exhibition, which was organised by the Royal Scottish Arboricultural Society. Arboriculture is so closely allied to agriculture, that it is hoped the exhibition will be an annual one in connection with the Highland Society's gatherings. Certainly, the promoters were able to gather together, in a very short time, a fairly representative collection of objects relating to forestry in the north of Scotland. It is intended that the effort should be principally a local one, so that each year fresh exhibits, peculiar to the district, may be brought forward.

The exhibition originated in the failure of the Arboricultural Society to secure adequate space in the Glasgow Exhibition for a display of objects connected with forestry; and the suggestion to organise it came from the Highland Society through Mr Prentice, Factor at Raith. Sir Robert Menzies, Convener of the Forestry Committee of the Highland Society, was the moving spirit in connection with the arrangements; and the whole of the exhibits were effectively laid out within the showyard, under the supervision of Mr James Gossip, of Howden & Co., Nurserymen, Inverness, who kindly became responsible for the decoration with plants in tubs, etc., both outside and at the entrance to the exhibition. In their preliminary circular, the Joint-Committees of the two Societies in charge of the matter, declared their object to be to secure the best possible exhibition, within a limited space, of objects relating to forestry in all its branches; and a ready response was made by proprietors and others in the north — the space originally allotted being found quite insufficient to meet all the applications received.

The exhibits, which were accommodated in twelve stands under cover and nine stands outside, consisted chiefly of home-grown timber, suited for practically all purposes for which timber is used. There were over twenty entries, embracing over three hundred items. Specimens of almost everything of interest in forestry were shown, from the tiny plant to the finished article of furniture. They included the produce of exotic, as well as of indigenous trees. It may not be out of place to explain a few

of the exhibits, which are referred to in the order in which they are catalogued.

Mr Munro Ferguson, M.P., contributed from sixty to seventy items, amongst which were excellent examples of Scots fir, a tree at home on Novar, and for which that estate has long been famed; a few normal specimens of larch blister; a small but very interesting collection of plants, showing the effect the various methods of transplanting have upon the roots; a quantity of manufactured timber, equal in quality to the very best imported redwood and other timber. Besides a good collection of literary works on forestry, Mr Munro Ferguson exhibited a very interesting entomological collection of forest pests, together with examples of the depredations caused by the different insects; a quantity of home-saved seeds of exotic and other conifers; and also butts of trees, showing rate of growth in girth; timber damaged by squirrels; and creosoted timber for railway and other purposes.

Sir Robert Menzies's collection was very interesting, owing to the fact that he had a large collection of furniture, consisting of panelled doors, etc., made from home-grown wood, and an excellent farm-cart and barrow made from his own Scots fir. In this exhibit was to be seen a specimen of Scots fir which did duty as one of the principal beams in Castle Menzies for the long period of three hundred and thirty years. All Sir Robert's exhibits, which had been manufactured from wood grown on his own estates, were of the best possible quality, well and clean grown, hard and very durable. It is proper to mention that Sir Robert took a great deal of trouble with his exhibit, he having taken several of the castle doors to Inverness for the purpose of showing the beauty of colour and figure of our home-grown timber, as well as its durable quality. The exhibit received much attention from the public, and was very favourably commented on.

A very neat and interesting collection of solid oak parquetry, laminated parquetry, and oak block flooring,—made from oak, teak, beech, and pitch pine,—with a few fine carved-wood panels, were shown by Turpin's Parquet Floor, Joinery, and Wood-Carving Company, Ltd., London.

The Earl of Mansfield sent a most interesting collection of timber infested with "forest pests." From the attention this exhibit received, it was evident that, to most people, the depredations shown were a revelation. Photographs of the famous Douglas fir plantations at Taymount, near Stanley, gave a good idea of what might be expected of this excellent fir as timber.

The Countess of Seafield sent, from Castle Grant, a very practical and select collection of manufactured and other specimens of home-grown timbers. This collection comprised both planted and natural-grown timber. The difference was very visible, and, to the expert, was most interesting. In this collection were specimens of timber destroyed by squirrels, and also of injury done to trees by foxes.

Mr Dyson Perrins, of Ardross, sent, from his excellently timbered estate, very good specimens of timber grown there—consisting of larch, Scots fir, and spruce, some well-made “rustic work,” and specimens of damage done to trees by beetles, black game, and squirrels.

Mr Steuart Fotheringham, of Murthly, sent, from his extensive and beautiful collection of coniferous trees, cones, foliage, and sections of exotic conifers; also a few fence posts of Douglas fir that had been fourteen years in use, and which, from the appearance they then presented, might last for fourteen years more, the sapwood only being in a state of partial decay.

Miss Fraser, of Bunchrew, showed a nice collection of exotic conifers in pots—comprising Japanese larch, *Abies nobilis*, and *Pinus rigida*; also some fir tops damaged by squirrels.

From the Blackwood Estate, Mr Sleigh sent about twenty specimens of indigenous, together with thirty specimens of exotic timber, all grown on the Blackwood Estate, near Lesmahagow. All the specimens were of good quality, and suitable for the purposes for which they were intended.

Only three wood merchants furnished exhibits :—

Mr James Mackenzie, Inverness, sent a full collection of home-grown Scots fir of good quality, as manufactured for both the English and Scotch markets—comprising the various sizes of pit-wood, sleepers, staves and heading for dried and salted goods; also boxwood, fencing posts, etc.

Messrs Souness & Spiers, Warriston Sawmills, Edinburgh, had on view a number of large heavy planks of oak, ash, elm, etc. These planks showed very clearly the colour and quality of the timber, all of which was of first-class quality.

Messrs Denholm & Co., Pit-prop Importers, Bo'ness, exhibited a neatly got-up collection of pit-wood of various lengths and thicknesses. They were the production of Norway, Sweden, Russia, and Germany. It was quite evident that the pit-woods here shown were superior to those obtained from our home woods. In the matter of bulk this was most evident.

The difference in carriage alone would represent a fair profit, especially in view of the railway companies' preferential rates for foreign goods.

A collection, not received in time to be included in the catalogue, was sent in by The Wood Syndicate, Ltd., 2 Newgate Street, London. It consisted of specimens of a large number of woods used in manufactures and arts, treated by their superheated steam drying and seasoning process. This collection deservedly received marked attention. The process, as carried out by this Company, is very important. One can go to the forest to-day, cut down an oak, an elm, an ash, or a fir, and in three days' time may begin to build a carriage or house with thoroughly dried and seasoned timber. This must be a great boon to coach-builders, cabinetmakers, and others, who have to maintain a large stock of wood, now requiring from three to five years to season in the log or plank. The wood thus treated has been thoroughly tested, and found to be harder than that seasoned by the time method. The same Company have, by their method of creosoting, overcome every obstacle to the proper impregnation of the timber. The timbers creosoted by them are found to be impregnated to the very centre. In this case, also, the timber can be tanked quite green, and in a few hours it is fully and properly seasoned, and even Pitch pine becomes thoroughly impregnated. Besides the proper impregnation of the wood-cells, any cellular contents are coagulated and "cooked," freeing the wood from the chances of being infected with the spores of the dry rot (*Merulius lacrymans*)—a pest now only too common in most timber yards. This exhibit was certainly a most instructive one.

The inventor was also in evidence. Mr Boyd, forester, Pollok, exhibited his guillotine for cutting wire netting used to make protecting cages for young plants. The machine did its work well, and it could easily be seen that, where wiring to a large extent was necessary, this machine would pay for itself very quickly.

Mr Campbell, Rosemill Cottage, Strathmartin, showed some ingenuity in piecing together an ornamental table, containing over two hundred pieces, chiefly of home-grown woods. His pitched chain and ratchet wire-strainer seemed a useful article in the hands of a capable workman.

Altogether, this Forestry Exhibition was an unqualified success. It showed, in the clearest possible manner, that good and useful timber can be profitably and rapidly grown in this country, if it be given the opportunity of doing so.

XLI. *Report of Deputation from the Society received by the Right Hon. R. W. Hanbury, M.P., President of the Board of Agriculture, 9th October 1901.*

A deputation from the Royal Scottish Arboricultural Society was received by the Right Hon. R. W. Hanbury, M.P., in the City Council Chamber, Edinburgh, on Wednesday, 9th October 1901, and submitted to him suggestions for the improvement of the practice of, and the education in, Forestry in Great Britain.

Mr Hanbury was accompanied by Mr T. H. Elliott, C.B., Secretary to the Board of Agriculture, and Mr A. Goddard, Private Secretary.

The deputation included Mr R. C. Munro Ferguson, M.P., hon. secretary; Colonel Bailey, Lecturer on Forestry in Edinburgh University; Mr D. P. Laird, Mr D. F. Mackenzie, and Mr James Cook, vice-presidents; Mr John Methven, Edinburgh; Mr John Boyd, Pollok; Mr A. Pitcaithley, Scone Palace; Mr Charles Buchanan, Penicuik; Mr James Robertson, Panmure; Mr R. Forbes, Kennet; Mr G. U. Macdonald, Raith; Mr John Annand, Haystoun; Mr Geo. Mackinnon, Melville Castle; Mr James Watt, J.P., Carlisle; Mr Alexander Milne, Edinburgh; Mr James Whytock, Dalkeith Gardens; Mr D. R. Adair, S.S.C., Edinburgh; and Mr Robert Galloway, S.S.C., secretary and treasurer.

Mr Munro Ferguson, in introducing the deputation, said: Mr Hanbury, we are met here this morning under somewhat disadvantageous circumstances, because Lord Mansfield, who was to have introduced this deputation, writes that he does not feel able to come; and we all of us here, who are united to him by many ties of regard, feel that it would have been a great advantage to have had him with us, although you will readily understand that he could not come owing to the terrible loss he has sustained. Your predecessor at the Board of Agriculture suffered at my hands some years ago, and on that occasion he asked us to submit to him a definite scheme; and this letter, which I have here, sent to him, along with a pamphlet which was written by Colonel Bailey, really contains our main request for an experimental area, where we could test the different methods of growing timber, where practical demonstrations could be made, and where also working foresters, agents, and owners could obtain technical in-

struction. We have observed with great pleasure your own interest in the subject of technical instruction for agriculture, and I might point out to you, perhaps, that if it is necessary for agriculture it is far more necessary for forestry, because the forestry crop extends probably over a century, whereas the crop in agriculture is a matter of a few weeks. Colonel Bailey will speak on the subject of his pamphlet, and Mr Pitcaithley, forester at Scone, will offer you a few observations also upon the want that is felt by the practical working forester of some provision of the character we ask. Reference will also be made to the subject of the quantity and quality of home produce, and the probable falling off of foreign supplies. Schools at which forestry instruction is provided are very considerable in number in Germany. At places like Munich there are several forestry chairs, and at the University of Giessen you find a set of forestry gardens—25 acres or so—divided into plots, in each of which a separate experiment is being carried on, to find out under which systems the greatest amount of wood can be produced per acre, and to ascertain the best means of preserving trees against various kinds of diseases and insects. We have nothing of that kind here, and no amount of private enterprise will really provide what we seek, because you can have no guarantee of continuity in private management. One proprietor or one forester may begin a demonstration of all that is required, but the chances are a hundred to one that the whole thing will be upset by his successor. The only satisfactory thing, therefore, is to have this kind of work done by the State. You will have perceived that from the time of the Select Committee on Forestry, the amount of material connected with our case is coming to be large. I have here one or two other papers which perhaps I may hand in. There are papers in our *Transactions*, and there are pamphlets and reports which have been submitted to the Board of Agriculture. We find that although we have concentrated on two or three main points, yet the demands made on the Government are on the whole pretty considerable: and if I might venture off my own bat to make a suggestion, it would be that perhaps you might consider whether a committee might not be appointed, partly official, partly unofficial, to deal with these different propositions and to make a report to you, sir. The most effective committee or commission that I ever served on was one in connection with lighthouses, some four or five years ago. We had Mr Lamb from the Post Office, Mr Kemp from the Treasury,

and one or two other very eminent officials, among whom was Sir George Nares of the Board of Trade. The result of that committee's inquiry was an immense amount of practical work, including an extension of telephonic communication and life-saving apparatus at the lighthouses and along the whole coast. I think that the mixture of an official and unofficial element is very apt to produce some workable scheme which could be submitted to heads of departments, and offers a course of possible promise for some progress being made. In this committee the suggestions which have been made could be thoroughly threshed out, and if that were done and a report submitted to you, if it met with your approval, I am sure that with that energy which we were accustomed to see in you in dealing with the Treasury, something definite might be done, and a very great need would be met.

Colonel Bailey, who next spoke, said: Mr Munro Ferguson has mentioned a pamphlet which he is good enough to say I drew up. I may say that a great deal of pains was taken to make this pamphlet a clear and concise statement of our case. It was presented to the Council of the Society, and by them, at a meeting held to consider it, was accepted as embodying their views. So far as I am aware, little or nothing has occurred since the acceptance of this memorandum by the Society to alter the position; therefore, in presenting it to you, I would urge that you should, if possible, run over the pamphlet, because there you will find the whole of our case stated. I may say that the pamphlet is on these lines. We begin by quoting the opinions of certain experts, French and German, on the system that they found in vogue amongst us. We go into the cause of these conditions, we show how reform in our methods is necessary, we deal with the forest school, if it may be so called, in Edinburgh, we explain where a model forest ought to be located, we show that a working plan to control the management should be provided, we state the financial results expected, and so forth. What I should like to emphasise at present is the very great difficulty that is found in trying to teach forestry without a proper field of practical instruction. I am well acquainted with the system of forestry instruction pursued in several Continental countries, in America, and elsewhere. I may say that in every one of these countries I have named, as well as in many others, they have great organisations for the teaching of forestry by professors. Mr Munro Ferguson has mentioned one or two instances, and I could add

half a dozen others. I was two and a half years attached to the national forestry school at Nancy, where I had the supervision of the instruction given to the Indian Forest Service pupils. I followed the course myself, and made myself fully acquainted with the system of instruction there. I was afterwards appointed by the Government of India to be the first director of the Indian forest school at Dehra Dún, and I was there for seven years. I mention these things to show that I have had experience in these matters. What I find is that in all countries where forestry education is satisfactorily given in a forestry school by professors, they have at each of such institutions a forest area under the control of the professors, who can illustrate on the ground what they have taught in the class-room. That is what we greatly feel the need of here. It is true that we have private estates to which we can go, and a neighbouring proprietor has very kindly placed his woods at our disposal, where I am permitted, as lecturer of the University, to go with the students as often as I like. This is a privilege which we highly appreciate; but, at the same time, no amount of visits to a private forest could possibly take the place of visits to an organised public forest, under a continuous and permanent system of management. Mr Munro Ferguson has mentioned the liability of a change of system on these private forests. A change of owner often means a change of system, but if you have a State forest its management is continuous. The State never dies, and the result is that, under regulations drawn up for the treatment of these woods, it is not possible for any manager to alter the system or to disturb the continuity of management, or to render the woods unsuitable for purposes of instruction. In Edinburgh, I find great difficulty in teaching forestry without such a forest area. I go to my class-room, I do my best there to tell the students what they ought to do, and explain matters as well as I can; but you will readily understand that no words can really paint the picture to the minds of the students as it might be shown to them in five minutes under the trees. In the Indian forestry school we conduct our teaching something in this way. We have three months during the rainy season, when instruction is given in the house. During the other nine months of the year the professor and his students are under the greenwood. We have a large marquee pitched, or some shelter-building erected; there the students camp out, and there, under the trees, the professor speaks, and practically illustrates what he is teaching. That, I think, is the

way to teach forestry. Here we cannot do that; I can only appeal to the ear. With a forest area under State management, the eye as well as the ear could be appealed to, and with much greater effect. Until something of this kind is accomplished, I do not see how we can have in Scotland any real practical instruction in forestry. The proposal is that we should ask the Government to provide a small area, say 5000 acres, which would be brought gradually into as perfect a condition as it could be, to act as an educational area where practical and technical instruction could be given.

The Secretary, Mr Galloway, S.S.C., read the following note on the unsatisfactory condition of the timber trade in this country, which had been prepared by Mr D. F. Mackenzie, Mortonhall, who, he said, was present, but was, unfortunately, not in a sufficiently good state of health to deliver it himself:—

With your permission I would make a few remarks upon the unsatisfactory state of the timber trade in this country, and the exhaustion of our foreign supplies. This is a question with which, I regret to say, comparatively few people have any sympathy, hence the reason why it receives such limited attention from the Government. It is, notwithstanding, a question of vital importance to this country. The unsatisfactory state of the timber trade is due to several causes, but mainly to the limited and decreasing area under timber in the United Kingdom, the want of knowledge of the best method by which the greatest possible yield of the best quality of timber can be had from the land under wood, and also the deterrent effects of taxation, and the greatly reduced revenue the landowner is now receiving from his land. These all tend not only to reduce the area under timber, but to discourage planting. Then we have to face the certain fact that the main sources of our foreign supply are year by year receding farther from the export ports. So that, with an increasing demand, we have a diminishing supply; and although the prices are enhanced, the quality has deteriorated. To a people situated as we are, this is a rather serious state of matters. Let us see how the matter exactly stands. According to the latest statistical tables, it would appear that we are at present consumers of timber at the rate of over 31 millions sterling yearly, of which only a little over 3 million pounds' worth is produced in the United Kingdom, giving a turn-over in money of about 8 millions sterling annually. Of the 28 millions' worth from abroad, 7 millions' worth comes from cur

own colonies and dependencies, and is, generally speaking, for materials we cannot grow. The remaining 21 millions' worth comes from foreign countries. It is this large sum annually sent out of the country which causes us anxiety, more especially when we are in a position to be able to produce the major part of it, thereby benefiting our own people, and assuring us of a supply within our own borders in times of trouble. The area of the United Kingdom is about 71 million acres in extent: of this area, about 26 million acres are practically waste, or are producing less than an average of 2s. per annum per acre. Of these 26 million acres, 12 million are capable of producing pine timber equal to any at present imported, and of a value, when in full bearing, of at least 18 million pounds sterling. Notwithstanding this large extent of practically idle land, we have only 3,038,848 acres under wood—England 1,665,741, Wales 181,610, Scotland 878,765, Isle of Man 826, Channel Islands 43, and Ireland 311,863. This is an extremely poor account for Great Britain. I said a minute ago that the area under timber was diminishing. In this I shall confine my remarks to Scotland. In 1812 we had an area under timber of 907,695 acres, in 1872 we had 734,488, in 1880 we had 811,703, in 1894 946,453, and per the latest return 878,765, or over 67,000 acres of a deficit. This is a very large deficit. What is the remedy for this state of things? I reply, that it can only be remedied by Government. You are entitled to ask me how could the Government do it without a mandate from the people. I would reply (1) by subsidising owners to the extent of the cost of the plants, either by supplying the plants direct, or paying for them after the plantation had been formed in accordance with any specification issued by the Board of Agriculture; (2) issuing loans at low deferred interest; and (3) taking the land compulsorily, paying for the same either by a capital sum or by an annual rent or feu-duty, leaving it in the option of the owner to redeem the land and crop upon payment of outlays, with modified interest to date. The machinery for carrying out the work might be the County Councils, advised by experts from any or all of the National Societies. In the Highlands, the Congested Districts Board. I shall be told, and quite correctly, too, that by a wholesale extension of plantations, our supply of mutton would thereby be diminished. I admit that to a certain extent that is true; but when we consider that it takes about four acres of this same land to feed one sheep, our apparent loss would be turned into a huge

gain. The producing power would be increased from 2s. per acre for mutton to at least 20s. annually for timber. To our trade we owe the increase in our population, and to that extent we owe the necessity for trading in wood. In this branch of industry we differ from almost every other nation, and I conceive it to be the duty of the Government, as it is the aim of the Royal Scottish Arboricultural Society, to remove the existing cause of that difference. We cannot always draw upon the surplus growth of foreign countries, because, apart from the fact that these supplies are getting more difficult of access, the populations are increasing, and, with the increase, the consumption of timber with them will increase in ratio. Our own demands for timber are rapidly increasing, the production is limited and more difficult of access, and the quality decidedly inferior. Under these circumstances, it appears to me to be the duty of the Government to step in and remedy this state of things. I quite admit that this is as much a question for the people as for the Government, but I believe that if the present aspect of affairs were sufficiently appreciated by the Government, and the people shown the necessity for going on with such an undertaking, and shown the great amount of wealth sent annually abroad for material we could easily produce at home, the Government would, I think, get a mandate to proceed.

Mr A. Pitcaithley, Scone Palace, said: I cannot add very much to what has been said by the gentlemen who have already spoken. I may add a word to what Mr Munro Ferguson in his paper has referred to—how poorly we compare with foreign countries in area, and how poorly also we compare with the quality of these areas. The question why the quality of home timber is not up to that of foreign is simply answered by Colonel Bailey. It is the want of education, though there are no doubt some other small side issues connected with it. For instance, the protection of game may prevent the forester from carrying out ideas, and there are other reasons; but it is an undoubted fact that the great failure to produce an article which can compete with the foreigner in quality has been the want of education. We have not had information how to grow our forests as they ought to be grown: I allude particularly to our coniferous woods, as Scotland is more a coniferous country than one of broad-leaved trees. What we have to compete against principally is Baltic timber. We have much to learn regarding the suitability of different soils to different trees. We often find a particular forest of one particular

tree where the soil suggests there should be a mixture of woods, and we find a mixed wood where only one kind of tree should be growing. We find often on a piece of low damp ground, where spruces would thrive and come to great perfection, that an attempt has been made to drain it in order to grow Scots firs, the crop of which would always be inferior, as the soil is not suited for that species. This is the first mistake, planting trees in soil not suited to their growth. Then comes a course of wrong management, and we find, even where plantations have been wisely planted, that they have been thinned at the wrong age, and the timber thereby spoiled for the purpose it was produced for. Foreign timber is always preferred in this country for building purposes, and if that is so, it stands to reason that home timber must be inferior in quality to it. Before we can get the same price for our home timber as they get for foreign, we must produce as good an article. I am speaking as a practical forester. In my young days—I am glad to say we are better now—we had not even a text-book to teach us the rudiments of forestry, and we went by the rule of thumb, which has been proved to be wrong. We get a little more light now, for there are several text-books which we can consult to keep us right, but that is not sufficient. We have perhaps plenty of theory. Various opinions are held by different authorities in the country: what we want is that a practical school should be established, where we can see for ourselves the results of good forestry. That is how, it seems to me, we can improve the quality of our timber, and until that is done it is perfectly evident, as I said before, that we cannot get the same prices for home-grown timber as are given for foreign timber.

Mr Munro Ferguson said: I think, Mr Hanbury, you may take that as the expression of the opinion of our practical foresters, nurserymen, and others who work amongst trees. There is only one point I should have referred to. I handed in a pamphlet drawn up for our Society with regard to the Sparks Bill which Mr Jeffreys brought in last year, and with which I had also something to do. I find that although it occupied the first place on the list of private members' bills at the beginning of the session, it nevertheless was unable to pass. Our feeling is that it is quite impossible for a Bill of this kind to be got through by a private member, and I think it well worth the attention of the Government. There is no doubt much damage might be saved if loco-

motive engines were fitted with such spark-guards as are used in America and elsewhere. An immense amount of damage is done, especially in the Highlands, by sparks from trains. I myself have seen, between Aviemore and Inverness, a moor on fire after the new railway was made, and that is no exceptional case. It is a serious disadvantage to the growth of timber. With the great speeds now common on railways, and with forced draughts, red-hot coals will often fly for more than a hundred yards on each side of the railway track.

REPLY.

Mr Hanbury, in reply, said: Mr Munro Ferguson and gentlemen, I will first go to the question of the Sparks Bill. I regret exceedingly that that Bill did not make more progress last session than it did. I was unfortunately ill, and not able to attend the House when its second reading came on, or I should have spoken in favour of it. To outsiders it may seem a small matter; still, as Mr Munro Ferguson said, with the forced speeds of the present day there is no doubt that a train may cause a good deal of damage by sparks flying from the engine. I feel also it is a difficult thing for a private member to fight a railway company; but something ought to be done to ensure that railway companies should take greater precautions than they do at present. It is no doubt difficult for a private individual to proceed against them, but we want the onus of proof of taking proper precautions thrown more on the railway companies than it is at present. That is the direction in which I think we ought to proceed. With regard to the main subject—that is, the question of forestry, which, I take it, is quite different from arboriculture—this deputation that has come here to-day no doubt concerns itself in the first instance with Scotland more than with the United Kingdom, or at any rate more than it does with Great Britain, with which I have to deal; for I have nothing to do with Ireland. I am bound to say, looking farther ahead, that one sees that it is a question which really concerns the whole of the United Kingdom, because the demand for timber is naturally growing every year with our increasing population, and, on the other hand, the timber supply of the world is diminishing. At any rate, it is likely that we shall have to go much farther afield to get it, and the result may be a considerable appreciation in the price of timber. I think we may take it for granted that the Forestry Committee

which sat thirteen or fourteen years ago brought out very clearly—at least it did to my mind—the fact that we are very much behind other nations in our knowledge and practice of forestry. I do not know how far that may be due to the fact that at the present moment there is no one department of State with which forestry is specially connected. You point out, for example, in your opening resolution, that the Congested District Board for Scotland should do something for forestry. Well, that is a department over which the Board of Agriculture has practically no control whatever. Then you suggest that a good deal more might be done in Scotland and England—in Scotland more particularly—for education in forestry. Well, I am determined not to allow one portion of agricultural education in England to go from the control of the Board of Agriculture; but a distinction is made in Scotland, and the Board of Agriculture, as you know, has no control over Scottish education. It is entirely in the Scottish Office. Then again, there is the Department of Woods and Forests. The Crown forests would naturally afford the best possible field for instruction in forestry. But again I point out to you that they are not under my control, but under the Office of Woods and Forests and the Treasury. As so often happens in England, and we regret exceedingly to find it so, an important subject of this kind, instead of being managed from beginning to end by one department, is split up among two or three or four. Although I am receiving this deputation to-day, do not suppose I speak with more than one quarter of authority. I have got three other colleagues to consult; but I will take care to see that what you, gentlemen, have said is laid before them. So much for the State attitude with regard to forestry. It is only fair to recollect that at any rate up to the present moment, and probably for many years ahead, until, say, a timber famine might possibly arise, the position of Great Britain is in a good many respects different from that of some of those Continental countries where, no doubt, timber-growing is made much more profitable than it is here. To begin with, in a country where coal is so abundant as it is in England, we do not have the demand on our forests for firewood which undoubtedly exists, for instance, in France, and to a great extent in portions of Germany. Then again, it is a fact that over the greater portion both of England and Scotland timber is not grown for profit. I suppose the proper way really to grow timber for profit is to grow it as one sees

it in the forests, say of Germany, where you get tall straight trees shooting up like so many poles, with nothing except a top—no branches, and nothing ornamental or beautiful about them. That, no doubt, is the proper way to grow timber for commercial purposes, but it is not the principle upon which we manage our woods in England. Here the individual, as a rule, considers to a greater or less extent not only the sporting purposes of woods, but he is also very proud of his ornamental timber; and there is no doubt that that old feeling stands very much in the way of growing, as you suggest, timber merely for commercial purposes. Then again, people say that there is a great deal of waste land in England. I am not quite sure if, after all, that is not really exaggeration. No doubt there is a good deal of land both in Scotland and portions of England where the return brought in by the land is very small. But it is quite possible that that area is not a very large one, because, after all, even land called “waste” does bring in for sporting or other purposes a fair rental, and gives to the landlord a more immediate return, and perhaps even a greater return over a large number of years, than the planting of timber might eventually produce. Then there is, as Mr Munro Ferguson has said, no great inducement to the private landlord to do very much in the way of forestry, especially as there is no guarantee that his successors might take the same view of the matter as he does, and I think there that Mr Munro Ferguson hit the right nail on the head when he said that, that being so, the State ought to take up this matter. There again our difficulty is that we have got no great State forests which we can use for educational purposes to quite the same extent as they do the forests of Germany and France. Of course we have got forests under the care of the Office of Woods and Forests. The two principal ones are the New Forest and the Forest of Dean. With regard to the New Forest, I am afraid it is hopeless to attempt to do anything there in the way of commercial planting, because if there is one thing the people have set their hearts on, it is that the New Forest shall be a national playground; and whenever the slightest enclosure takes place there for the purpose of growing timber, there is an outcry, and the Treasury and Woods and Forests have given it up as a bad job. There is the Forest of Dean, which, as you know, is a very large area, though nothing like the size of the New Forest, where there is not the same claim on the part of

the public. There the Treasury and the Woods and Forests Department have practically a free hand, and I am glad to say that during the time I was at the Treasury I took the greatest interest in the Forest of Dean. There has been inaugurated there a system under which I hope—I do not know how far it will be a benefit to Scotland—that the Forest of Dean may gradually become, what you have been urging should be formed—a sort of experimental forest, which will indicate, to those who are able to see what is being done, the proper way in which to manage a great forest like that. Colonel Bailey has spoken of the Indian Forest Department with the knowledge which a gentleman connected with it was able to bring forward. I am glad to say that while I was at the Treasury we did bring over from India a gentleman connected with the Indian Forest Department, and we got him to travel over the Continent to see the best schools of forestry, and to see the principles on which the various foreign forests are managed; and the Forest of Dean will now, under his guidance, be conducted on, I think, a much more rational basis than has ever been the case hitherto. Of course the difficulty there is one which does not arise in foreign countries, and that is in dealing with the rights of commoners. A great deal of the Forest of Dean is being enclosed. As it is enclosed, replanting is taking place, but this can only be a gradual process, for there are difficulties even there in extending the enclosures. But it is being gradually done. I have often been asked, with regard to the Welsh hills, why the Woods and Forests Department have not done more in the way of afforesting these hills. There, again, we have to deal with public feeling and the rights of commoners. The Woods and Forests Department were only too anxious to carry out the views of those who wanted to see the hills planted, but again the rights of commoners intervened, and that made it difficult for a Government Department to do any planting there. The only planting they have been able to do in Wales has been on farms which were bought specially for the purpose. The Welsh hills are suitable for planting, and their value is very small, but the rights of commoners are valued so highly that it has been found practically impossible to do planting there. I am bound to say that in England another difficulty stands in the way. I was a member of the Railway Rates Commission which sat about twelve years ago, and unless you get the timber cut up and sawn into shape on the spot, the cost of carriage of

rough timber as compared with timber prepared for the market is very great indeed. That is one way in which the foreigner gets such an enormous pull over us, as his timber, if I may use the word, is "manufactured" where it is grown, and the sea passage is so cheap that it can be landed at innumerable ports, and must at any time—even if our railway rates were a little more equable than I think they are—be able to compete with any home-grown timber to great advantage. These are some of the difficulties that surround this question. Now the last speaker laid great stress on the fact that a wrong kind of timber is very often planted, that thinning is by no means judiciously carried out, and that generally there is not that accurate, that scientific knowledge brought to bear upon forestry which those interested in the forests of the country would be glad to see much more widely spread. Well, in regard to education in Scotland, I must practically hold my tongue. Agricultural education in Scotland was taken out of the hands of my predecessors, and it is out of mine. But with regard to the English colleges to which the Government gives grants, we are doing our best to see that a certain amount of education in forestry is given, and I hope that even the limited number of men that we shall send out from these colleges with a fair knowledge of forestry will do something to do away with what the last speaker very fairly said was a serious blot on our present system, namely, that we do as a matter of fact plant entirely wrong trees, and when we have planted them we do not know how to make the most of them. I saw that on one of the deputations which waited upon my predecessor a member of it was Professor Somerville. Well, I am happy to say that Professor Somerville has now joined the staff of the Board of Agriculture. He takes a great interest in forestry, and you may depend on it in the future, that on this question of forestry I shall have a man whose experience and information will, I think, be of great service to us indeed. There is one other point I must not forget, and that is in regard to money. That is a fifth department I have to reckon with in addition to the other four I previously indicated. It is said to be always difficult to get money from the Treasury, but especially at a time like this, when money is hard to find for other purposes, the Treasury does maintain a firmer grip over the money at its disposal than it would do at other times. But, on the other hand, I am sure that in Sir Michael Hicks Beach we have a Chancellor who has

always taken a great interest in agriculture and its cognate subjects, and I feel sure any reasonable request I make to him he would grant. Of course, our main difficulty at the present moment is that which Mr Munro Ferguson has hinted at, namely, that we really want our information on this subject focussed. There is a great deal of talk at large on the subject. We recognise what I alluded to at the beginning as possible—a timber famine and a considerable rise in prices, and of course there is the further difficulty I have mentioned of this question being dealt with by so many departments. Therefore, with regard to the committee suggested, it is a little difficult for my department, before consultation with others, to give any definite pledge on the subject. I must say, however, that Mr Munro Ferguson is on right lines when he suggested that a committee, consisting partly of officials and partly of outside experts, should get together, and, as it were, focus the information on the subject, so that we may get from them some practical suggestions, and know exactly where we stand. We could get information as to what is supplied from foreign countries, and as to what is being done in this country. There is a vast amount of information floating about on this subject, partly, as I say, because so many departments are connected with it, which could be brought into one centre. I confess, as a rule, I am not a great friend of commissions or committees. There is a belief that a Minister agrees to the appointment of a commission or a committee when he wants to shelve a subject. I assure you in this case that is not my wish at all. This is a subject that should really be dealt with. Now, with regard to Mr Munro Ferguson's suggestion, what I will do is this: I will consult the other departments connected with this subject, which really is not in my own hands. I am only one of four, so far as Scotland is concerned, which can deal with this matter, and I will lay before them your views. My own view strongly is that such a committee should be appointed; I feel it has become a necessity, and you may depend on me to use my best efforts with my colleagues to see that such a committee as that suggested is appointed.

Mr Munro Ferguson said: Mr Hanbury, may I be permitted to express my extreme personal gratification at the very kind way in which you have adopted the suggestion I ventured to put before you. I quite share in your suspicion of these bodies; but a commission, like hunting, is a kind of thing that brings people

together who would not otherwise meet. I have been from pillar to post in many departments on this subject, but, as I said, it was the experience that I gained on the Lighthouse Commission, where we got the officials of two or three departments interested on the same subject together, and which led to some practical action, that made me think of the committee or commission that I have suggested. If such a committee is appointed, we have nothing further for the moment to ask.

Mr John Methven said: I have to thank you very much, on behalf of the members of the Royal Scottish Arboricultural Society, for your great kindness in receiving this deputation, and for the courtesy you have shown towards us, and for giving us such an interesting address. I have some hope that out of this conference some good may arise to forestry in this country. I am pleased to hear your remarks favourable to the passing of the Sparks Bill. I should like to make this observation, that the Government themselves are sufferers from damage by fire, for a plantation which I know something about, planted by the War Office at Barry Links, has on two occasions suffered by fire from railway engines. The sooner the Sparks Bill is passed, so much the better for our Government property. I have, on behalf of the Society, to move a vote of thanks to you.

The proceedings then terminated.

[*Note.*—We are authorised to state that it is Mr Hanbury's intention to appoint a Departmental Committee, "to inquire into and report as to the present position and future prospects of forestry, and the planting and management of woodlands in the United Kingdom, and to consider whether any further measures might, with advantage, be taken, either by the provision of further educational facilities or otherwise, for their promotion and encouragement." Mr Munro Ferguson, M.P., has been invited, and has consented to act as chairman of the committee. —Ed.]

XLII. *Report showing the Financial Results of the Cultivation of Timber.* By D. F. MACKENZIE, F.S.L., Mortonhall, Midlothian.

Under present circumstances it is scarcely possible to estimate exactly the financial results of woods and plantations grown in this country, owing to the many uses to which they lend themselves. When judiciously placed, they are of great pecuniary advantage to the surrounding district, on account of the shelter afforded and the other amenities arising from their presence. When properly managed, the direct financial profits are very considerable, as will be shown later on. In valuing woods and plantations, more often than not no notice is taken of their indirect advantages, and seldom is any account taken of the timber used for estate purposes; in fact, in eight cases out of ten the writer could get no information as to the quantity or value of wood cut and employed in the maintenance of the properties. Sales of thinnings and final clearings are all that have been entered to the credit of the Forestry Department of many estates; but in very few cases has anything approaching a complete record been kept.

Given proper management, or at least fair management, in all details, it ought to be, and is, quite possible to determine the value of a given area of plantations. Bad management upsets every calculation of profits in this as in any other business.

Land is said to be a bad or a good investment, according to the continuous yearly returns it yields in the shape of rents. Therefore Forestry, or Sylviculture, should be carried on in such a way as to give the greatest possible rent continuously. But to do this, a system of management different from that at present practised in this country must be adopted. Probably the best way to illustrate this would be to take a given piece of land at its highest present rental for any and all purposes,—say 1000 acres, of a present yearly value of 3s. per acre. The total yearly rent will be £150, which, capitalised at twenty-five years' purchase, represents £3750. Hence, taking $3\frac{1}{2}$ per cent. as the rate of interest, the yearly revenue to be produced continuously from the plantation would be £131, 5s., plus interest on cost of planting and cost of management and taxes. The question at once arises, Will any land of this value in this country produce a continual net yearly rent or revenue of $3\frac{1}{2}$ per cent. on the total

outlays? The reply is in the affirmative, provided always that the woods are planted and managed so as to yield permanently the greatest mass of timber of the best quality. A good example of how the woods on an estate should be managed was given some time ago by a writer signing himself "N. N." As an illustration, he gives a block or blocks of timbered land 800 acres in extent, with a rotation of eighty years. Ten acres were felled, and the like area planted each year. He shows that the gross annual returns from the 800 acres amount to £1377, 12s., and the total yearly expenses to £138, 13s. 4d., leaving the net yearly revenue £1238, 18s. 8d. He concludes, from the amount of the rent, that the land as capital is value for £7881, 1s. 2d.; and he contends that the timber thereon had a value of £33,416, 14s. 4d. He shows the rent to be 3 per cent. on £7881, 1s. 2d., and that therefore an area with a rotation of eighty years can furnish an equal yearly revenue continuously, the stock of which would represent a capital of more than four times the value of the land. He shows further that, after paying a ground-rent of 5s. 11d. per acre annually for the 800 acres, the block produces a forest rent of 32s. per acre annually. He also shows that the total value of the 800 acres, stock and land, amounts to £45,920. Thus,—

	£4,622	4	6	as working capital ;
	33,416	14	4	as timber capital ; and
	7,881	1	2	as ground capital.
Total,	<u>£45,920</u>	<u>0</u>	<u>0</u>	

This is, however, beyond the purpose of this paper, and therefore need not be pursued further.

In order to get the necessary information and corroborative evidence to show whether woodlands pay or not, the writer sent out a considerable number of circulars, asking for information on the following points :—

1. Extent and age of woodlands to which replies refer.
2. Value of land per acre previous to its being planted.
3. Cost of fencing, draining, and planting, and any other necessary initial outlay.
4. Cost of management, including taxes.
5. System of management.
6. Value of thinnings.
7. Value of timber taken for estate purposes.

8. Value of shootings during the existence of the plantations.
9. Value, if any, of grazings, and for what period.
10. Value of final cutting or standing crop.
11. If replanted, state age, cost, and present value, including grazings and shootings, if any.
12. Value of shelter to arable land, and how many acres sheltered.

It was stated that all replies would be treated confidentially; but notwithstanding this, only a few were returned filled up. A good many were returned partially filled up. Questions Nos. 5, 6, 7, 8, and 12 were left blank, indicating that no information could be given on these points. The greater portion of the circulars have not been returned.

From the replies received, it is quite evident that even with very ordinary management the planting of timber has been fairly remunerative, from a purely financial point of view. What, then, could be expected from a proper system of sylviculture, except that planting would be a paying concern?

It has been indicated that woods, or at all events belts of wood, pay indirectly; such belts and limited areas of planted timber having direct and very beneficial influence upon adjacent agricultural lands, and thereby increasing their rental. More especially is this the case in pastoral districts, even though they be not high-lying nor excessively exposed. There are numerous instances in Aberdeenshire, Banffshire, Perthshire, and other counties, where the value of such plantations is proved by the rent within the area so belted or wooded being higher by 50 per cent., and sometimes even more, than that of better land in the vicinity unsheltered by woods. This increase in the rent is due to the fact that the pasture comes earlier, remains later, and is not so readily burnt or scorched by the dry spring and summer winds. Cattle can be put earlier to grass, and can remain on it longer in the autumn than upon equally good or even better land which is not so sheltered from cold winds. Such sheltered lands are also very suitable for the wintering of sheep, and this, of course, increases their value to the grazier. The increase in rent thus caused is, however, very rarely credited to the woods in the estate accounts. To show clearly how this works out in practice, one instance only need be given. Let us take an estate in the south of Scotland, where land is valuable. This estate is a good example, because all the details are given. For convenience, we shall assume that the land has been bought out-

right, as it is necessary to keep a continuous crop up. This enables us to saddle the area under timber with every farthing of costs and outlays that might have to be spent were the lands changing hands. Therefore the sum of £1050 shown in the account represents the capitalised net rental, and is a hypothetical sum. It is, however, quite a proper sum, the annual rental or value of the land being the basis of calculation. (See Example I., p. 498.)

The plantations to which the foregoing account refers consist of both broad and narrow belts of mixed woods, chiefly of the broad-leaved varieties of trees. They were planted with the object of sheltering the adjoining agricultural land, which object they adequately serve. The rents of the parks sheltered have in consequence risen by over 20 per cent., and have never suffered a fall in rent. The ages of the crops range from two to eighty years, the whole ground being always kept covered. The timber thinned out, for which there is a good demand, is either sold or used for estate purposes. The crop is at present at the age when the growth of timber is most rapid, and in a few years it will be very much more valuable. These plantations receive little or no attention in the way of pruning or thinning, the object being simply shelter, and therefore the crop is not of the value that it might have been had the area been judiciously managed from time of planting till now. But the owner seemed to think that so long as shelter for his parks and cover for game were maintained, all the good that could be expected was got; in other words, the planting was not carried out with a view to producing a profitable crop of timber. It is, however, quite different in the case of large areas planted by way of investment. In these areas slipshod management tells more heavily. Account No. II. shows what may be expected of this kind of plantation with ordinary management. (See Example II., p. 499.)

The fencing of the wood to which the foregoing account refers was of the turf and ditch type, the total cost being about £90. The plants consisted of Scots fir seedlings with a few larch. Included with the results of the final cutting are several heavy thinnings. The return states that there was no game. The grazings were let to crofters, and for wintering sheep.

The following two accounts (Examples III. and IV., pp. 500 and 501) will further illustrate what has been done, and what may be done under ordinary management:—

EXAMPLE I.

To 80 acres of land at 10s. 6d. per acre net price, 25 years' purchase,	£1050 0 0				
Expenses of transfer (proportion), say	20 0 0				
Cost of planting 80 acres,	240 0 0				
Proportion of cost of fencing,	180 0 0				
		£1490 0 0			
Amount of interest on capital ex- penditure of £1490 for 35 years at 4 per cent.,	2086 0 0				
Amount of taxes for 85 years,	510 0 0				
Amount for repairs and management,	960 0 0				
Cost of replanting various portions,	170 0 0				
Amount of profit,	4175 13 0				
					£9391 13 0
					<hr/>
By Amount for early thin- nings—no account,	£121 13 0				
Cash for thinnings sold,	1100 0 0				
Amount of various sales, —falls,	1380 0 0				
Amount taken for estate purposes,				£2601 13 0	
Proportion of game rent for 46 years,				960 0 0	
Present value of standing crop,				1960 0 0	
Value of shelter to grass and other crops— 300 acres at 5s. per acre per annum,			£3000 0 0		
Less depreciation of 10 acres overshadowed, at 10s.,			200 0 0		
					2800 0 0
Value of land as pur- chased,			£1050 0 0		
Increase in value through deposits of leaves, etc., at 5s. per acre,			20 0 0		
					1070 0 0
					<hr/>
					£9391 13 0

EXAMPLE III.

To Planting, fencing, and "beating-up" of 1000 acres of sandy moor, planted 1779-1782,	£1,200 0 0	By Cash, various sales to 1820,	£420 4 0
" Expense of thinning, dragging, and lotting, 1800,	£130 10 0	" Cash, various petty sales and large thinnings, 1830-1860,	16,537 0 0
" Expense of thinning, dragging, and lotting, 1800-1820,	426 0 6		
" Cost of various works, roads, saw-pits, and thinning, to 1830,	336 10 0	Total for thinnings and small "falls," 1864-1872,	£16,957 4 0
" Thinning and lotting to 1860,	340 0 0	" Cash, final cuttings, 1864-1872,	62,250 0 0
" Expenses of sales (?) 1864-1872,	352 12 0	" Game rent (no entry), . . . . .	...
		" 16 years grazing rent at £12,	192 0 0
" Amount of rent of land, 93 years at £10,	1,585 12 6		
" Taxes and "calculated" amount of wages,	930 0 0		
" Interest on £1200 at 5 per cent.,	850 10 6		
" Apparent cash balance,	5,580 0 0		
	69,253 1 0		
	<u>£79,399 4 0</u>		
			<u>£79,399 4 0</u>

EXAMPLE IV.

To Cost of planting and fencing 187 acres,	£654 10 0
„ Cost of replanting portions,	30 0 0
„ Cost of management and taxes,	1,340 0 0
„ 80 years' rents of 187 acres at 1s.,	748 0 0
„ Interest on rents and initial cost for 40 years,	3,245 13 4
„ Apparent balance,	14,301 16 8
	<hr/>
	£20,320 0 0
	<hr/> <hr/>

This is a very fair example of how woods in this country are at present managed.

By Wood for estate and other purposes, £10,500	0 0
„ Cash for wood sold,	3,400 0 0
„ Standing crop,	5,670 0 0
„ Game rent for 15 years at £50,	750 0 0
	<hr/>
	£20,320 0 0
	<hr/> <hr/>

From the value of standing crop, this seems an old transaction.

Another example may be given. It is that of a wood in the north of Scotland. The wood, which was 26 acres in extent, consisted chiefly of larch and Scots fir. The cost of planting, fencing, and draining was £84, 10s.; forty-five years' rent at 10s., £585; amount of taxes, repairs, and management, £409, 10s.; interest on capital expenditure (£84, 10s.) at 4 per cent. for forty-five years, £152, 2s.—Total charge, £1231, 2s. Three sales of thinnings took place, realising the total sum of £1040; proceeds of final cutting, £1560—Total, £2600; which leaves an apparent profit of £1368, 18s. It cannot be traced whether the cost of thinning is included in the cost of management, or falls to be deducted from the total sums received. At the last thinning, however, as well as at the final cutting, the trees were splash-marked, and felled by timber merchants. The following figures show net results, and refer to thirty enclosures, extending over 2320 acres. The net valuation of standing timber and sales is £87,270. There is no mention of either the rent of the land or of the interest on capital expended. One wood, 300 acres in extent, gave a net return of £16,000 for the fifty years it stood. The land was of no value previous to its being planted. On the same site there is now growing a thriving plantation of Scots fir and larch, worth about £10,000 gross.

From the counties of Aberdeen, Banff, Inverness, Moray, and Perth, a number of figures on the same lines are available; but the results are so similar that to insert them here would simply be a repetition of what has gone before.

There are a few returns which, on being analysed, show a decided loss, accounted for by remarks such as "Injudicious planting," "Destroyed early in life by game," "Would have paid well if properly managed," "Not planted for profit," "Everything in forestry has to give way to the gamekeeper." Such are some of the reasons given for woods, though fairly extensive, not being remunerative.

The following is an account of an unremunerative plantation. A piece of land, 15 acres in extent, planted about 1800, was cut in 1868, realising only £350. The land was replanted in 1869, at a cost of £4 per acre. This crop was, however, eaten down by game, and had to be replanted in 1871, at a cost of £3, 10s. This also was eaten down, and the wood was again planted at a cost of £2; so that the total cost of planting came to £9, 10s. per acre. The value of the crop at this date is under £15 per acre. Not far from this wood is an

equally bad one. A considerable extent of land was planted with larch, Scots fir, and spruce. The species had been badly selected for the soil and situation, and game had done its work early, the result being that at the age of thirty-eight the sale-value of the timber on the land amounted to less than the original cost of planting.

On an estate in the north of Scotland, a piece of land 36 acres in extent, worth 10s. per acre as pasture, was planted with larch, with some spruce and Scots fir. Four thousand trees per acre were planted. The trenching, fencing, and planting cost £11 per acre. Thinnings took place at 14, 20, 28, 35, and 45 years, and the final cutting at 60 years of age. The total cost per acre was £44, 15s. Of the 4000 trees planted, only 2580 were accounted for, 1400 odd trees per acre were lost through bad management or other causes. The money received for the 2580 trees was £189, 11s. 8d., and the owner is satisfied that he made a profit of £144, 16s. 8d. per acre. I think this is hardly correct, because no allowance is made for the loss of sixty years' rents at 10s. per acre, nor is there any allowance for interest on the admitted capital expenditure of £44, 15s. As the third, fourth, and fifth thinnings more than paid expenses, we may take one-half of the capital expenditure (say £22, 10s.) at 4 per cent. for thirty years, which is £27, and sixty years' rents and taxes, which amount to £33. We have thus a charge of £104, 15s., which leaves an apparent credit balance of £74, 16s. 8d., and not £144, 16s. 8d. as claimed by the owner. It is said that had this plantation been properly managed, the profits would have been much greater than they actually were.

The writer has, to the best of his ability, analysed the figures sent him; and although on the whole the returns show fairly good results, it is to be regretted that the accounting, even amongst the best, has been defective. Some returns were not of sufficient interest to be noticed. The fact that in this country nearly half the area under woods is kept more for game preserves, shelter, or other amenities than for the profitable growth of timber, must not be lost sight of. The writer, however, sees no reason why better results could not be obtained without sacrificing these amenities, which are not incompatible with profitable management. One cannot help thinking that there is a great field for enterprise in connection with the raising of crops of timber on a large scale; but the initiative must be taken by some influential individual or public body.

XLIII. Abstract of Returns of Prices of Home-grown Timber

LOCALITY.	Class.	ASH.		BEECH.		ELM.		OAK.		PLANE.		
		Per Cubic Foot.	Per Ton.									
ENGLAND.												
<i>County—</i>												
Derby,	1	1 6	...	0 8	...	1 0	...	1 4	...	0 9	...	
Durham,	1	1 0	...	0 6	...	0 6	...	1 0	...	...	...
Gloucester (near Bristol),	Average	1 11	...	0 11	...	1 1	...	1 6	...	...	...
Hants,	2	2 1	...	1 0	...	...	...	2 6	...	...	...
Hants, North,	1	3 0	...	1 0	...	1 0	...	2 3	...	...	...
" "	2	2 0	...	0 10	...	...	...	2 0	...	...	...
" "	3	1 6	...	0 9	...	...	...	1 7	...	...	...
Hertford,	1	2 2	...	...	...	...	...	2 3	...	3 6	...
Kent (Canter- bury District), } Average	...	...	...	0 8	...	1 8	...	2 6	...	...	...
Leicester,	1	1 8	...	...	...	0 11	...	1 6	...	...	...
SCOTLAND.												
<i>County—</i>												
Ayr,	1	1 2	...	0 11	...	1 0	...	1 2	...	1 3	...	
"	1	1 1	25 0	0 6	12 0	1 0	...	1 2	26 0	1 4	26 0	
"	2	0 6	12 0	...	7 6	0 6	10 0	0 8	13 0	0 8	14 0	
"	3	...	7 6	...	...	...	...	...	...	...	...
" . . . . .	...	1 2	...	1 2	...	...	...	1 4	...	...	...
Dumbarton,	2	1 0	12 0	0 10	10 0	1 0	10 0	1 0	10 0	5 0	50 0	
Fife,	Average	...	...	1 2½	10 0	1 2	...	1 3	...	1 6	...
"	"	1 9	...	1 1	...	0 11	...	1 7	...	2/-to3/6	...	
" . . . . .	"	...	...	1 3	...	1 3	...	1 8	...	...	...
Forfar,	1	2 0	...	2 3	...	1 9	...	2 0	...	4 0	30/-to	
"	2	1 3	...	1 0	...	1 3	...	1 3	...	1 3	40/-	
" . . . . .	...	1 4	12 0	1 0	12 0	1 4	12 0	1 3	...	3 6	20 0
"	
Forres,	Average	...	...	...	...	...	...	...	...	...	...
Peebles,	1	1 4	...	0 8	...	...	...	1 4	...	3 6	...
" . . . . .	...	1 2	...	0 6	...	...	...	1 0	...	1 6	...
" . . . . .	...	0 10	...	0 4	...	...	...	0 10	...	1 0	...
Ross,	Average	1 6	...	0 8	...	1 6	...	1 6	...	1 0	...	
Roxburgh,	1	1 6	...	0 10	...	0 8	...	1 4	...	2 0	...	
"	2	0 9	...	0 8	...	0 6	...	1 0	...	1 4	...	
Sutherland,	1	1 6	...	1 0	...	1 6	...	1 6	...	...	...
"	2	0 8	...	0 6	...	0 8	...	0 9	...	...	...
IRELAND.												
<i>County—</i>												
Armagh,	1	1 0	...	...	8 0	0 9	...	0 10	...	2 0	...
"	2	0 9	...	...	6 0	...	7 0	...	10 0	...	10 0
Kilkenny, . . . . .	...	1 0	20 0	...	10 0	0 9	15 0	1 0	20 0	...	...

in 1901. By D. F. MACKENZIE, F.S.I., Mortonhall, Midlothian.

LARCH.		SCOTS FIR.		SPRUCE.		VARIOUS.			REMARKS.
Per Cubic Foot.	Per 100 Lineal Feet.	Per Cubic Foot.	Per 100 Lineal Feet.	Per Cubic Foot.	Per 100 Lineal Feet.	Per Cubic Foot.	Per 100 Lineal Feet.	Per Ton.	
s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	
1 1	...	0 9	...	0 7	...	Cord wood,		5 0	There is a good demand for all sorts of timber in this district. Sold by private tender. Soft woods used for estate purposes. All wood fair quality. Good demand for home-grown timber of fair quality. These prices range lower than formerly.
...	
1 0	...	0 8	...	0 8	...	...	...	...
...	...	0 6	...	0 6	...	...	...	...
1 0	...	0 8	...	0 6	...	...	...	...
...	
...	...	...	...	...	...	Spanish Chestnut,		...
1 4	...	0 11	...	0 6	...	1 10	...	...
...	
1 1	5 0	0 7	3 0	0 5	3 0	
1 4	9 6	0 6	...	0 6	...	0 6	3 4	...	
1 0	5 0	...	3 4	...	...	...	...	...
...	
1 0	8 4	0 8	4 0	0 8	4 0	0 9	Birch, Salix,	9 3	The Beech was of superior quality. Not a very good timber-growing district. Small Plane for Rollers at 41s. 8d. to 50s. per 100 lineal feet. Ash ranges from 1s. 6d.
1 1	...	0 6	...	0 5	...	...	...	8 0
1 1	...	0 7	3 6	0 4 $\frac{1}{2}$	3 0	...	3 0	8 0	
1 3	...	0 6	...	0 3 $\frac{1}{2}$	...	...	...	...
1 6	...	0 6	Stack Props,	0 4	Stack Props,	1 2	} Poplar.	} Wood of all kinds getting scarce, and still rising in price. Birch and Elder in demand at 10s. to 15s. per ton. Beech limbs for turning 10s. to 15s.	
1 0	...	0 4	8 4	0 3	6 4	0 10			
1 0	17 0	0 6	3 6	0 5	3 6	Plane trees 7 ins. to 9 ins. diameter, and limbs same size, 6d. to 10d. per lineal foot. This is for timber in the woods. Heavy larch gives 1s. 4d. to 1s. 6d. Markets—boat-building, stations, etc.
...	Alder,	12 0	Three miles from railway station. Sold in lots lying cut in wood.
1 0	12 0	0 5	5 6	} Grown at 700 to 1320 ft. above sea-level, easterly exposure. These prices are for root cuts. Pine timber excepted, manufactured wood sells at double these figures. Most of this was blown timber.
1 0	...	0 6	...	0 4	...	...	...	...
0 11	...	0 5	...	0 3	...	...	...	...
0 9	...	0 3	...	...	...	...	...	...
1 0	...	0 4 $\frac{1}{2}$	...	0 4	...	...	10 0	...
...	
1 0	...	0 6	...	0 5	Alder,	5 0	} All sold by private tender. Wood situated 3 to 8 miles from railway and shipping port.
0 8	...	0 4	...	0 3 $\frac{1}{2}$	...	...	...	...
0 8	...	0 4	...	0 4	10 0	} Used for general purposes locally, and exported. Branches 1s. to 1s. 6d. per load. Lime and Horse Chestnut 7s. per ton. Spanish Chestnut not in demand. The prices per ton are for mining timber and firewood.
0 6	...	...	...	...	...	...	...	...
0 9	15 0	...	...	0 4	6 0	...	...	...

Note.—That these figures will be found useful to many cannot be doubted. The number of returns received is, however, disappointingly few. England sends eight, Scotland fourteen, and Ireland only two. These are sufficient, however, to indicate the direction in which the timber trade is drifting. It is stated in several of them that the supply is unequal to the demand.

In analysing the figures, it may be observed that they vary considerably; but it is quite evident that a great improvement in values has taken place, and that the demand is good throughout. In districts adjacent to boat-building stations, prices rule higher for most kinds of wood. It is evident that a good deal of the timber sold has been of second and even third quality. This may be accounted for in several ways—(1) Hardwoods, or broad-leaved trees, are seldom put upon the market in quantity and in proper condition. They are either so old as to be decayed in the heart, branchy and brittle, or are of such small dimensions as to be useless for the best markets. Timber merchants say that a good sound lot of hardwood of large size rarely finds its way into the market. This is to a great extent the explanation of the variation in prices for the same article. Take Plane for example, the returns range from 1s. to 5s. per cubic foot. Distance from market is not accountable for this difference. (2) The quality of Pine and other timber of small sizes is inferior, owing to the large quantities of immature timber thrust upon the market through the bad effect of gales; and also, generally speaking, to the fact that parts of our woods are grown on the clump-and-belt system, where silvicultural principles cannot be observed, and which produce an inferior, coarse-grained, and brittle class of timber. (3) The felling of timber which is immature, and is cut at all seasons of the year. These facts, taken together, account to a large extent for the amount of inferior timber one finds in the market. Notwithstanding all defects and faults, our home timber in the manufactured state fetches, class for class, a higher price than is paid for the imported article.

XLIV. *The Annual Excursion in 1901.*

[Compiled from the Report which appeared in the
North British Agriculturist.]

Monday, 5th August.

On Monday afternoon, 5th August 1901, the Excursion party of the Royal Scottish Arboricultural Society started from Edinburgh for Ayr *via* Glasgow, on the Twenty-fourth Annual Excursion of the Society.

The company included The Earl of Mansfield, *President*; R. C. Munro Ferguson, M.P., *Honorary Secretary*; David R. Adair, Edinburgh; Thomas Bond, Lambton Park, Durham; John Boyd, Pollok, Pollokshaws; John Broom, Bathgate; David Brown, Royal Bank, Maybole; Gilbert Brown, Stormontfield, Scone; Charles Buchanan, Penicuik; D. Buchanan, The Gardens, Bargany; Dr Cameron, Loanhead, Midlothian; M. Chapman, St Ninians, Stirling; Wm. Christie, Fochabers; James Cook, Arniston, Gorebridge; James Crabbe, Glamis; J. D. Crozier, Durris, Aberdeen; Geo. Cunningham, Edinburgh; J. Dalziel, Forester, Culzean; Robert Douglas, Edinburgh; W. D. Edminson, Berwick-on-Tweed; Dr Robert Farquharson of Finzean, M.P.; J. A. Ferguson, Ardnith, Partickhill; James Forbes, Overtown, Dumbarton; Robert Forbes, Kennet Estate, Alloa; James Foster, Kennet, Alloa; R. Galloway, *Secretary and Treasurer*; George Hannah, The Glen, Innerleithen; John Hay, Dollars Estate Office, Kilmarnock; Wm. P. Hay, Loanhead; W. Henderson, Gosford Demesne, Co. Armagh; George Jack, Dalkeith; Henry Jonas, London; John Kerr, Yorkston, Midlothian; Wm. Kidd, Harewood, Leeds; D. P. Laird, Pinkhill, Murrayfield; George Leven, Auchencruive, Ayr; Alex. M'Gregor, Penicuik; Geo. Mackinnon, Melville, Midlothian; Wm. Mackinnon, Edinburgh; D. L. Macintosh, Castle Wemyss Gardens, Wemyss Bay; Donald M'Laren, Overseer, Sundrum, Ayr; James Maxwell, Ruglen, Maybole; John Methven, Edinburgh; Alex. Milne, Edinburgh; R. P. Milne, Spittal Mains, Berwick-on-Tweed; W. Milne, Foulden Newton, Berwick-on-Tweed; Wm. Moffat, Possil, Maryhill; Alex. Morgan, Turret Bank, Crieff; Andrew Morgan, Glamis; David Murray, The Gardens, Culzean; Ed. Badenach Nicolson, Edinburgh; Andrew D. Page, Culzean, Maybole; Walter Page, Myregornie, Kirkcaldy; R.

Johnston Paton, Kilmarnock; T. L. Patterson, Hardengreen, Dalkeith; Geo. Paxton, Richardland, Kilmarnock; James Pearson, Sessay, Thirsk, Yorks; Alex. Pitcaithley, Scone, Perth; George Porteous, Poltonhall, Lasswade; W. M. Price, Minto, Hawick; A. B. Robertson, The Dean, Kilmarnock; Donald Robertson, Dunrobin, Golspie; Alex. Robson, The Kennels, Culzean; A. D. Richardson, Edinburgh; J. Scott, Forester, Dumfries House; Thos. Sharpe, Monreith, Wigtownshire; Thomas Smith, The Castle, Maybole; Adam Spiers, Edinburgh; W. J. Stalker, Nairn; James Stoddart, Bonnyrigg, Midlothian; Robert Storie, Dalkeith, Midlothian; Edward P. Tennant, yr. of The Glen; D. Thomson, Oakley, Dunfermline; D. W. Thomson, Edinburgh; R. B. P. Wallace, Leith; Eugene Wason of Blair, M.P.; John Watson, Edinburgh; Jas. Wm. Watt, Carlisle; Wm. White, Edgefield, Loanhead; J. Whytock, The Gardens, Dalkeith; Gilbert Wilson, Dailly, Ayrshire; Wm. G. Wilson, Overseer, Dalquharran; Edward Wiseman, Elgin. A number of members' guests joined the Excursion.

On arriving at Ayr, the party betook themselves to their several hotels. Later in the evening they all dined together in the "Ayr Arms"—Mr D. P. Laird, of the Murrayfield Nurseries, presiding.

Tuesday, 6th August.

Despite the very unpromising appearance of the weather, and the long drive that had been mapped out for the day's programme, the party mustered in full force, under the direction of Mr Laird. Lord Mansfield, the president of the Society, and Mr Munro Ferguson of Novar, the hon. secretary, were there, as usual, to enjoy the outing, and testify by their presence to the deep and abiding interest which they take in the work of the Society.

After visiting the birthplace of Burns, and the monument erected to his memory on the banks of the Doon, the party proceeded to Auchendrane, the residential estate of Miss Cathcart. As they passed down the avenue to the mansion-house, they saw a number of silver firs, planted in 1707, to commemorate the union of Scotland with England, by Mr John Muir, the first member for the Ayr Burghs in the British Parliament. The avenue is known to this day as the Union Avenue. Some of these silver firs are of great size, the largest one now girthing 15 feet 9 inches,

as compared with 15 feet 5 inches in 1896, when it was measured by the Field Naturalists' Society. Some very fine larches and Scots firs were also seen, one of the Scots firs growing on the banks of the Doon being known to be two hundred years old.

The members were received in front of the mansion-house by Miss Cathcart, who directed their attention to a couple of venerable yew trees, and also to a birch tree which was planted in 1820, and now girthed no less than 10 feet 4 inches. Some good specimens of the tulip tree, the variegated oak, and the eagle's claw maple were also seen, and a turn through the gardens completed the inspection. Mr Brown, solicitor, Maybole, who is factor on the estate, gave the party a most courteous reception, and readily supplied the fullest information as to all that was to be seen there.

Remounting their brakes, the party next drove to Culzean Castle, the seat of the Marquis of Ailsa, who received them with the greatest kindness, and entertained them to a sumptuous lunch. The party afterwards spent the afternoon in exploring the beautiful garden and policy grounds. Mr Smith, the factor; Mr Page, land steward and Local Secretary to the Society; Mr Dalziel, forester; and Mr Murray, the gardener, acted as guides, and readily supplied all information required. When the afternoon was well spent, the party remounted their brakes, and drove by the shore road back to Ayr.

The Annual Dinner of the Society was held that night in the King's Arms Hotel—Lord Mansfield presiding. At the Business Meeting, which followed, it was remitted to a committee to arrange for next year's Excursion being held in Scandinavia.

Wednesday, 7th August.

The first place of call was Doonholm, the beautiful residence of Mr Kennedy, timber merchant, Glasgow. Here the party saw some good timber crops, and a fine collection of exotic plants of many kinds. Thence the drive was continued to Cassillis, the property of the Marquis of Ailsa, where some well-managed woods were seen. From Cassillis the party drove on to Maybole, where ex-Provost Marshall, of Messrs Jack & Sons, agricultural engineers, had lunch in readiness for them.

The party inspected with great interest the works of Messrs Jack & Sons, where they saw large quantities of home-grown

hardwood 'being manufactured into carts, lorries, hay trollies, and other agricultural implements. The firm of Messrs Jack and Sons purchase and use up every year several thousands of tons of home-grown timber in the carrying out of their business. The superior quality and workmanship of all the finished articles seen at this place were warmly eulogised.

Remounting their brakes, the party proceeded to Kilkerran, where they inspected the pyroligneous works, and also some silver firs, larches, and Scots firs. They next visited Dalquharran, where they saw some very good timber trees. Before leaving, they were very hospitably entertained to tea by Mr Paterson, tenant of the Castle. From Dalquharran they drove to Bargany, where they saw some good Douglas firs and other trees. Mr Inglis, the factor, who received them there, was not a believer in the German system of thick planting and deferred thinning, and he affirmed that the adoption of that system had resulted in a loss of £25,000 to Lord Stair, through the thick-planted trees being levelled by a gale. He also told them that he had now a plantation of larch which, though only nine years old, had been thinned three times already, and he was about to thin it a fourth time. Time did not permit of the question of Thick *v.* Thin Planting being threshed out there, and the party, leaving Bargany, drove along the Girvan Valley to Girvan, whence they returned by train to Ayr.

Thursday, 8th August.

The party were early on the road, and began the day by fighting their battles of the previous night over again, in regard to thinning plantations, larch disease, etc. The first place visited was Sundrum, where they were very hospitably received by Mr Claude Hamilton. Here they saw some very fine larches, Scots firs, and silver firs. They also inspected the creosoting plant, which was of a very simple and inexpensive kind, consisting of an open boiler and a furnace. Thence the party drove on to Barskimming, the residence of the Misses Anderson, who received them very kindly, and conducted them over the beautiful gardens, which are surrounded by stately trees. From Barskimming they proceeded to Ballochmyle Quarries, where the up-to-date appliances for cutting amorphous blocks of rock into any form required were inspected with great interest. Thence

they proceeded to Mauchline, where a halt was called, and the party enjoyed the hospitality of Mr Paton, of the firm of Messrs Samson & Co., nurserymen, Kilmarnock.

By the time they were ready to start from Mauchline, a thick drizzling rain had again come on, and the rest of the journey to Ayr was accomplished under very unfavourable conditions. It was their intention to spend some time at Montgomerie Castle, but, owing to the state of the weather, they had to content themselves with a drive through the grounds without dismounting from their carriages. Their only other place of call was, therefore, at Auchencruive, where Mr Oswald had tea ready for them on the lawn. Unfortunately, the dismally wet afternoon prevented them from exploring, as they would have liked to do, the arboricultural treasures of Auchencruive; but they saw enough to show them that they were well worth going a long way to see.

With ringing cheers for their kind and hospitable host, the party remounted their brakes and drove in to Ayr, where, in the evening, after dinner, they had a most enjoyable smoking concert in the "King's Arms."

Friday, 9th August.

On Friday the party proceeded to Glasgow Exhibition, where they were very kindly received and entertained by Mr Cameron, on behalf of Messrs A. & J. Main & Co., Ltd. After a visit to the sights of that great show, the Excursion terminated.

DISCUSSION AT THE EXCURSION DINNER.

At dinner on Wednesday, 7th August 1901, there was a full muster of the excursionists. Mr Munro Ferguson presided, and was supported at the head of the table by Dr Farquharson, M.P., Mr Eugene Wason of Blair, M.P., Mr D. P. Laird, Mr Alex. Milne, Mr John Methven, etc. After the dinner, the Chairman announced that the evening would be devoted to the discussion of some questions of great interest to arboriculturists. He called upon Dr Farquharson to open the discussion.

Dr Farquharson began by referring to the advantages which landed proprietors might obtain from hearing and taking part in a discussion such as they hoped to have that night. There was

occasionally a little friction between scientific and practical men, and farmers, as well as foresters, were sometimes a little dubious about accepting the dicta of scientific men. There were several important questions affecting forestry which it would be for the good of them all to get thoroughly well threshed out. He was a bit of a forester himself, and had planted a good deal of land, but he felt inclined to regret that he had not planted more extensively than he had done. They used to think that the growing of timber crops did not pay. They wanted a quicker return of profit, and, besides, they thought that it spoiled their grouse moors. In that connection they might look to the experience of his friend, Sir John Gladstone of Fasque. Sir John, or his forbears, had planted extensively, and he thought he had spoiled his grouse moors, but he had now found it was the other way about. Sir John had also gone in for a deer forest, and he now found the great benefit there was in having plantations that the deer could go into for shelter. Besides, the price of timber had gone up, and he was now getting a very good return for his thinnings, so that the planting had proved very profitable. But in this matter landlords should not think solely of their own pockets, for the general community had a great interest in forestry—as trees improved the climate, they provided work for a great number of workmen, and they also protected the country against what might come to be a timber famine. They were told that the forests of the Continent and of the New World were shrinking in area, and if that went on timber would go up in price, and there might even be a wood famine. With the present prices for timber and for farm crops, it was far better to plant waste land than to attempt reclaiming it. He strongly held that, of all the wasteful practices in the world, the reclaiming of waste land was the most wasteful. The reclaimed land might do very well for a year or two, but after that it began to throw back to the original state—the heath and the whins and the weeds began to come up again, and the whole thing was no good. Take, for example, the great land reclamations of the late Duke of Sutherland. The intention was good—it was splendid—but the result was a failure, and the land thus reclaimed had again gone back to the whins and the heather. If the land had been planted with trees, it would have given a far more remunerative return. There was a great deal of sentiment mixed up with the talk of putting land under sheep or

deer; but common-sense told them that any one who held land must make the best of it for himself, and he believed that in many cases both the sheep and the deer had better give way to trees. It was a good advice that the old laird gave to his son, to "Aye be stickin' in a tree; it'll be growin' when ye're sleepin'." They should, however, not only be "aye stickin' in a tree," but they should also keep "stickin' it in" with knowledge, and that was where the great benefit of association with a Society like the Royal Scottish Arboricultural Society came in. The Society aimed at helping to show how to grow the best kind of trees, suited to the different localities, in the best method, and with the best results—financial and otherwise. He did not profess to be an expert in forestry, but, with the view of eliciting a useful and instructive discussion, for the purpose of drawing out the ideas of the scientific and theoretical arboriculturists present, he would adopt the plan that was always adopted with political candidates, and would heckle them a bit. He would invite them to give their different views about the following questions:—(1) The thinning of woods. Should trees be planted close and thick, and the thinning be deferred till a late period of their growth; or should the thinning be early and extensive? There was a great boom in light and air just now, as a means of keeping human beings and farm live stock healthy, and the only argument for close planting and deferred thinning was that, if the trees were close together, you keep them from throwing out superfluous branches, and get them to grow straight, and yield clean good timber. (2) Natural regeneration: is it better than artificial planting? (3) Diseases of trees. There was the larch disease, for instance. They had all been told by bacteriological scientists, in recent years, that tuberculosis, or consumption, was caused by a bacillus, and he would like to know whether there was any bacillus in connection with larch disease. They should always try to get at the root of a thing, and, in the case of a disease, they should aim at discovering its cause; for if the cause could be removed or prevented, the effect—that was to say, the disease—would be removed or prevented also. The fourth point was the cultivation of trees, and that was a wide subject. The fifth point was foreign competition. How could they keep ahead of foreign competition? They had not so much foreign competition to meet in the case of hardwoods, such as the oak, the elm, and the ash. As to the ash, there had for some time

been a boom in ash on account of the boom in golf. The ash was needed for the making of golf clubs, so that the golf links that were being formed in all directions were helping those who were growers of ash. The sixth question was that of damage by game. Finally, there was the question of how far they could look for State aid to forestry. Mr Munro Ferguson and he had sat on the Committee that investigated that question, and that Committee had made certain suggestions, but none of these suggestions had been acted on by the Government. They wanted to get some State aid for forestry education. They wanted a forestry school, to which practical working foresters could go for a short course in the scientific principles of their business. It was not unreasonable also to look for the Government giving, under just and equitable conditions, some pecuniary assistance to impecunious proprietors in the afforestation of waste lands. The Government were doing a great deal for forestry in Ireland, and Scotland should now have a look in, to see if there was any public money to help impecunious landlords to afforest their waste lands, seeing that this was a matter of national importance, and was for the good of the whole community. He (the Doctor) was not at all proud in these matters, and he was quite prepared to take pecuniary aid if the Government saw fit to give it. If there were a Carnegie who had fifty millions to give away, and who knew the national importance of afforesting waste lands and advancing forestry education, he would invite him to step forward and announce his munificent gifts. But Carnegies did not grow on every bush. He was not a married man—unfortunately or fortunately, as they might choose to regard it—but if he were a married man with a family, he did not know that he could take a better way of providing for his successors than by the planting of a large extent of forest land, which his sons and grandsons could cut down fifty or sixty years hence. In such a case, he could not help thinking that it would be ineffable bliss for him, some fifty years hence, to look down from the celestial regions, and see his grandsons enjoying themselves, and reaping the fruits of the timber crop he had planted for them.

After the loud and prolonged cheering, with which the genial Doctor's peroration had been received, had subsided, the Chairman said that the speech they had just heard from Dr Farquharson was one of the most amusing and interesting addresses it had

ever been their good fortune to hear. He trusted they would have a good discussion on the points raised by the Doctor.

Mr Pitcaithley, forester, Scone, said there was no doubt about the fact that the superiority of the home-grown hardwood was due to the open way in which it was grown. He had not much faith in growing larch. There were isolated cases, in Alpine situations, where the larch did well; but in nine cases out of ten the disease was so prevalent that it was unprofitable to plant larch. He did not think Scots fir really required any thinning in the true sense of that term. Of course you had to cut down all the dead or dying trees, and suppressed trees which had been overshadowed by other trees, but that was not thinning in its true sense. A great many plantations of Scots fir were very much over-thinned. That had been brought about by different causes. He himself had sold wood, by the shipload, cut out of the plantations that were too thin before that wood was cut, but the cutting was due to the fact that good prices were being got for prop-wood.

Mr Edward Tennant of The Glen, said he had recently been to Germany to see all that was to be learned in practical management of the forests there, and he would briefly give them the results of his observations. The finest wood he saw in Germany was in the neighbourhood of Eberswalde, which the Excursion party of the Society had visited in 1895. This wood extended to three thousand acres, and was composed entirely of Scots fir and beech. The Scots fir in that wood was one hundred and twenty years old, and was from 70 to 90 feet high. It had been under-planted with beech when the Scots fir was sixty years of age. These Scots firs were perfectly straight, and showed clean, well-formed boles. They were ready for the market, and were just on the point of being cut down—the period of one hundred and twenty years being the maximum of the rotation which the Germans work upon. They left about four hundred trees per acre to come to maturity. The result was that these trees thus selected to remain for matured growth were perfect specimens of trees. In Germany they had some oak plantations, but they did not strike him as being very good. The best plantations were chiefly of beech and Scots pine. The Harz Mountains were completely covered with spruce, and there the same system was followed. The trees he saw there were eighty years of age and 80 feet high. In Germany,

forestry was a national industry; and in Central Europe—in the Austrian Tyrol and northern Germany—there were hundreds of villagers who depended on the woods for their livelihood. Of course there were no coal-pits there, and there was an enormous consumption of wood, chiefly for fuel. There was also a considerable export trade in wood, but nothing to compare with that which comes to this country from Norway, Sweden, and America. In Germany, women were very largely employed in forestry. The seeding and the planting in all the nurseries were done by women. Of course labour was more plentiful, and much cheaper than it was here. He saw very little natural regeneration in Germany. Experimental forestry work was largely carried out there, and in many places the visitor saw, at the nurseries, experimental plots of different kinds of trees, all growing near each other. He saw very little larch, as the Germans were not planting much of it, on account of the prevalence of disease. The Douglas fir was of more recent introduction, and he did not see one that was over 20 feet high; but the German foresters were very favourably impressed with the capabilities of that tree. As regards the larch in the Harz Mountains, it was distinctly bad. He saw five or six hundred acres of it, half of which was dead, and the other half was in a very indifferent condition. The land there was very steep and dry. He never saw draining of any kind in the forests of Germany, and he thought that our home forest-lands had been over-drained. He felt quite certain you could find trees to suit any kind of soil, and even in the very wettest of lands the alders would grow all right. They might say that the alder was not a valuable timber. That was true; but, then, it was grown much cheaper. If suitable kinds of trees were selected and planted, he was satisfied that even the moss land—the peat-bogs—could be very profitably planted with trees.

Mr Boyd, Pollok, said it was quite true that alder was easily grown, but then it was of little value, and in the remoter parts of the Highlands it could not be sold at all. With respect to Mr Tennant's remarks on the drainage of land, he (the speaker) said that, in Germany, the conditions were altogether different from those that prevailed in this country. In Germany, the soil of the forest areas was light, and the climate was drier than ours; but, on the flat lands of this country, it was absolutely necessary to drain the land before planting it.

Mr Robertson, forester, Dunrobin, said that, with respect to the German system, they, in their own country, had an equally good system in times past. The old forests which used to abound in this country were never thinned by any forester, and they grew better timber than a great deal of what was grown nowadays. With respect to thinning, he strongly held that they should follow Nature as far as possible—to take out the dead and suppressed trees and leave the others alone. The gentleman who had told them that day of having planted his larch very thin, to prevent them being blown over, and thinned them three times in nine years, was a long way off the mark. As to Dr Farquharson's comparison of trees with human beings who had to get plenty cubic air space to keep them healthy, the comparison did not hold good at all, because the human beings did not develop superfluous branches. As to draining, he was convinced that to plant wet land without draining it would be simply a throwing away of money. When the Scottish arboriculturists were in Germany, they saw very little land that required draining. In fact, they only saw a little of that kind of land in the Harz Mountains. As to planting alders in wet land, he could take Mr Tennant to wet lands where alders had been planted, but would not grow at all. As to the Sutherland reclamations, that reclaimed land had not gone back to the original waste state, as it was now mostly under grass, and it was much better than the land that had never been reclaimed. A great deal of planting had been carried out in the Lairg district, and the gentleman who recommended planting without draining should go there for an object-lesson. As to planting peat-bogs without being drained, he could show them some peat-bogs up that way which had been planted a good many years ago, and the plants to-day were not much higher than the bottle on the table. That was up beyond Shinness, on very bleak, exposed ground. There were a few patches where the timber would have grown had it got the chance. It was enclosed by a low dyke, which had a couple of wires on the top of it, but whenever a snowstorm came the sheep came over the dyke and ate up the young trees. In that county, whenever anything black appears above the snow, nearly every living animal, whether horse, deer, or sheep, makes straight for it, and it gets little chance of living unless fully enclosed.

Mr Eugene Wason, M.P., said he had done a little planting,

and his experience was that it was not a bit of use planting unless the land were properly drained. It was perfectly useless planting in low level mosses without drainage. Of course, he did not mean the kind of drainage required for agricultural land. For forest lands, surface draining, with a tolerably deep cutting to run off the heavier water, answered all practical purposes. He had to confess that his experience with timber had not been a success. Some sixteen years ago he purchased a little place called Blair, and there was a great quantity of blown timber on it. He got a travelling saw-mill to saw it up, and that cost £54, but when he tried to dispose of the sawn-up wood the highest offer he could get for it was £23, 15s. He found, too, that in the erection of fences it was no use putting in Scots fir or spruce posts, which required renewal every few years. It was far better to put in larch posts or iron bars. Then in the management of their woods they must be careful to wire out the rabbits, or their labour would be in vain, and they must keep out the sheep as well, or they would destroy the young trees. It was very important, also, that they should plant only the kinds of trees suited to the soil and climate. He (the speaker) had once travelled to America with a Yankee who had come over here to buy the best hardwood for the building of Pullman cars. The Yankee heard that the finest oaks in the world were these in the Windsor Forest, and he went to Windsor to see them. He found the Windsor oaks were as good as he had been told they were, but he was disappointed because the Queen's Commissioner rejected his overtures to purchase them, and he said, "There are only two things I can't buy in this country; I can't buy up the judges, and I can't buy the oaks in the Windsor Forest."

Mr Leven, Auchencruive, said that the ash sprang so readily from the seed, and in such numbers, that in some plantations it came up like beans, and they got splendid specimens of it grown naturally, but it grew to be something in the nature of a fishing-rod in appearance. The ash, however, responded readily to a little judicious thinning at twenty-five to thirty years of age, and they could get an excellent return from well-grown ash.

Mr Crozier, Durris, said that larch disease was practically unknown in old times. If larch could be grown and kept healthy up to thirty years old, it would be good policy to plant

it As to indiscriminate planting, the late Mr Young, at Durriss, planted a lot of black Italian poplars, and in a few years the whole crop was gone. The Douglas fir had been propagated largely at Durriss both by self-seeding and in the usual way, and it produced very good timber. It grew very rapidly, and he had himself measured a Douglas fir which in three years had grown 14 feet in height. For pit-wood, it should be planted close, and allowed to grow for thirty years, by which time it would be ready for the pits.

Mr John Methven, nurseryman, Edinburgh, said he thought there was a great deal of truth in Mr Robertson's contention that Nature was the best thinner of plantations. In all plantations, both here and in Germany, there were a considerable number of deaths among the trees, and these dead trees had to be removed, or they would form breeding-grounds for injurious insects and other woodland pests. Trees that were not growing well, or had lost their crowns, should also be removed. As to larch disease, his theory was that the larch, being a precocious grower, was very liable to be injured by spring frosts, which burst the young buds. So far as his observation went, it was the early growing trees in southern exposures which were most liable to be affected by the disease. The larches that were grown on the northern side of a hill, and which did not come into leaf so early, were not often affected by disease.

Mr Pitcaithley said he did not think that any practical forester would accept the theory that larch disease was caused by spring frosts. They were indebted to the Germans for showing them the true nature of larch disease. Professor Hartig had thoroughly investigated the question, and his writings on the subject had been translated by Dr Somerville for the use of English readers. For himself, he thoroughly accepted Professor Hartig's theory as to the larch disease being the result of a fungus growth on the blisters caused by the attack of the larch-bug. The bug punctured the tree at the base of the bud, and it was always there that the disease took root.

Mr Robertson said Mr Methven's idea that the larches grown on a northern exposure were generally free from disease was wholly a fallacious one. He had seen larches on the northern side of a hill that were killed off by the disease. He quite agreed with Mr Pitcaithley as to Hartig's theory of the larch

disease being the right one. He had often noticed that before the blister appeared, they had experienced a bad attack of the bug.

Mr Munro Ferguson said many eminent authorities told them that there was less liability to larch disease when the larches were not grown in pure woods, but were mixed with beech and Douglas fir. Any experience that he had confirmed this idea, but he knew of no reason why the growing of beech or Douglas fir, along with the larch, should diminish the liability to attack from larch disease and bugs.

Mr Crabbe, Glamis, said he had always found that late spring frosts were followed by larch disease where the trees were growing on a southern exposure, so that they came into leaf early. He had a large plantation thirty years old on the high ground, where the trees did not come into leaf so early as in the lower and more southerly exposures, and the trees on these higher grounds were all free from the disease. When the trees were injured in their growth by late frosts or other causes, they were always liable to succumb to disease.

Mr Alex. Milne (of Messrs Dickson & Sons, Edinburgh) said that with regard to the diseases affecting timber crops, he thought a great many of these diseases were caused by climatic influences. In this country they had such a treacherous climate that they had often half a dozen different kinds of weather in a week, or even in a day. When a tree or an animal got into a weakened state through any cause, it was all the less able to resist any attack, and all the more liable to succumb to disease. He held that they did not plant enough forest lands in this country, and he said that the Board of Agriculture had issued a return showing that the value of the timber imported into this country last year had reached the enormous total of thirty-nine millions sterling. Mr Milne's figures, on this point, were at once challenged by several members of the party, but he stood to his guns, and insisted that he had quoted correctly enough from the return issued by the Board.

Mr J. Badenach Nicolson of Glenbervie, said it would be very interesting if the foresters present would give their views as to the merits of home-grown larch seed as compared with foreign larch seed. As to the larch disease being caused by spring frosts, he had to point out that the larch did perfectly well in this country for the first one hundred and fifty years

after it was introduced, and there were no records of our climate having changed for the worse since the larch was introduced.

Mr Robertson, Dunrobin, said he had long experience of larch grown from home-saved seed, and also of larch grown from foreign seed, and he was clearly of opinion that the plants from foreign seed were better disease-resisting plants than those grown from home-saved seed. The plants from foreign seed came into leaf pretty early, and were liable to get damaged by spring frosts, but, so far as his experience had gone, he was certainly of opinion that trees from foreign larch seed resisted disease better than those from home-saved seed. The larches planted in the early times of larch growing in Scotland grew well, and were free from disease, and these larches were all grown from foreign seed. The larches planted from forty to sixty years ago were to a great extent grown from home-saved seed, and it was on these larches that they first began to see the blister and the heart-rot. When they came to the larches from ten to thirty years old, they saw still more of the blister and a great deal more of the heart-rot, and a greater proportion of these trees also were grown from home-saved seed.

Mr Pitcaithley, Scone, said his experience exactly accorded with that of Mr Robertson. The first grown larches were free from disease. The larch was introduced into Perthshire in 1708, and it was not till 1839 that they had any record of disease having appeared in the Atholl plantations. Before the introduction of the disease, the larch grew so well on any soil that many people began to plant it on soil that was not suitable for it. There was a widespread idea that Scots fir grown from Scotch seeds was better than that from seed grown out of the native habitat of the tree. But the thing cuts both ways. Some foresters, in sending to nurserymen for Scots firs, stipulate that the plants must be grown from seed saved in Scotland, which was the native habitat of the Scots fir. It was natural to expect that the Scots fir would be healthier if grown from seed raised in its native habitat, and in the same way the Tyrolese larch seed was grown in the native habitat of the larch, and the larch trees should be healthier if grown from seeds raised in the native habitat of the larch. He held that the Tyrolese larch seed should be called native seed, and that the Scotch saved larch seed should be called foreign seed.

Mr Crabbe, Glamis, said he once grew 20,000 seedlings off

home-saved larch seed and 20,000 seedlings off foreign seed. These were grown in two adjoining breaks, and got the same treatment in every way. The seedlings grown from the home-saved seed did very well, but of the 20,000 seedlings grown from foreign seed, he had only about a hundred plants which did any good, and he had never used foreign larch seed since that time.

Mr Munro Ferguson said it was clear that the subject of larch disease required further consideration. With respect to the seed imported from abroad as compared with the seed produced at home, they had to remember that very often the season in this country was unfavourable for the ripening of the larch seed. He did not know how far the climate in the Tyrol was more favourable for the ripening of the larch seed. There seemed to be some uncertainty about that yet. Mr Robertson had raised an important question as to the planting of mossy land. That question had been fully dealt with in a paper by Dr Schlich, which had been published in their *Transactions*. Dr Schlich investigated this question in Germany, where he had examined three places at which mossy land had been planted. In one case he found a very good crop of trees growing in moss land, but in the other two cases, where the moss had been very well drained, the crop was a failure where the moss was more than two feet deep. At the Paris Conference there was a great deal of discussion on the thinning of plantations. He had got the reports of that Conference, and he would suggest that the Editing Committee should go over the reports, and consider how far these discussions should be reprinted. Thinning was probably carried out as scientifically in France as it was in Germany. As to thinning, the only practical suggestion he had to make was that they should have in this country what might be called a forest garden, on which the results of the different systems of planting, thinning, and trimming could be demonstrated. That, however, could only be carried out by the Government. Many of them had doubtless tried these plots before, but continuity could not be ensured unless such work was undertaken by the State. As to naturally seeded wood, that kind of wood was perhaps not quite so open to disease, but this was perhaps because it was less exposed to the attack of bugs than where it was grown thick. But forest pests, whether they were larch disease, or rabbits, or squirrels, or crossbills, attacked the trees whether naturally grown or planted. They should try and

arrive at some conclusion as to whether the mixing of larch with other trees, such as the beech and Douglas fir, served in any marked degree to prevent the ravages of larch disease. He thought he had seen sufficient to warrant him in believing that the mixing of the larch with these other trees served to protect the larch against disease, and they certainly made very pretty woods in that way. With respect to game, he noted with great pleasure a general tendency, not so much to wire in the woods, as to wire the rabbits within warrens and such-like places, and leave the foresters and the farmers to pursue their occupations undisturbed. As to State aid, there was great need for an experimental area, and there was great need also for more adequate provision for forestry education; and they all hoped that something might yet be done by the State to give foresters a chance of a proper training. It was a source of great pleasure to them all to see so many proprietors now joining their ranks, and coming with them to their annual excursions in order to pick up at first hand the knowledge required for the proper management of their woods. Since he himself had gone with them on their annual excursions, he had acquired a great deal of practical and useful knowledge as to the profitable growing of timber crops.

The proceedings then terminated with a vote of thanks to the Chairman for presiding.

NOTES AND QUERIES.

SPARKS FROM ENGINES.

The following appeared in a leading article in the *Times* of 6th December 1901:—We printed last week a very interesting communication from a correspondent on “Fire-throwing by Locomotives” and its prevention. From this it appears that the problem of its prevention has been completely and very advantageously solved by Mr Dugald Drummond, the chief mechanical engineer of the London and South-Western Railway. Mr Drummond has invented an appliance whereby the escape of sparks and cinders from the funnel of a locomotive can be arrested without in the least impairing the draught, and with a very appreciable economy of coal consumption. This is no mere theoretical improvement; indeed, it appears already to have passed beyond the purely experimental stage. “The arrangement is simple,” says our correspondent, “and it can be fitted easily in the smoke-box of existing engines.” It has already been fitted in many engines, both passenger and goods, belonging to the South-Western Railway, with results alleged to be completely satisfactory as regards the prevention of sparks, and not less advantageous in the concomitant economy of coal. Our correspondent gives detailed figures in proof of this, and they are not a little remarkable. It appears to be a very moderate estimate that the adoption of Mr Drummond’s appliance for all locomotives would result in a net saving of 5 lbs. of coal per train mile. Taking the price of coal at no more than 10s. per ton—it has been much higher of late—this means that the railway companies of the country now have it in their power to save no less than some £400,000 annually on their coal bills. Will they rise to the occasion? Mr Jeffreys seems to think that the success of Mr Drummond’s invention will at last convince Parliament and the Government of the necessity of passing his Bill. We should rather have thought that the railways will at once find themselves caught in the legal net they have so ingeniously woven for others. The law at present holds them blameless for damage caused by sparks from locomotives so long as they can show that they have adopted the best-known appliances for the prevention of the danger. As Mr Drummond’s invention is alleged to prevent the danger altogether, or, at any

rate, to prevent it far more effectually than any other known appliance, it would seem to follow that a locomotive not fitted with it cannot be held to satisfy the legal rule of immunity. No Act of Parliament should be needed to compel the adoption of this or any other appliance. The law as it stands requires that a peccant locomotive should be shown to be fitted with the best-known appliances. This cannot possibly be shown so long as a completely efficient appliance is known to be in existence and has not been fitted to the locomotive in question. How the railway companies can escape damages in these circumstances it is not easy to see.

IMPREGNATION OF TIMBER IN AN OPEN BOILER.

(From information supplied by Mr D. M'Laren, Overseer on the Sundrum Estate, Ayrshire.)

The apparatus consists of an open iron boiler, bedded in brick or stonework, with a furnace below it. At one end is the furnace-door, divided horizontally into two parts, in order to permit better regulation of the draught. At the opposite end rises the chimney-stalk. The masonry is very carefully built with good fire-clay, in which the boiler is laid, as lime-mortar would not stand the heat. The platform into which the boiler is bedded is 26 feet long, 5 feet wide, and 5 feet high, and must be substantially built to withstand the forces of expansion and contraction to which it is subjected.

The oil used is creosote, costing 4d. a gallon.

The oil and wood are placed together into the boiler, and are boiled for two days, during which time great care is needed to prevent the oil from boiling over and taking fire. Slabs of wood are laid across the boiler. As the oil is gradually absorbed into the wood it has to be replenished, usually on the second day, for the wood must be always completely immersed in oil.

On the Sundrum Estate the apparatus is usually employed for impregnating stobs 5 ft. \times 3 ins. \times 3 ins. When these are of beech-wood, they become fully impregnated to the centre; but the result is much less satisfactory with dry than with green beech, since the former, after impregnation, becomes hard and brittle. But spruce-wood, seasoned for at least twelve months, is much better than dry wood of that species. Larch and oak wood are not well penetrated by the oil, but they are very durable without treatment. Creosoted beech stobs will last twenty years, and are

as good as Sundrum larch in this respect; but untreated beech will not last for more than two years.

Four barrels, each holding 120 lbs. of creosote, will suffice for 750 stobs; each therefore absorbs about .65 gallon of oil, costing about $2\frac{1}{2}$ d. Fuel and labour, which cost about an additional 1d., bring the cost per stob to $3\frac{1}{2}$ d. The cost of the plant, which is not included in this rate, is about £50.

SCOTTISH TREE-SEEDS FOR NORWAY AND SWEDEN.

Several Edinburgh nurserymen have received orders from Norway and Sweden for seed of Scotch-grown larch and Scots fir seed. Experiments made in those countries appear to indicate that trees raised from such seed are particularly healthy and hardy.

AN ARBORICULTURAL SOCIETY FOR IRELAND.

The following circular has been received by the Secretary:—

BALLYCOURCY, ENNISCORTHY,
Co. WEXFORD, November 1901.

Irish Arboricultural Society.

Several gentlemen interested in Agriculture, and the condition to which Ireland is likely to be reduced by being further denuded of timber trees, met in Dublin on the 19th October, by the invitation of Dr Robert Cooper, of London, to consider the subject. After a full discussion, they resolved to form a Society on the lines of the Scottish and English Arboricultural Societies, its object being to disseminate information among our countrymen on the subject of the injury done to the climate and agricultural prosperity of the country by the continued destruction of timber, and the benefit to be derived from replanting the mountain and waste lands with forest trees. The indiscriminate destruction of forests, and the consequent injury thereby accruing to their country, are at present seriously occupying the attention of the United States Government. In most European countries, also, such as Germany, Hungary, Scandinavia, Denmark, France, etc., there are Governmental Departments which control the management of woodlands, and they have insisted upon cleared ground being systematically replanted with suitable tree and shrub growth. In the United Kingdom there is no such depart-

ment, and it is left to individuals to look after the welfare of the country. The two Arboricultural Societies in Great Britain have already done good service in diffusing a knowledge of Forestry, and it is hoped that a somewhat similar Society in Ireland will meet with the approval and support of landed proprietors, gentlemen, and tenant farmers. It is intended to hold a meeting of all who are interested in its object, in the work of the Winter Show, at Ball's Bridge, so as to put the Society into working order. In the meantime we have to express a hope that you will encourage the good work by intimating to us that you are willing to join the Society. The annual subscription to the English Society is 10s. 6d., and probably this Society will adopt the same. It is hoped that the Government may be ultimately induced to put in force an organisation for the administration of forest lands and the replanting of waste, and especially of hill-side areas, as has been done with such manifest advantage to our Indian Empire.

We await a favourable answer from you, and remain,

Your obedient Servants,

CHARLES G. GREY, } *Joint Hon. Secs.,*
 JAMES MUNFORD, } *pro tem.*

The new Society will have much useful work before it, and will have our heartiest good wishes for its success.

THE CAPE OF GOOD HOPE.

In his annual report for the year 1900, Mr Hutchins, who has charge of the Western Conservancy, states that the Forest Bill, to which the Government stood pledged, was, unfortunately, not proceeded with during the previous session of Parliament. "The national forests," he says, "remain with an uncertain tenure, and until they are properly secured, the danger of serious disaster is very real." Over a quarter of a million pounds sterling have been spent in the Colony on these forests, chiefly in the western portion, where the greatest demand for timber exists. The outlay during 1899 amounted to £263,491; and the value of the wood annually imported into the Colony is about £250,000.

We join Mr Hutchins in trusting that these valuable national properties may be secured to the Colony by a strong protective enactment, before it is too late to rescue them from destruction

TEACHING OF FORESTRY IN THE PROVINCES.

At the request of the Aberdeenshire County Committee on Secondary Education, the lecturer at the University of Edinburgh has undertaken to deliver, during the month of April next, at Torphins, a series of four lectures on Elementary Forestry.

EDINBURGH UNIVERSITY FORESTRY CLASS.

The lecturer would feel greatly obliged to any members of the Society who would increase his facilities of imparting instruction by sending him, to the Agricultural Class-room, specimens of special interest in connection with forestry. He has not, at present, the means of accommodating very *large* specimens. In case of doubt as to the value to the class of any object the sending of which may be contemplated, reference might be made to the lecturer before its despatch.

THE MENZIES FIR.

Describing a mixed plantation of larch, Scots pine, spruce, Douglas fir, and Menzies fir on the Durris estate, Aberdeenshire, Mr Alexander Yeats writes that the plantation in question lies on a northern slope, at an elevation of about 600 to 700 feet. The soil, to a depth of 4 feet, is peat, with the addition of a certain amount of mineral matter, which has been washed down from higher ground immediately behind it. The crop was planted seventeen years ago, after the ground had been drained, but the drainage was imperfectly carried out. The larch has almost entirely disappeared, the Scots pine struggles on, and even the spruce has a yellow, sickly appearance. The Douglas firs and the spruces now average about 17 feet in height, with a diameter of 4 inches at breast-height. Of these two species, the Douglas fir has the healthier foliage (but, apparently, the conditions do not suit it particularly well, or it would have outgrown the spruce). Mr Yeats says that the Menzies fir, on the other hand, seems to rejoice in its environment, dominating all the other species; its average height is now about 27 feet, with a diameter of 6 inches at breast-height. While the crowns of other species growing with it on the northern edge of the plantation show a permanent inward deflection, those of the Menzies fir are normally developed, and stand out strongly against the wind. For a cold aspect, with a water-

holding soil, it has no rival; it will grow rapidly, and yield timber of good quality; but on a light sandy soil signs of falling off have been observed after the fortieth year. Its power to bear shade is less than that of the spruce, for where the two species are growing in contact, the lower branches of the Menzies die off earlier than those of the spruce. It does not appear to be an abundant seed-bearer in this country. It is certainly a tree which is well deserving of further attention.

BRIEF STATEMENT OF THE OBJECTS, METHODS, AND RESULTS OF MEASUREMENTS OF GIRTH-INCREASE IN TREES UNDERTAKEN BY THE LATE SIR ROBERT CHRISTISON IN 1878, AND CARRIED ON BY DR D. CHRISTISON TO THE PRESENT DAY.¹

1. OBJECTS.—Girth-measurement of trees, chiefly in the Botanic Garden, Edinburgh, was initiated in 1878 by Sir Robert Christison in order to establish an accurate system of measurement. He showed that the measurements given in books of travels and forestry were almost invariably useless from the neglect of the simplest precautions, and pointed out the practical importance of accuracy for estimating the cubic contents of trees, for ascertaining when trees were ceasing to grow, and what were the effects of position, pruning, thinning, etc. He laid down rules for taking girth-measurements, and showed the erroneousness of De Candolle's statement, until then not challenged, that after some years of youth, trees increased nearly regularly for the rest of their lives. Sir Robert afterwards directed his observations mainly to ascertain the duration of the growing season, the annual rate of the different species, and the effect of the hard winters 1879-80-81 in checking girth-increase.

Since my father's death in 1883 I have worked on the same lines, but on a much larger scale and on younger trees, both to compare with his older set and because they are more accurately measurable. The great improvement in tapes, also, enabled me to determine with greater accuracy the duration of the growing season and the monthly rates, to undertake observations at fortnightly and even at five-day intervals, and to ascertain the immediate effects of low temperatures. Other new investigations were upon the effects of pruning and transplanting.

2. METHODS.—My method is (1) to select smooth, cylindrical stems as far as possible; (2) to measure at 5 feet above ground,

¹ The detailed report has been printed for the Royal Botanic Garden, Edinburgh.

or to raise the measurement as soon as possible to that point if it was necessary to begin lower in very young trees; (3) to mark the position with a circle of short lines of white paint, one being specially marked as the starting-point; (4) to use Chesterman's steel tapes, graduated to centimetres by preference, specially made with a square "ring," slightly wider than the tape, and included in the graduation. Holding the bottom bar of the square with the nail of the left forefinger against the measuring point, the tape is passed round the stem, and the result read off where it passes over the upright bar. I find it possible to measure smooth stems thus to half a millimetre, and even roughish ones with a risk of error of only from half to a whole millimetre.

3. RESULTS.—*The annual observations* chiefly show the rate of girth-increase in different years of different species, the temporary and permanent effects of extremely cold winters, the great reduction of increase caused by transplantation, for three or four years in young trees and for six or seven in older ones, the occasional total cessation of girth-increase for a year or more, with or without eventual recovery; the similar reduction as an effect of pruning, and the disastrous effect of over-pruning.

The monthly observations mainly show that the proportional increase due to each month varies greatly with the species, that some increase mostly in the first half, others mostly in the second half of the growing season, and that some accomplish the bulk of their annual increase in much shorter time than others.

The short-interval observations, already published, show that the Coniferæ under observation started growing between 6th April and 3rd May, and ceased to increase between September 20th and October 11th, and that the corresponding periods for the Deciduae were from 20th April to 17th May, and from August 23rd to September 27th; and that the rise and fall in the annual increase was not progressive, particularly in the Coniferæ, which experienced a great retardation in midsummer, succeeding a vigorous growth in spring, and preceding renewed vigour in autumn, there being a complete cessation of increase for a week or a fortnight in the genus *Abies*.

The unpublished short-interval results are not yet put together, but one interesting observation made this winter is that all of thirteen Deciduous trees, measured for the purpose of ascertaining the effects of hard frost on 30th January, were found to have contracted on an average 2 millimetres, and had recovered their loss after a thaw when remeasured on 4th February. D. C.

Royal Scottish Arboricultural Society.

Instituted 16th February 1854.

PATRON.

HER MOST GRACIOUS MAJESTY THE QUEEN.

THE ANNUAL MEETING.

The Forty-sixth Annual Meeting of the Royal Scottish Arboricultural Society was held in the HALL OF THE YOUNG MEN'S CHRISTIAN ASSOCIATION, 14 South St Andrew Street, Edinburgh, on Tuesday, 24th January 1899, at 2 P.M. Colonel BAILEY, President of the Society, occupied the Chair.

MINUTES.

The Minutes of the General Meeting of the Society, held on Tuesday, 2nd August 1898, which had been printed and circulated amongst the Members, were held as read, and approved of.

APOLOGIES FOR ABSENCE.

The Secretary reported that apologies for absence had been received from The Marquis of Lothian, The Earl of Mar and Kellie, Sir Robert Moncreiffe, Bart., Sir T. D. Gibson-Carmichael, Bart., M.P., W. Stewart Fotheringham, Esq. of Murthly and Fotheringham, Professor Bayley Balfour, Professor Somerville, and Messrs D. F. Mackenzie, James Moffat, and Charles Buchanan.

NEW MEMBERS.

The election of the following thirty-eight Candidates for Membership, whose names had previously been submitted to the Council, was duly confirmed, viz.:—

ANDERSON, Robert, Assistant Forester, Knowsley, Prescot.
BEATSON, David J., Crown Office, Parkend, near Lydney.

- BELL, R. Fitzroy, of Temple Hall, Coldingham.
 BORTHWICK, Albert W., B.Sc., 11 West Princes Street, Glasgow.
- 5 BROWN, Charles, Wood Merchant, Arbroath.
 BROWN, John C., The Gardens, Abercainey, Crieff.
 BURN-MURDOCH, John, of Gartincaber, by Doune.
 CAMERON, John J., Clydesdale Ironworks, Possilpark, Glasgow.
 CRAWFORD, Francis C., 19 Royal Terrace, Edinburgh.
- 10 CUNNINGHAM, John, Woodward, Lydney Park, Gloucestershire.
 CURTIS, Charles E., Moor View, Setley, Brockenhurst, Hants.
 DEWAR, Daniel, Curator, Botanic Gardens, Glasgow.
 EADSON, Thomas G., Assistant Forester, Whaley Clowne, Chesterfield.
 FISHER, W. R., Assistant Professor of Forestry, Royal Engineering
 College, Coopers Hill, Surrey.
- 15 FORBES, James, Commissioner to Her Majesty the Queen, Balmoral,
 Ballater.
 GEEKIE, C. W., 24 St Andrew Square, Edinburgh.
 GUTHRIE, P. H., B.Sc., 24 St Andrew Square, Edinburgh.
 JACKSON, James, The Gardens, Methven Castle, Perth.
 JOHNSTON, John, Forester, Oathlaw, Forfar.
- 20 LAIRD, James W., Nurseryman, Monifieth.
 MACFADYEN, Donald, Assistant Forester, Drumlanrig, Thornhill.
 MACLEAN, Archibald Douglas, J.P., Harmony, Balerno.
 MARSHALL, John, Timber Merchant, Maybole.
 PATTERSON, Thomas L., Hardengreen, Eskbank.
- 25 POWER, David F., Forester, Fetternear, Kemnay, Aberdeenshire.
 PRICE, Aaron W., Forester, Bolstone, near Ross.
 RAFFAN, James, Estate Steward, Granston Manor, Abbeyleix, Queen's
 County.
 ROBSON, Alex., of Smith & Son, 18 Market Street, Aberdeen.
 RUTHERFORD, John E. F., Land Agent, Kirkleatham Old Hall, Redcar,
 Yorks.
- 30 SCOTT, James, 3 Comely Green Crescent, Edinburgh.
 SHEPPARD, Rev. H. A. Graham, of Rednock, Port of Menteith, Stirling.
 SKINNER, William L., Nurseryman, Silcoates Nurseries, Wakefield.
 SMITH, William, The Gardens, Oxenford Castle, Dalkeith.
 WILSON, David, Timber Merchant, Troon, Ayrshire.
- 35 WILSON, Gilbert, Timber Merchant, Dailly, Ayrshire.
 WILSON, William, Timber Merchant, Auchenleck, Ayrshire.
 WYLLIE, Robert, Assistant Forester, Knowsley, Prescot.
 YOUNGER, Henry J., of Benmore and Kilmun, Greenock.

JUDGES' REPORT ON "UNIFIC" WIRE-FENCING.

The Judges appointed by the Council, with the approval of the Society at last Meeting, reported that the Model and Drawings submitted to them had been very accurately and neatly prepared, and the Specification and Report drawn out in a business-like way; and although they had come to the conclusion that the

system of fencing advocated would not be of general utility, they recommended an award of a No. 1 Silver Medal, in consideration of the care and trouble bestowed on the work. The recommendation was adopted by the Meeting. The Secretary intimated that the winner of the medal was Mr Anthony Simpson, Forester, Bargany, Ayrshire.

REPORT BY THE COUNCIL.

The Secretary read the Report by the Council, which briefly reviewed the work of the Society and of the Council during the past year. The Membership at the close of the year was as follows:—Honorary Members, 15; Life Members, 175; Ordinary Members, 612; being a total of 802.

The Report was approved of.

FINANCES OF THE SOCIETY.

The Accounts for the year ending 31st December 1898, which, after being audited, had as usual been printed and circulated amongst the Members, were held as read.

The following is a short abstract of the Accounts:—

RECEIPTS.	PAYMENTS.
1. Ordinary Subscriptions, . . £206 5 0	1. Printing and Stationery, &c., . £136 12 3
2. Life Subscriptions, . . . 68 12 0	<i>Less Receipts for Advertisements,</i> . . . 21 12 6
3. Donations, 31 1 0	£114 19 9
4. Dividend, Interest, and Miscellaneous, 17 16 0	2. Prizes, 1 6 0
	3. Expenses of Management, . . . 83 1 6
	£199 7 3
	Balance of Receipts over Payments, 124 6 9
£323 14 0	£323 14 0

The total funds of the Society at the close of the year (including the donation of £30 for the Raith Bursary) amounted to £578, 13s. 6d., of which £497, 18s. 5d. was invested, in the names of the Trustees, in Caledonian Railway Co. 4 % Guaranteed Annuity Stock No. 2. The arrears of subscriptions carried forward amounted to £32, 6s.

On the suggestion of Mr GEORGE FRASER, Factor, Dalzell, it

was agreed that the published Accounts should in future be divided into Capital and Revenue.

On the motion of Mr W. M. WELSH, Convener of the Finance Committee, the Accounts were approved of.

EXCURSION FUND.

The Secretary read Abstracts of the Accounts in connection with the Excursions to Ireland and Dolphinton in 1897, and to the Forest of Dean and Haystoun in 1898, which showed that there was a balance in hand of £22, 12s. 11d., subject to the payment of the cost of presentation copies of the Excursion Report and a fee to the Auditor for last year.

The Accounts were approved of.

PRESIDENT'S ADDRESS.

Colonel BAILEY, the retiring President, then delivered his Address, a full report of which will be found in the *Transactions*. In closing, Colonel BAILEY proposed that the EARL OF MANSFIELD be elected his successor, which was unanimously agreed to, and his Lordship accordingly took the Chair.

ELECTION OF OFFICE-BEARERS.

The election of other Office-Bearers was then proceeded with. Colonel BAILEY, MALCOLM DUNN, and ALEXANDER MILNE were elected Vice-Presidents. Mr Milne, Edinburgh, moved that the following Members, recommended by the Council in terms of the Laws, be elected Councillors, viz.—CHARLES BUCHANAN, Overseer, Penicuik; WM. GILCHRIST, Forester, Leuchars, Elgin; WM. MACKINNON, Nurseryman, Edinburgh; JOHN T. M'LAREN, Factor, Polmaise; and JOHN METHVEN, Nurseryman, Edinburgh. The motion was duly seconded. Mr Alexander Pitcaithley, Forester, Scone, moved that the name of JOHN BOYD, Forester, Pollok, be substituted for that of Mr M'Laren. The amendment was seconded, and, on a vote being taken, was carried. The Honorary Secretary, the Secretary and Treasurer, the Auditor, the Honorary Scientists, the Photographic Artist, and the Local Secretaries were re-elected. Mr ROBERT LINDSAY, Corstorphine, was elected a Member of the Judges and *Transactions* Committee

in place of Professor Bayley Balfour, resigned. The other Members of that Committee were re-elected.

The Office-Bearers and Officials elected for the year 1899 were therefore as follows :—

PRESIDENT.

The Right Hon. the EARL OF MANSFIELD, Scone Palace, Perth.

VICE-PRESIDENTS.

WILLIAM SOMERVILLE, D.Cec., D.Sc., F.R.S.E., Professor of Agriculture, Cambridge University.

W. M. WELSH, Nurseryman and Seedsman, 1 Waterloo Place, Edinburgh.

Colonel F. BAILEY, R.E., Lecturer on Forestry, Edinburgh University.

MALCOLM DUNN, The Palace Gardens, Dalkeith.

ALEXANDER MILNE, Nurseryman and Seedsman, 32 Hanover Street, Edinburgh.

COUNCIL.

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.

CHARLES BUCHANAN, Overseer, Penicuik Estate, Penicuik.

WILLIAM GILCHRIST, Forester, Leuchars, Elgin.

WILLIAM MACKINNON, Nurseryman, 144 Princes Street, Edinburgh.

JOHN BOYD, Forester, Pollok Estate, Pollokshaws, Glasgow.

JOHN METHVEN, Nurseryman, 15 Princes Street, Edinburgh.

HON. SECRETARY.

R. C. MUNRO FERGUSON, M.P., of Raith and Novar, Raith House, Kirkcaldy, Fife.

SECRETARY AND TREASURER.

ROBERT GALLOWAY, S.S.C., 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 SOMERVILLE, University of Cambridge.
MALCOLM DUNN, The Palace Gardens, Dalkeith.
JOHN METHVEN, Nurseryman, Edinburgh.
JOHN MICHIE, Forester, Balmoral.
JOHN CLARK, Forester, Haddo House, Aberdeen.
ROBERT LINDSAY, Kaimes Lodge, Murrayfield.

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.Æc., D.Sc., F.R.S.E., F.L.S., Professor of Agriculture, Department of Agriculture, Cambridge University.
- Consulting Entomologist*, ROBERT STEWART MACDOUGALL, M.A., D.Sc., Professor of Biology, New Veterinary College, 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.
- 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.

Counties.

- 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, University of Cambridge.
Hants, . . . ANDREW SLATER, Land Steward, Osborne, Cowes, Isle of
 Wight.
Hereford, . . . WM. STORIE, Forester, Holme Lacy, Hereford.
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.

Counties.	
<i>Norfolk</i> ,	H. MUNRO, Garden Cottage, Holkham. JAMES RODGER, Forester, Morton Hall, Norwich.
<i>Northampton</i> ,	F. MITCHELL, Forester, Harlestone, Northampton.
<i>Northumberland</i> ,	JOHN DAVIDSON, <i>Secretary</i> , English Arboricultural Society, Haydon-Bridge-on-Tyne.
<i>Notts</i> ,	W. MICHIE, Forester, Welbeck, Worksop. WILSON TOMLINSON, Forester, Clumber Park, Worksop.
<i>Salop</i> ,	FRANK HULL, Forester, Lillieshall, Newport.
<i>Stafford</i> ,	ROBERT T. COLLINS, Forester, Trentham, Stoke-on-Trent.
<i>Suffolk</i> ,	ANDREW BOA, junior, Sub-Agent, Great Thurlow.
<i>Surrey</i> ,	PHILIP PEEBLES, Estate Office, Albury, Guildford.
<i>Warwick</i> ,	W. BERRIDGE, Forester, Stoneleigh Abbey Farm, Kenilworth. A. D. CHRISTIE, The Gardens, Ragley Hall, Alcester.
<i>Wilts</i> ,	A. C. FORBES, Wood Manager, Bowood, Calne.
<i>Yorks</i> ,	WM. FORBES, Forester, Swinton, Masham. ADAM MAIN, Forester, Rose Cottage, Loftus. D. TAIT, Estate Bailiff, Owston Park, Doncaster.

Wales.

<i>Flint</i> ,	R. V. KYRKE of Penywern, Mold.
<i>Glamorgan</i> ,	ARCH. MITCHELL, Forester, Dunraven, Bridgend. GEO. WILSON, Forester, Penrice Castle, Reynoldston R.S.O.

Ireland.

<i>Antrim</i> ,	JOHN SCRIMGEOUR, Land Steward, Shane's Castle.
<i>Galway</i> ,	THOMAS ROBERTSON, Forester, Knockboy, Recess.
<i>Kildare</i> ,	ROBERT M'KERROW, Manager, Carton, Maynooth.
<i>Kilkenny</i> ,	ALEX. M'RAE, Forester, Castlecomer.
<i>King's County</i> ,	ARCH. HENDERSON, Forester, Clonad Cottage, Tullamore.
<i>Monaghan</i> ,	JAMES BRODIE, Land Steward, Glaslough.
<i>Tipperary</i> ,	DAVID G. CROSS, Forester, Kylisk, Nenagh.
<i>Wicklow</i> ,	ADAM JOHNSTONE, Forester, Coollattin, Shillelagh.

PHOTOGRAPHIC ARTIST.

GEORGE PAXTON, Richardland, Kilmarnock.

STATE MODEL FORESTS FOR SCOTLAND.

The Secretary read the following letter, which had been received from the Board of Agriculture:—

BOARD OF AGRICULTURE,
4 WHITEHALL PLACE, LONDON, S.W.,
26th October 1898.

SIR,—I am directed by the Board of Agriculture to advert to your letter of the 13th inst., and to say that, as the Royal

Scottish Arboricultural Society would be aware from what was said at the interview which took place between Mr Munro Ferguson, Colonel Bailey, and myself at this office on the 27th of June last, the Board have very much sympathy with the object in view, as expressed in the Society's letter of the 8th June last; but, as was then explained, it was felt that, in the present condition of public opinion on the subject, the Board would not be able to approach the Treasury with any probability of their being successful in obtaining the very large grants of public money which would be requisite for the carrying out of the scheme outlined in the printed note which accompanied the letter above referred to.—I am, Sir, your obedient Servant,

T. H. ELLIOTT,
Secretary.

The Secretary,
Royal Scottish Arboricultural Society,
5 St Andrew Square, Edinburgh.

Colonel BAILEY said it was disappointing that the Board of Agriculture had not seen its way to give practical effect to its sympathy expressed in the letter. He mentioned that he and the Honorary Secretary were hopeful that they might yet be able to interest Her Majesty's Commissioners of Woods and Forests in the scheme, and the matter was remitted to the Council.

BURSARY FOR EDUCATION IN FORESTRY.

Colonel BAILEY intimated that Mr MUNRO FERGUSON had very generously agreed to contribute for a few years the sum of £30 per annum as a Bursary for a Student of Forestry and kindred subjects at Edinburgh University, who should be expected to devote himself to the practice of Forestry in the United Kingdom. He also mentioned that Mr Munro Ferguson had begun operations under the Working Plan prepared for his woods at Raith, and had consented to permit them to be visited from time to time by parties of students with their teachers. It was part of the arrangement that each student who held the Bursary should get employment in the Raith woods during that part of the year when the classes were not in session.

On the motion of Mr DUNN, a very hearty vote of thanks was accorded to Mr Munro Ferguson for his liberality, and for the public spirit he had displayed in the matter.

It was suggested that the Society might give a similar Bursary, and the matter was remitted to the Council for consideration.

LIBRARY AND MUSEUM.

The Secretary reported that the following publications had been received since the General Meeting in August :—

LIST OF PRESENTATIONS TO THE SOCIETY'S LIBRARY.

1. *Journal of the Royal Agricultural Society*, London, vol. ix., parts 3 and 4.
2. *Journal of the Royal Horticultural Society*, London, vol. xxii., parts 2 and 3.
3. Report of the Council of the Royal Horticultural Society, 1898–99.
4. Arrangements of the Royal Horticultural Society for 1899.
5. *Transactions of the English Arboricultural Society*, vol. iv., part 1.
6. *Transactions of the Massachusetts Horticultural Society*, 1897, part 2.
7. Report of the Forest Department, Madras Presidency, 1896–97.
8. Agricultural Returns—Statistical Tables, 1898, and various Leaflets. From the Board of Agriculture.
9. Provincial Government Crop Report, Nova Scotia, 1898.
10. Annual Progress Report of the Woods and Forests Departments of South Australia, 1897–98. By Walter Gill, Conservator of Forests.

Note.—Members may borrow from the Secretary any of the Books or Pamphlets mentioned above, provided they pay the cost of transmission, and guarantee their safe return within a reasonable time.

Colonel BAILEY reported that, following up the remit made at last Meeting regarding the disposal of the Society's books, etc., the Council had agreed to recommend that the Cleghorn Library should get the first choice, and the Lecturer on Forestry the next, and that what they did not select would not be worth preserving. This was approved of.

EXCURSION IN 1899.

Mr DUNN intimated that the Council had agreed to recommend that the Annual Excursion should be made to the Counties of Sutherland and Ross, the estates proposed to be visited being Dunrobin, Dornoch, Skibo, and Novar. Mr PITCAITHLEY moved that the Excursion be made to Novar for three days. Mr J. WILLIAMSON seconded. Mr DUNN moved that the matter be remitted to the Council, with powers, as hitherto. Mr WM. MACKINNON seconded. On a vote being taken, Mr DUNN's motion was carried. Mr PITCAITHLEY suggested that cheap fares should be arranged from other centres than Edinburgh, such as Perth and Aberdeen, and the matter was remitted to the Council.

PARIS EXHIBITION IN 1900.

Mr DUNN intimated that the Council had decided not to send an exhibit to the Exhibition, but proposed to arrange an Excursion to France that year, and to visit the Exhibition.

The matter was remitted to the Council, with powers.

MOTIONS DISPOSED OF.

In submitting to the Meeting the motion standing in name of the Council regarding the Election of Members, Colonel BAILEY said that the Council's experience of the working of the motion, which had been in operation during the past year, led them to suggest that before it was finally adopted it should be amended, to the effect that confirmation by the Society of the Election of Members should be abandoned, and the great delay in admitting Candidates to full Membership be thus dispensed with. This was agreed to. The motion, as amended, was then read and formally put to the Meeting, and unanimously adopted, as follows :—

Every Proposal for Membership shall be made on the FORM provided for the purpose, which must be signed by two Members of the Society as Proposer and Seconder, and delivered to the Secretary to be laid before the next Meeting of the Council. The Proposal shall lie on the table till the following Meeting of the Council, when it shall be accepted or otherwise dealt with, as the Council may deem best in the

interests of the Society. The Proposer and Seconder shall be responsible for payment of the new Member's first Subscription.

It was intimated that Mr CLARK had withdrawn his motion regarding the establishment of Branches of the Society.

NOTICES OF MOTION.

Mr GEORGE FRASER, Factor, Dalzell, Motherwell, gave notice of the following motion:—

That at all General Meetings of the Society the Members shall be entitled to vote by proxy.

EXHIBIT.

Sir JAMES GIBSON CRAIG, of Riccarton, exhibited a section of a very fine Scots Fir, believed to be 270 years old, which had recently been blown down in his policies, and a vote of thanks was accorded to him for his very interesting exhibit.

OTHER VOTES OF THANKS.

Votes of thanks were also accorded to Colonel BAILEY, the retiring President, for his services to the Society during the past year; to the Honorary Secretary and the Secretary and Treasurer; to the donors of Books and Pamphlets to the Library; and to the EARL OF MANSFIELD, the President-elect, for presiding, which concluded the business.

At the close of the business Colonel BAILEY gave a short account of his recent visit to Canada, illustrated by limelight views, and a very hearty vote of thanks was accorded to him for his lecture¹ and exhibition.

THE ANNUAL DINNER.

After the Meeting the Members and their friends dined together in the Royal British Hotel. The EARL OF MANSFIELD, President of the Society, was Chairman, and Colonel BAILEY and Mr W. M. WELSH, Vice-Presidents, were Croupiers. The com-

¹ The lecture is printed in Vol. XVI. of the *Transactions*.

pany numbered about sixty. The guests of the Society were Lord KYLLACHY; Rev. ARCHD. FLEMING, of Tron Church; Bailies HAY and MACKENZIE; Mr ISAAC CONNELL, Secretary of the Scottish Chamber of Agriculture; Mr WYLIE, Secretary of the Edinburgh Agricultural Society; Mr KINGHORN, of the Caledonian Railway Company; and Messrs ANDERSON and YOUNG, of the *North British Agriculturist*. Lord KYLLACHY proposed the toast of the Society, which was replied to by the President. Mr MUNRO FERGUSON proposed "Forestry Education," and Colonel BAILEY replied. Other toasts followed, and a number of songs were contributed by members of the company in excellent style.

LECTURE.¹

Sir DIETRICH BRANDIS, K.C.I.E., LL.D., ex-Inspector-General of Forests, India, addressed a meeting held under the auspices of the Society in 5 St Andrew Square, Edinburgh, on Friday, 24th February 1899, at 7.30 P.M., his subject being "Pure Forests and Mixed Forests." The Earl of Mansfield, President of the Society, presided, and introduced the Lecturer, and there was a large attendance of Members of the Society and of the general public. A discussion followed the lecture, and was taken part in by Messrs Malcolm Dunn, Dalkeith; James Whitton, Glasgow; John Methven, Edinburgh; and James M'Donald, Craigharnet.

At the close of the Meeting votes of thanks were accorded to the Lecturer and the Chairman.

THE GENERAL MEETING.

A General Meeting of the Royal Scottish Arboricultural Society was held in No. 5 St Andrew Square, Edinburgh, on Tuesday, 1st August 1899, at 11 o'clock A.M. The EARL OF MANSFIELD, President, in the Chair.

MINUTES.

The Minutes of the Forty-sixth Annual Meeting of the Society, held on 24th January 1899, were held as read and approved of.

¹ The lecture is printed in Part 1 of Vol. XVI. of the *Transactions*.

PROPOSED QUARTERLY PUBLICATION BY THE SOCIETY.

The following note, prepared by Colonel BAILEY, was, in his absence, read by the Secretary:—

Under the present system of publishing an annual volume of *Transactions* (only), opportunity is not afforded for discussions and correspondence; nor is space available for the printing of notes on current topics, the reproduction of interesting articles from other journals, reviews of books, and other matter which might be of great interest and use to the Members of the Society. Addresses and papers printed a year after they have been delivered or read have often lost much of their interest.

There could hardly be a more certain indication of vigour in a Society than its power to sustain an active publication issued at comparatively short intervals, and I hope and think that the Society is capable of this.

I would propose that such a publication might be organised on the following lines:—

1. *Formal Papers*—including papers written specially for it, prize essays, and reprints of articles and papers of a similar nature.
2. *Notes*—gathered from records of facts communicated by Members and others, and from other publications. These would be brief and less formal notices than the above.
3. Correspondence.
4. Obituary notices.
5. Reviews of books.
6. Advertisements.

It might be issued in four quarterly parts, each of 64 pages.

* The present *Transactions* run to an average of 167 pages, of which 36 pages are occupied by business matter, and 131 by essays, notes and queries, and excursion reports. The average cost for 809 copies has been £64, 17s. 5d., but £20, 10s. 7d. have been received for advertisements, leaving a nett expenditure of £44, 7s.

Note.—The figures in this paragraph are the averages of the past five years.

The new publication would run to 256 pages, which would afford 220 pages for other than business matters. The gross cost would probably be £82, and if £20 be allowed for advertisements, the nett cost would be £62, or some £18 more than at present. This cost might perhaps be reduced by increased advertising.

The journal would have to be conducted by an honorary editor, who might be aided by an honorary assistant-editor.

It was mentioned that Colonel Bailey had consented to act as editor, for a time, at least, in the event of the proposal being carried out. Professor SOMERVILLE supported the proposal, and suggested that contributors should be paid.

The matter was remitted to the Council for further consideration.

THE LATE MR MALCOLM DUNN.

At the request of the President, the Secretary read the following Resolution, which had been sent by the Council to the representatives of the late Mr Dunn:—"The Council of the Royal Scottish Arboricultural Society desire to record their deep sense of the irreparable loss which the Society has sustained in the death of Mr Malcolm Dunn, one of its Honorary Members. For the last twenty-four years he has devoted himself with characteristic energy to the welfare of the Society, and has taken an active part in all its schemes and undertakings, especially in those for the promotion of professional education by means of lectures and excursions. A man of many interests, whose sagacious advice was sought in all departments with which he associated himself, he always found time to advance the work of the Society, and to carry through any project regarding the utility of which he had become convinced. The Council feel that the success which has attended the Society's efforts has been in large measure due to Mr Dunn's zeal and devotion, and to the influence he exerted among all classes of its Members. It is with sincere sorrow that they now record the loss of so highly valued a colleague, in whom they recognised not only a trustworthy counsellor but a faithful friend.

"They request the Secretary to send a copy of this Resolution to Mr Dunn's family, and at the same time to express deep sympathy in their bereavement."

The following reply was also read:—

TURRET BANK, CRIEFF, N.B.,
22nd June 1899.

DEAR MR GALLOWAY,—Your kind letter of the 17th, with Minute enclosed, came safe to hand. Will you convey my thanks to the Royal Scottish Arboricultural Society for their kind sympathy expressed with us in our sorrow for the death of my dear and only brother, Malcolm Dunn? It is so kind of all the Societies to endeavour to perpetuate his loved memory. My family and other relatives join me in again thanking you all for your true sympathy.—Yours sincerely,

(Mrs) JESSIE MORGAN.

The Secretary reported that the Council had joined with the Royal Caledonian Horticultural Society, the Botanical Society of Edinburgh, and the Scottish Horticultural Association, in issuing an appeal for funds to perpetuate Mr Dunn's memory, and that it was proposed to erect a suitable monument in Dalkeith Cemetery, and devote the balance to charitable and educational objects in connection with Horticulture and Arboriculture.

The action of the Council was approved of.

LOCAL SECRETARIES.

The appointment by the Council of the following additional Local Secretaries was confirmed:—

<i>Dumbarton,</i>	.	ROBERT BROWN, Forester, Boiden, Luss.
<i>Kincardine,</i>	.	JOHN HART, Estates Office, Cowie, Stonehaven.
<i>Peebles,</i>	.	GEORGE HANNAH, Forester, The Glen, Innerleithen.
<i>Ross,</i>	.	MISS AMY FRANCES YULE, Tarradale House, Muir of Ord.

JUDGES' REPORT ON THE ESSAYS.

The Secretary intimated that, owing to a mistake in connection with the transmission of the Essays between the Judges, their Report had not been received, and the matter was remitted to the Council, with powers.

THE RAITH BURSARY.

Attention was directed to the intimation in the notice calling the Meeting that applications for this Bursary should be sent in as soon as possible. A Print of the Particulars, prepared by the

Council for the information of inquirers, was submitted and approved, as follows:—

The Bursary is given to enable a Student to attend the Edinburgh University Course in Forestry, which extends from October to March, together with such other Courses, at the University or elsewhere, as the Lecturer may consider desirable.

Conditions.

1. *Age.*—Candidates must be not less than 18 nor more than 25 years of age.
2. *Character.*—They must produce evidence of good character.
3. *Education.*—They must satisfy the Lecturer that their Educational Attainments are sufficient to enable them to follow his Course with profit.
4. *Health.*—They must be of sound constitution and active habits.
5. *Parentage.*—Preference will be given to the sons and other relatives of Foresters, or others employed in connection with woods, in Scotland, and also to Candidates who have themselves been so employed.
6. *Future Career.*—Candidates must declare their intention to follow the profession of Forestry in the United Kingdom.
7. *Appointment.*—Appointments to the Bursary will be made by the President of the Royal Scottish Arboricultural Society, to whom the Lecturer will submit the names of qualified candidates.
8. *Financial.*—The successful candidate will receive £25 to cover the expenses of his attendance as a Member of the University Class in Forestry, including the Class Fee. The balance of £5 will be at the disposal of the Lecturer for the payment of fees for other classes, purchase of books, and accessories of a like nature.

The holder of the Bursary can obtain employment at £1 a week, for a course of practical work at Raith or at Novar, for the period between March and the middle of October.

RAITH WORKING PLAN.

The Secretary reported that specially bound copies of the Raith Working Plan had been sent to Her Majesty the Queen at Balmoral, and to H.R.H. the Prince of Wales, on the occasion of his recent visit to Edinburgh, and had been graciously received and acknowledged by them.

EXCURSION, 1899.

The Committee reported that, with the approval of Lord Lovat and Mr Munro Ferguson, the Lovat Woods, near Beauuly, would be visited on Wednesday, 2nd August, instead of the Novar Woods, and that Dunrobin would be visited on the 3rd, and Dornoch and Skibo on the 4th, as previously arranged. About ninety members had entered their names for the trip.

EXCURSION IN 1900.

The Secretary reported that some progress had been made with the proposed trip to France next year. A programme had been prepared covering a fortnight, and had been submitted to the French Forestry authorities at Nancy by Colonel Bailey, and approved of by them. Inquiries were being made as to the expense, and further progress would be reported at next Meeting.

The matter was remitted to the Council, with powers.

GLASGOW EXHIBITION IN 1901.

It was mentioned that the Council had represented to the Manager of the Exhibition that Forestry should be included in the official programme, and that the Society should be represented on the Committee in charge of the matter, and on the Executive Council. The Manager had, however, indicated that he had little hope of finding room for any Forestry Exhibits, but would lay the Council's request before his Committee.

LIBRARY AND MUSEUM.

The Secretary reported that the following publications had been received since the Annual Meeting in January:—

LIST OF PRESENTATIONS TO THE SOCIETY'S LIBRARY.

1. *Journal of the Royal Horticultural Society*, London, vol. xxii., part 4.
2. Annual Progress Report of the Woods and Forests Department of Western Australia, 1897-98. By J. Ednie Brown, Conservator of Forests.
3. *Transactions of the Highland and Agricultural Society*, 5th series, vol. xi.
4. New and little known North American Trees: a reprint. By Professor Sargent.

5. Announcement of the New York State College of Forestry, 1898-99. Pamphlet by the Director, B. E. Fernow.
6. From the United States of America Department of Agriculture :—
 - Report upon Forestry, 1877. By F. B. Hough.
 - Timber Pines of the Southern United States, etc., 1897. By C. Mohr and F. Roth.
 - Timber Physics—Part 1, Preliminary Report, 1892. Compiled by B. E. Fernow.
 - Check List of Forest Trees of the United States, 1898. By G. B. Sudworth.
 - Experimental Tree-Planting on the Plains, 1898. By C. F. Keffer.
 - Forest Growth and Sheep Grazing, 1898. By F. V. Coville.
 - Some Foreign Trees for the Southern States, 1895.
 - Forestry Conditions and Interests in Wisconsin, 1898. By F. Roth.
 - Systematic Plant Introduction, 1898. By D. G. Fairchild
 - Forestry for Farmers, 1898. By B. E. Fernow.
 - Also a number of Circulars issued by the Department.

Note.—Members may borrow from the Secretary any of the Books or Pamphlets mentioned above, provided they pay the cost of transmission, and guarantee their safe return within a reasonable time.

The Secretary also reported that, as authorised at last Meeting, he had handed over to the Librarian of the Cleghorn Library and the Lecturer on Forestry such of the Society's books as had been selected by them, and that signed lists had been put up with the Society's papers.

NOTICES OF MOTION.

Notice was given, on behalf of the Council, of the following Motions, which will fall to be discussed at next Meeting :—

Amendment of Law III.

1. That an additional order of Members be established, to be called "Honorary Associate Members," who shall receive the publications of the Society *gratis*, and shall not be called upon to pay any subscription.

2. That, on the recommendation of the University Lecturer, the Senior Student of the University Class in Forestry shall be made an Honorary Associate Member. This Resolution to have effect for five years from 1st January 1899, when it will be reconsidered.

VOTES OF THANKS.

On the motion of Mr ALEXANDER MILNE, a hearty vote of thanks was accorded to the Earl of Mansfield for presiding, which closed the business.

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 1899 :—

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 1899 or 1st June 1900; stating the time they may require for reading the paper.

Royal Scottish Arboricultural Society.

INSTITUTED 16th FEBRUARY 1854.

PATRON—HER MOST GRACIOUS MAJESTY THE QUEEN.

I.—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 DUCHE.
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.S.S. 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.
1897.	Ditto,	ditto.
1898.	Colonel F. BAILEY, R.E. (retired), Lecturer on Forestry, University of Edinburgh.	
1899.	The Right Hon. THE EARL OF MANSFIELD, Scone Palace, Perth.	
1900.	Ditto,	ditto.

2.—LIST OF MEMBERS.

Corrected to December 1900.

HONORARY MEMBERS.

Date of Election.	
1886.	AVEBURY, The Right Hon. Baron, D.C.L., High Elms, Down, Kent.
1873.	BRANDIS, Sir Dietrich, K.C.I.E., Ph.D., <i>Ex-Inspector</i> General of Forests in India, Bonn, Germany.
1886.	CAMPBELL, Sir James, Bart. of Aberuchill, Redhill, Lydney, Gloucestershire.
1886.	HOOKE, Sir Joseph D., M.D., K.C.S.I., The Camp, Sunningdale, Berks.
1886.	JOHORE, The Maharajah of, Johore, Malay Peninsula.
1894.	LOGAN, Sir Charles B., W.S., 23 Queen Street, Edinburgh.
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, 11 Alexandra 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 Scot-
 land, Kennet House, Alloa.
 1900. BALFOUR, Charles B., of Newton Don, Kelso.
 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. BAXTER, Robert, Forester, Dalkeith Park, Dalkeith.
 1871. *Bell, William, of Gribdale, 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.
 1900. BROWN, Charles, Factor, Kerse, Falkirk.
 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, Ardnaine, Lochgilphead, Argyleshire.
 1896. CARMICHAEL, Sir Thos. D. Gibson, Bart. 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.
 1898. CRAWFORD, Francis C., 19 Royal Terrace, Edinburgh.

Date of
Election.

1900. CROOKS, James, Timber Merchant, St Helens.
 1865. CROSS, David G., Forester, Kylisk, Nenagh, Ireland.
 1895. CROZIER, John D., Forester, Durris, Drumoak, Aberdeen.
 1880. CURE, Henry, Brooklee, Helensburgh.
 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.
 1900. DALHOUSIE, The Right Hon. the Earl of, Brechin Castle, Forfarshire.
 1892. DAVIDSON, William, Forester, Margam Park, Port Talbot, Wales.
 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, Lieut.-Colonel Robert, Yr. of Arniston, Kirkhill, Gorebridge.
 1876. EDWARDS, William Peacock, S.S.C., 21 Hill Street, Edinburgh.
 1881. ELLIOT, Walter, Manager, Ardtornish, Morvern, Oban, Argyle.
 1899. ELLISON, Francis B., Bragleenbeg, Kilninver, Oban.
 1879. FALCONER, Dr John, St Ann's, Lasswade, Midlothian.
 1900. FERGUSON, James Alex., Ardnith, Partickhill, Glasgow.
 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.
 1881. FORBES, Arthur Drummond, Millearne, Auchterarder, Perthshire.
 1878. FORBES, Robert, Estate Office, Kennet, Alloa.
 1890. FORBES, William, Forester, Swinton, Masham, Yorkshire.
 1869. FORGAN, James, Forester, Bonskeid, Pitlochry, Perthshire.
 1897. FOTHERINGHAM, W. Steuart, of Murthly, Perthshire.
 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.
 1893. GALLOWAY, Robert, S.S.C., *Secretary*, 48 Castle Street, Edinburgh.
 1899. GARRIOCH, John E., Factor, Lovat Estates, Beauly.
 1881. GILCHRIST, Wm., Forester, Leuchars, Elgin.
 1900. GLADSTONE, Sir John R., Bart. of Fasque, Laurencekirk.
 1897. GOUGH, Reginald, Forester, Wykeham, York.
 1868. GOSSIP, James A., of Howden & Co., The Nurseries, Inverness.
 1884. GRAHAM, Wm., 6 Royal Crescent, W., Glasgow.
 1874. GRANT, John, Overseer, Daldowie, Tollcross, Glasgow.
 1880. GRANT, Sir George Macpherson, Bart., Ballindalloch Castle, Banffshire.
 1867. GRIMOND, Alexander D., of Glenericht, Blairgowrie, Perthshire.
 1900. HALDANE, William S., of Foswell, W.S., 55 Melville Street, Edinburgh.
 1882. HAMILTON, Donald C., Forester, Knowsley, Prescot.
 1899. HAMILTON, The Right Hon. Baron, of Dalzell, Dalzell House,
 Motherwell.
 1880. HARE, Colonel, Blairlogie, Stirling.

Date of
Election.

1880. HAVELOCK, W. B., The Nurseries, Brocklesby Park, Ulceby, Lincolnshire.
1874. HERBERT, H. A., of Muckcross, Killarney, Co. Kerry, Ireland.
1884. HEYWOOD, Arthur, Glevering 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.*
1883. JOHNSTON, Robert, Forester, Blackhouse, Reston, Berwickshire.
1882. JONAS, Henry, Land Agent and Surveyor, 23 Pall Mall, London, S.W.
1890. KENNEDY, James, Doonholm, Ayr.
1892. KER, John, Farmer, Barney Mains, Haddington.
1898. KINROSS, John, Architect, 2 Abercromby Place, Edinburgh.
1890. LAIRD, David P., Nurseryman, Pinkhill, Murrayfield, Edinburgh.
1896. LAIRD, Robert, Nurseryman, 17a South Frederick Street, Edinburgh.
1894. LAMINGTON, The Hon. Lord, G.C.M.G., 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.
1881. LEYLAND, Christopher, Haggerston Castle, Beal, Northumberland.
1883. LONEY, Peter, Estate Agent, 6 Carlton Street, Edinburgh.
1881. LONSDALE, Claud, Rose Hill, Carlisle.
1898. LOVE, The Right Hon. Baron, Beaufort Castle, Beaulieu, 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.
1900. LOW, William, B.Sc., Tighnamuirn, Monifieth.
1891. LUMSDEN, Hugh Gordon, of Clova, Lumsden, Aberdeenshire.
1875. LUTRELL, George F., of Dunster Castle, Taunton, Somersetshire.
1900. LYELL, Sir Leonard, Bart. of Kinnordy, Kirriemuir.
1894. MACDONALD, James, Forester, Kinnaird Castle, Brechin.
1874. MACDONALD, Ranald, Factor, Cluny Castle, Aberdeenshire.
1895. MACDOUGALL, Professor Robert Stewart, M.A., D.Sc., New Veterinary College, Edinburgh.
1884. MACDUFF, Alex., of Bonhard, Perth.
1885. MACINTOSH, William, Fife Estates Office, Banff.
1879. MACINTOSH, Dr W. C., Professor of Natural History, University of St Andrews, 2 Abbotsford Crescent, St Andrews.
1872. MACKENZIE, Donald F., F.S.I., Estate Office, Mortonhall, Edinburgh.
1893. MACKENZIE, James, Forester, Cullen House, Cullen.
1897. M'KERROW, Robert, Manager, Carton, Maynooth, Co. Kildare.
1898. MACKINNON, A., The Gardens, Scone Palace, Perth.

- Date of Election.
1895. MACLACHLAN, John, of Maclachlan, 12 Abercromby Place, Edinburgh.
1898. MACLEAN, Archibald Douglas, J.P., Harmony, Balerno.
1879. M'LAREN, John, Marionville, Sciennes Gardens, Edinburgh.
1898. M'LAREN, John, Gardener, Ballenerieff, Drem, East Lothian.
1899. MACRAE-GILSTRAP, Major John, of Ballimore, Otter Ferry, Argyleshire.
1879. MACRITCHIE, David, C.A., 4 Archibald Place, Edinburgh.
1880. MALCOLM, Lieut.-Col. E. D., R.E., Achnamara, Lochgilhead.
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.
1879. MEIKLE, R. A., Ri Cruin, Lochgilhead, Argyleshire.
1880. MESHAM, Captain, Pontryffydd, Bodvari, Rhy1, 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, Woburn, Beds.
1889. MOFFAT, James, 48 Castle Street, Edinburgh.
1895. MONCREIFFE, Sir Robert D., Bart. of Moncreiffe, Perth.
1899. MORGAN, Andrew, Assistant Factor, Glamis.
1895. MORGAN, Malcolm, Timber Merchant, Crieff, Perthshire.
1898. MURRAY, Hon. Alan David, Scone Palace, Perth.
1896. MURRAY, William Hugh, W.S., 48 Castle Street, Edinburgh.
1899. NAIRN, Michael B., of Rankeillour, Manufacturer, Kirkecaldy.
1893. NISBET, J., D.Ec., Royal Societies' Club, 63 St James Street, London, S.W.
1899. NOBBS, Eric Arthur, B.Sc., Pension Walraff, Schiffbauerdamm, Berlin, N.W.
1894. ORKNEY, William C., Surveyor's Office, Montrose Royal Asylum.
1899. ORR-EWING, Archibald Ernest, Ballikinrain Castle, Balfroun.
1898. PATON, Robert Johnston, Nurseryman, Kilmarnock.
1900. PERRINS, C. W. Dyson, of Ardross, Ardross Castle, Alness.
1878. PITCAITHLEY, Alexander, Forester, Jeanie Bank, Scone.
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., Experimental Cottage, Inverleith Row, Edinburgh.
1876. RITCHIE, William, Dalawoodie, Dumfries.
1879. ROBERTSON, Donald, Forester, Dunrobin, Golspie.

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, K.G., K.T., Dalmeny Park,
 Edinburgh.
 1894. SANDERSON, Wm., Talbot House, Ferry Road, Leith.
 1867. SCOTT, Daniel, Wood Manager, Darnaway, Forres.
 1890. SCRIMGEOUR, John, Overseer, Shane's Castle, Antrim, Ireland.
 1896. SHAW-STEWART, Michael Hugh, M.P., of Carnock, 7 Charles Street,
 Berkeley Square, London, S.W.
 1898. SHEPPARD, Rev. H. A. Graham, of Rednock, Port of Menteith, Stirling.
 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.Æc., F.R.S.E., Professor
 of Agriculture, Cambridge University.
 1883. SPROT, Major Alexander, of Garnkirk, Chryston, Glasgow.
 1873. STAIR, The Right Hon. the Earl of, Lochinch, Castle Kennedy, Wig-
 townshire.
 1899. STEWART, Duncan D., Factor, Rossie Estate, Inchtute.
 1892. STEWART, Sir Mark J. M^cTaggart, Bart., M.P., of Southwick, Kirk-
 cudbrightshire.
 1880. SUTHERLAND, Evan C., Highland Club, Inverness.
 1883. SUTHERLAND, His Grace the Duke of, Dunrobin Castle, Golspie.
 1865. TALBERT, Peter, Forester, David Street, Blairgowrie, Perthshire.
 1877. TERRIS, James, Factor, Dullomuir, Blairadam, Kinross-shire.
 1865. THOMSON, John Grant, Wood Manager, Grantown, Strathspey.
 1871. TOMLINSON, Wilson, Forester, Clumber Park, Worksop, Notts.
 1872. TROTTER, Colonel, R.A., The Bush, Roslin, Midlothian.
 1883. TROTTER, Major-General 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.
 1900. WARWICK, Charles, Land Steward, Clandeboye, Co. Down.
 1893. WATSON, John T., 6 Bruntsfield Gardens, Edinburgh.
 1891. WELSH, James, of Dicksons & Co., 1 Waterloo Place, Edinburgh.
 1871. WEMYSS, Randolph Gordon Erskine, of Wemyss and Torrie, Fife.
 1898. WHITE, J. Martin, Balruddery, near Dundee.
 1899. WHYTE, John D. B., Factor, Castlecraig, Dolphinton.
 1869. WILD, Albert Edward, Conservator of Forests, Darjeeling, India.
 1898. WILSON, David, Timber Merchant, Troon, Ayrshire.
 1889. WILSON, David, jun., of Carbeth, Killearn, Glasgow.
 1898. YOUNGER, Henry J., of Benmore and Kilmun, Greenock.
 1899. YULE, Amy Frances, L.A., Tarradale House, Muir of Ord.

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.
 1900. ADAIR, David Rattray, S.S.C., 24 Castle Street, Edinburgh.
 1892. ADAMSON, C., Merchant, Leven, Fife.
 1900. AITCHISON, John, Assistant Forester, Pollok, Pollokshaws.
 1878. AITKEN, Andrew Peebles, M.A., Sc.D., Professor of Chemistry,
 Veterinary College, Clyde Street, Edinburgh.
 1865. ALLAN, John, Forester, Dalmeny Park, Edinburgh.
 1898. ALLAWAY, William, 13 St Andrew Square, Edinburgh.
 1899. ANDERSON, Andrew W., Assistant Forester, Raith, Kirkcaldy.
 1895. ANDERSON, Duncan, Assistant Agent, Hutton Estate Office, near
 Preston.
 1897. ANDERSON, John, Forthbank, 18 Mentone Terrace, Edinburgh.
 1899. ANDERSON, Robert, Assistant Forester, Chatsworth, Derbyshire.
 1900. ANGUS, Alexander, The Gardens, Dalzell, Motherwell.
 1887. ANNAND, John F., Overseer, Haystoun Estate, Woodbine Cottage,
 Peebles.
 1899. ANNANDALE, William, Land Steward, Kincaidrum, Forfar.
 1897. ARMIT, James, The Gardens, Antrim Castle, Antrim.
 1898. ARMSTRONG, Thos. J. A., Factor, Glenborrodale, Salen, Fort William.
 1860. AUSTIN & McASLAN, Nurserymen, 89 Mitchell Street, Glasgow.
 1898. *Bain, Charles, Assistant Forester, Innes House, Elgin.*
 1892. BALLINGALL, Niel, Sweet Bank, Markinch, Fife.
 1898. BANNAN, Andrew, Forester, Glenfarg Estate, Abernethy.
 1897. BARCLAY, Robert Leatham, Banker, 54 Lombard Street, London, E.C.
 1900. BARKER, Arthur, Assistant Forester, Lymedoch, Perth.
 1867. BARRIE, David, Forester, Comlongan Castle, Annan, Dumfries.
 1895. BARRIE, James Alexander, Forester, Harlestone, Northampton.
 1889. BARRON, John, Elvaston Nurseries, Borrowash, Derby.
 1874. BARTON, James, Forester, Hatfield House, Herts.
 1899. BEATSON, David J., Crown Office, Parkend, near Lydney, Gloucester-
 shire.
 1898. BEDFORD, Surgeon Major Wm. Jas. Guthrie, Kierfield House, Stromness.
 1894. BEECH, George, The Grange Gardens, Bishops Stortford, Herts.
 1897. BEGG, James, The Gardens, Lanrick Castle, Doune, Perthshire.

Date of
Election.

1883. BELL, Andrew, Forester, Forglen, Turiff, Aberdeenshire.
 1898. BELL, David, Seed Merchant, Coburg Street, Leith.
 1900. BELL, Robert, Land Steward, Baronscourt, Newtown-Stewart, Ireland.
 1898. BELL, R. Fitzroy, of Temple Hall, Coldingham.
 1900. BELL, William, Assistant Forester, Pollok, Pollokshaws.
 1895. BENNET, J. B., C.E., A.M.I., 12 Hill Street, Edinburgh.
 1889. BERRY, Francis, Forester, Minto, Hawick.
 1899. BISSETT, Alexander, Assistant Forester, Dunrobin, Golspie.
 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, Albert W., B.Sc., Royal Botanic Garden, Edinburgh.
 1898. BORTHWICK, Francis J. G., W.S., 9 Hill Street, Edinburgh.
 1887. BOULGER, Professor, 34 Argyll Mansions, West Kensington, London, W.
 1896. BOWLES, William A., The Gardens, Adare Manor, Adare, Co. Limerick.
 1883. BOYD, John, Forester, Pollok Estate, Pollokshaws, Glasgow.
 1897. BRAID, J. B., Assistant Forester, Beeley Rowsley, Derbyshire.
 1899. BRAID, Thomas, Factor, Durris, Drumoak, Aberdeenshire.
 1889. BRITTON, Horatio A., Timber Merchant, Shrewsbury.
 1860. BRODIE, James, Land Steward, Glaslough, Armagh, Ireland.
 1900. BROOM, John, Wood Merchant, Bathgate.
 1897. BROUGH, D., The Gardens, Coollattin, Shillelagh, Co. Wicklow.
 1896. BROWN, David, Manager, Chevet Park Estate, Wakefield, Yorks.
 1900. BROWN, Gilbert, Assistant Forester, Almond Bank, Perth.
 1899. BROWN, John, C.A., 2 Hill Street, Edinburgh.
 1899. BROWN, John, Forester and Ground Officer, Craighall, Rattray,
 Perthshire.
 1878. BROWN, J. A. Harvie-, of Quarter, Dunipace House, Larbert.
 1898. BROWN, John C., West Gardens, Abercainey, Crieff.
 1893. BROWN, Robert, Forester, Boiden, Luss.
 1895. BROWN, Walter R., Assistant Forester, Harewood, Leeds.
 1900. BROWN, William, Assistant Forester, Scone, Perth.
 1883. BROWNING, John M., Seedsman and Florist, Perth.
 1893. BROWNIE, Alexander, Wood Merchant, Earlston, Berwickshire.
 1895. BRUCE, Peter, Forester and Estate Manager, 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.
 1895. BUIST, Robert, Overseer, Newbyth, Prestonkirk, East Lothian.
 1900. BULLOCK, Robert, Assistant Forester, Pollok, Pollokshaws.
 1899. BURN-MURDOCH, John, of Gartincaber, Doune.
 1887. CADELL, George, National Club, 1 Whitehall Gardens, London, S.W.
 1896. CAIRNS, Richard, The Gardens, Balruddery, near Dundee.

Date of
Election.

1896. CALLANDER, Henry, of Prestonhall, Dalkeith.
 1900. CAMERON, Dr James, The Fountain, Loanhead.
 1899. CAMERON, John J., Clydesdale Iron Works, Possilpark, Glasgow.
 1890. CAMPBELL, Alexander, of Auchindarroch, Lochgilphead, Argyle.
 1895. CAMPBELL, Alexander, Land Steward, Rosemill Cottage, Strathmartin,
 by Dundee.
 1899. CAMPBELL, Alexander, Hilton Cottage, Stanley, Perthshire.
 1865. CAMPBELL, James, of Tillichewan Castle, Dumbartonshire.
 1896. CAMPBELL, James Alex., M.P., of Stracathro, Brechin.
 1900. CAMPBELL, James S., Assistant Forester, Chatsworth, Bakewell,
 Derbyshire.
 1894. CAMPBELL, John, Timber Merchant, Inverness.
 1898. CARR, Alexander, Assistant Forester, Mansfield Cottage, Gretna.
 1900. CARRIE, William, Assistant Forester, Drumpelier, Coatbridge.
 1898. CARSON, David Simpson, C.A., 209 West George Street, Glasgow.
 1900. CAVERS, Walter, Timber Merchant, 12 East Brighton Crescent,
 Portobello.
 1897. CHALMERS, James, Overseer, Gask, Auchterarder, Perthshire.
 1898. CHALMERS, James, Forester, Ayton House, Abernethy.
 1898. *Chalmers, Thomas, Nursery Manager, Raith, Kirkealdy.*
 1892. CHAPMAN, Andrew, Breckonhill, Lockerbie, Dumfriesshire.
 1892. CHAPMAN, Mungo, Torbrix Nurseries, St Ninians, Stirling.
 1899. CHIRNSIDE, Robert, Woodman, Wynyard Park, Stockton-on-Tees.
 1897. CHISHOLM, Colin, Forester, Benmore, Kilmun, by Greenock.
 1884. CHRISTIE, Alex. D., The Gardens, Ragley, Alcester, Warwickshire.
 1890. CLARK, Charles, Forester, Cawdor Castle, Nairn.
 1900. CLARK, Charles, Assistant Forester, Almond Bank, Perth.
 1896. CLARK, George Fraser, C.A., 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, Bowland, Stow.
 1900. COLLIE, Alexander, Assistant Forester, The Kennels, Durris House,
 Durris, Aberdeen.
 1893. COLLINS, Frederick, Assistant Forester, West Mill, Ware, Herts.
 1882. COLLINS, Robt. T., Forester, Trentham, Stoke-on-Trent, Staffordshire.
 1895. CONNOR, George A., Factor, Craighielaw, Longniddry.
 1896. CONSTABLE, Geo. William, Estate Agent, Traquair, Innerleithen.
 1887. COOK, James, Land Steward, Arniston, Gorebridge, Midlothian.
 1895. COWAN, Bernard, Superintendent, Harton Cemetery, South Shields.
 1858. COWAN, James, Forester, Bridgend, Islay, Argyleshire.
 1899. COWAN, Robert, Chisholm Estates Office, Erchless, Strathglass.
 1900. *Crabbe, Alfred, Assistant Forester, Royal Botanic Garden, Edinburgh.*
 1875. CRABBE, David, Forester, Byreburnfoot, Canonbie, Dumfriesshire.
 1867. CRABBE, James, Forester, Glamis Castle, Forfarshire.
 1893. CRAIG, John, Craigesk, Caldwell Road, West Kilbride.
 1899. CRERAR, David, Land Steward, Methven Castle, Perth.
 1898. CRICHTON, William, Manager, Castle Ward, Downpatrick.

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1899. CROLL, David, Nurseryman, 63 Commercial Street, Dundee.
 1898. CROMBIE, Alexander T., Forester, Monreith, Port William, Wigtownshire.
 1900. CROMBIE, David, The Gardens, Curraghmore, Portlaw, Ireland.
 1898. CROMBIE, James, Forester, North Lodge, Lethen, Nairn.
 1900. CUMMING, John H., The Gardens, Grantully Castle, Aberfeldy.
 1898. CUNNINGHAM, George, Advocate, 19 Northumberland Street, Edinburgh.
 1898. *Cunningham, John, Forester, Aherlow Saw-mills, Banoka, Tipperary.*
 1897. CURR, William Henry, W.S., 226 West George Street, Glasgow.
 1893. CURR, W. S., Factor, Ninewar, Prestonkirk.
 1899. CURTIS, Professor Charles E., Woodlands, Brockenhurst, Hants.
 1891. DAGLISH, John, Rothley Lake, Cambo R.S.O., Northumberland.
 1897. DAILLY, James, Assistant Forester, Kirklea by Mossend, Lanarkshire.
 1900. DALE, Thomas, Nurseryman, Millport, Cumbræ.
 1900. DALGLIESH, J. Edward, Forester, The Nurseries, Market Weighton, Yorkshire.
 1884. DALZIEL, James, Forester, Culzean Castle, Maybole, Ayrshire.
 1869. DANIELS, Peter, Forester, Slindon Hall, Arundel, Sussex.
 1894. DARLING, David C., Nurseryman, Corn Exchange Buildings, Aberdeen.
 1865. DAVIDSON, John, Agent, Greenwich Hospital Estates, Haydon Bridge-on-Tyne.
 1892. DAVIDSON, John, Forester, Dalzell, Motherwell, Lanarkshire.
 1899. DEWAR, Daniel, Curator, Botanic Garden, Glasgow.
 1895. DICK, Joseph, Forester, Wentworth, Rotherham, Yorkshire.
 1897. DIGBY, Reginald, Land Agent, Geashill Castle, King's County.
 1895. DINGWALL, Alexander, Glendoig Villa, Perth.
 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, Nunthorpe R.S.O., 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, Pilsley, Chatsworth, Bakewell.
 1900. DRUMMOND, Dudley W., Commissioner for the Earl of Cawdor, Cawdor Estate Office, Ferryside, South Wales.
 1862. DRUMMOND & SONS, William, Nurserymen, Stirling.
 1896. DUNCAN, David, Forester, Guynd, Arbroath, Forfarshire.
 1873. DURWARD, Robert, Manager, Blelack, Dinnet, Aberdeenshire.
 1900. DUTHIE, James A., Traveller, 1 Waterloo Place, Edinburgh.
 1898. EADSON, Thomas G., Assistant Forester, Whaley Clowne, Chesterfield.
 1885. EDDINGTON, Francis, Overseer, Monk Coniston Park, Lancashire.
 1898. EDMINSON, Wm. D., Tweed View, Berwick-on-Tweed.

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Election.

1899. EDWARDS, Alex. W. B., Assitant Forester, Pollok, Pollokshaws.
 1893. ELDER, William, Forester, Cholmondeley Park, Malpas, Cheshire.
 1898. ELDER, Wm., Engineer, Berwick-on-Tweed.
 1898. EWAN, Peter, Assistant Forester, Halfway, Balquharn, Bankfoot.
 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.
 1899. FAWCETT, Thos. G., Land Agent, Yarm-on-Tees.
 1900. FEAKS, Matthew, Assistant Forester, 5 Bowhill Terrace, Edinburgh.
 1899. FERGUSON, J. E. Johnson, M.P., of Springkell, Ecclefechan.
 1880. FERGUSSON, Sir James Ranken, Bart., Spitalhaugh, West Linton.
 1893. FINLAYSON, Alexander, c/o Park, Dobson, & Co., Wood Merchants,
 Leith.
 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.
 1899. FISHER, W. R., Assistant Professor of Forestry, Coopers Hill, Surrey.
 1899. FLEMING, John, Timber Merchant, Albert Saw-mills, Aberdeen.
 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.
 1898. FORBES, James, Commissioner to Her Majesty the Queen, Balmoral,
 Ballater.
1891. FOREMAN, Frederick, Nurseryman, Eskbank, Dalkeith.
 1892. FORGAN, James, Sunnybraes, Largo, Fife.
 1892. FORGAN, William, Assistant Forester, Hotspur Place, Alnwick.
 1889. FORSTER, William A., Forester, Belgrave Lodge, Pulford, Wrexham.
 1898. FOSTER, James, jun., Kennet Village, Alloa.
 1899. *France, W. H. M., Assistant Forester, Ardgowan, Inverkip.*
 1900. FRASER, Alexander, Assistant Factor, Raith Estate Office, Kirkealdy.
 1898. FRASER, James, Assistant Forester, Cahir Park, Cahir, Co. Tipperary.
 1899. FRASER, James, Estate Manager, Aldowrie, Dores, Inverness.
 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.
 1899. FULTON, William, Overseer, Robertland, Stewarton, Ayrshire.
 1895. FYFFE, Robert B., Factor, Aden, Mintlaw Station.
 1899. FYSHE, Peter, Newtonlees, Dunbar.
1878. GALLETLY, James, Overseer, Bonhard, Perth.
 1874. GALLOWAY, George, Estate Offices, Woodhouses, Whitechurch, Salop.
 1896. GAMMELL, Sydney James, of Drumtochty, Drumtochty Castle, Fordoun.
 1898. GAULD, William, Assistant Forester, Binley Village, Coventry.

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Election.

1899. GEEKIE, C. W., 24 St Andrew Square, Edinburgh.
 1900. GELLATLY, John, Assistant Forester, Saucher, Balbeggie, near Perth.
 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.
 1897. GILLANDERS, A. T., Forester, Alnwick Castle, Northumberland.
 1894. GILLESPIE, James, Forester, Blairmore, Braco.
 1894. GILMOUR, Major Robert Gordon, of Craigmillar, The Inch, Midlothian.
 1880. GLEN, David A., Forester, Bedgebury Park, Goudhurst, Kent.
 1893. GOLDIE, George, Eskdale Lodge, Dalkeith, Midlothian.
 1899. GORDON, George, C.E., Queensgate, Inverness.
 1900. GORDON, Thomas, County Buildings, Edinburgh.
 1893. GORDON, John G., N.P., 48 Castle Street, Edinburgh.
 1897. GOW, Peter, Land Steward, Laggan, Ballantrae, Ayrshire.
 1897. GOW, Peter Douglas, Farmer, Bonaly, Colinton, Midlothian.
 1887. GRANT, Alexander, Forester, Rothie-Norman, Aberdeenshire.
 1867. GRANT, Donald, Forester, Drumin, Ballindalloch, Banffshire.
 1893. GRANT, John B., Forester, Downan House, Glenlivet.
 1893. GRANT, Peter, Land Steward, Kilmeade Farm, Athy, Co. Kildare.
 1883. *Green, Arthur A., 20 Annandale Street, Edinburgh.*
 1898. GREY, Sir Edward, Bart., M.P., of Falloden, Chathill, Northumberland.
1879. HADDINGTON, The Right Hon. the Earl of, Tynninghame, Prestonkirk.
 1880. HADDON, Walter, Solicitor, Royal Bank, Hawick.
 1897. HALLIDAY, Geo., Timber Merchant, Rothesay, Bute.
 1899. HAMILTON, James, The Gardens, Manderston, Duns.
 1897. HAMILTON-OGILVY, H. T. M., of Beil, Prestonkirk, East Lothian.
 1892. HANNAH, George, Forester, The Glen, Innerleithen, Peebleshire.
 1897. HANTON, Thomas, Solicitor, Dalkeith, Midlothian.
 1890. HARDIE, James F., Factor, Skibo, Dornoch.
 1896. HARLEY, Andrew M., Forester, Langford Lodge, Crumlin, Co. Antrim.
 1897. HARRIS, James, Manager, Linplum, Haddington.
 1895. HARROWER, David K., Timber Merchant, Elm Park, Bo'ness.
 1897. HARROWER, William, Forester, Garth, Aberfeldy, Perthshire.
 1897. HAET, John, Factor, Mains of Cowie, Stonehaven, Kincardineshire.
 1894. HARVEY, James, The Gardens, Mortonhall, Liberton.
 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.
 1899. HENDERSON, Robert, Assistant Forester, Seone, Perth.

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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.
1900. HEWITSON, William, Assistant Forester, Benmore, Kilmun.
1895. HILL, Claude, of Messrs John Hill & Sons, Spot Acre Nurseries, Stone, Staffordshire.
1900. HISLOP, William, Assistant Forester, Minto, Hawick.
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.
1880. HOPETOUN, The Right Hon. the Earl of, Hopetoun House, South Queensferry.
1876. HULL, Frank, Forester, Lilleshall, Newport, Salop.
1900. HUNTER, David, of Ahlbottn & Co., 21 St Andrew Square, Edinburgh.
1897. INCH, Charles F., Assistant Forester, Altyre, Forres.
1895. INGLIS, A. M., Nurseryman, Forres.
1897. INGLIS, George Erskine, Estate Agent, Campbeltown, Argyshire.
1893. INGLIS, John F., Forester, Amisfield Estate, Goatfield Cottage, Haddington.
1891. INGLIS, William, Forester, Brodick, Isle of Arran.
1895. INNES, Alexander, Forester, Drummuir, Keith.
1896. INNES, Alexander, Forester, Stourhead, Bath.
1893. JACK, George, S.S.C., Dalkeith, Midlothian.
1898. JACKSON, James, The Gardens, Methven Castle, Perth.
1895. JAMIESON, Andrew, Overseer, Carnbroe, Bellshill.
1898. JAMIESON, James, Forester, Ffairfach Nurseries, Golden Grove Estate, Llandilo, South Wales.
1896. JARDINE, R. W. B., Yr. of Castlemilk, Lockerbie, Dumfriesshire.
1900. JOHNSTON, David, Manager, Charlestown Limeworks, Fife.
1899. JOHNSTON, Edward, Forester, Dalquharan, Dailly, Ayrshire.
1899. *Johnston, John, Forester, Oathlav, Forfar.*
1878. JOHNSTONE, Adam, Forester, Coollattin, Shillelagh, County Wicklow.
1900. JOHNSTONE, William, Head Forester, Beil, Prestonkirk.
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.

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1899. KENNEDY, Thomas, Assistant Forester, Lambton Park Fence Houses,
Durham.
1899. KENNEDY, Thomas, Assistant Forester, Dalzell, Motherwell.
1896. KETTLES, Robert, Assistant Forester, Craigend, Perth.
1894. KIDD, Wm., Forester, Harewood, Leeds.
1879. KINCAIRNEY, The Hon. Lord, 6 Heriot Row, Edinburgh.
1900. KING, David, Nurseryman, Osborne Nurseries, Murrayfield.
1898. KYLLACHY, The Hon. Lord, of Kyllachy, 6 Randolph Crescent,
Edinburgh.
1899. LAIDLER, George, Assistant Factor, Ivy Cottage, Brodick.
1898. LAIRD, James W., Nurseryman, Monifieth.
1899. LAMOND, Alexander, Forester, Kersewell Cottage, Penicuik.
1899. LAMOND, William, Assistant Forester, Pinkhill Nursery, Murrayfield.
1873. LAURISTON, Alexander, Rufford Nursery, Ollerton, Newark, Notts.
1897. LAURISTON, John, Assistant Forester, Royal Botanic Garden, Edinburgh.
1900. LAWRIE, James, The Gardens, Murthly Castle, Perthshire.
1874. LEIGH, William, of Woodchester Park, Stonehouse, Gloucestershire.
1880. LEISHMAN, John, Manager, Cavers Estate, Hawick, Roxburghshire.
1893. LEVEN, George, Forester, Auchencruive, Ayr.
1898. LEYS, Wm. B., Foreman Forester, Novar, Evanton, Ross-shire.
1898. LIGHTFOOT, Francis P., Land Agent, Hafod, Devil's Bridge R.S.O.,
Cardiganshire.
1879. LINDSAY, Robert, Kaimes Lodge, Murrayfield, Midlothian.
1897. LITTLE, John, Land Agent, Hackness Hall, Scalby R.S.O., Yorks.
1897. LOCK, Hampton C.; Assistant Forester, Abbey Cottages, Medmenham,
Marlow, Bucks.
1898. LOW, James, Temple, Gorebridge, Midlothian.
1898. LOW, James, Forester, Innes Estate, Elgin.
1897. LOW, John, Timber Merchant, Kinghorn Saw-mills, Kinghorn.
1894. LUMSDEN, Fredk. R., Newburn, Largo, Fife.
1900. LUMSDEN, Robert, jun., Drinnsmittal Saw-mills, Kessock.
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, St Ann's Cottage, Lockerbie.
1870. M'CORQUODALE, D. A., Bank of Scotland, Carnoustie, Forfarshire.
1893. M'COUBRIE, M. S., Land Steward, Tullamore, King's County, Ireland.
1899. M'DIARMID, Hugh, Assistant Forester, Dalmeny Park, Edinburgh.
1900. MACDIARMID, Hugh, Factor, Island House, Tiree, Oban.
1893. MACDONALD, George U., Forester, Raith, Kirkcaldy.
1900. MACDONALD, Harry L., of Dunach, Oban.
1897. M'DONALD, James, Forester, Craigbarnet, Campsie Glen, Stirlingshire.
1895. MACDONALD, John, Forester, Skibo, Dornoch.
1897. M'DONALD, William, Assistant Forester, c/o Mrs Hurford, Mells
Park, near Frome.

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1894. M'DOUGALL, Alex., Forester, Tuncombe Park, Helmsley R.S.O., Yorks.
 1898. MACFADYEN, Donald, Assistant Forester, Drumlanrig, Thornhill.
 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.
 1899. M'GREGOR, Archibald, Forester, Airthrey Castle, Bridge of Allan.
 1878. *M'Gregor, Duncan, Forester, Camperdown, Dundee.*
 1900. MACGREGOR, James, Assistant Forester, Murthly Castle, Perth.
 1896. MACGREGOR, John C., Assistant Forester, Douglas Castle, Douglas.
 1899. M'HARDY, Alexander, The Castle, Inverness.
 1895. MACHRAY, Frank, Ground Officer, Culloden, Inverness.
 1894. M'ILWRAITH, Wm., Forester, Egton, Grosmont R.S.O., Yorks.
 1895. MACINTOSH, D. L., The Gardens, Castle Wemyss, Wemyss Bay.
 1899. M'INTYRE, James, Foreman Forester, Cordon, Lamblash, Arran.
 1898. M'INTYRE, Malcolm, The Gardens, The Glen, Innerleithen, Peeblesshire.
 1898. MACKAY, Aeneas J. G., LL.D., Advocate, 2 Albyn Place, Edinburgh.
 1892. M'KAY, Allan, Sycamore Saw-mills, Dundee.
 1865. MACKAY, John, Lauderdale Estate Office, Wyndhead, Lauder.
 1899. M'KAY, John, Assistant Forester, Golspie Saw-mills, Golspie.
 1887. MACKAY, Peter, Forester, Taymouth Castle, Aberfeldy.
 1900. M'KECHNIE, Angus, Assistant Forester, Raith, Kirkcaldy.
 1891. MACKENDRICK, James, Forester, Pallas, Longhrea, Co. Galway.
 1897. M'KENNA, Robert, The Gardens, Charleville Forest, Tullamore, King's County.
 1867. MACKENZIE, Alex., Warriston Nursery, Inverleith Row, Edinburgh.
 1899. M'KENZIE, James, Wood Merchant, Inverness.
 1897. MACKENZIE, John, Forester, West Barns, Dunbar.
 1867. MACKENZIE, John Ord, of Dolphinton, W.S., 9 Hill Street, Edinburgh.
 1900. MACKENZIE, Sir Kenneth John, Bart. of Gairloch, 10 Moray Place, 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.
 1893. M'LAREN, William, Forester, Altyre, Forres, Morayshire.
 1900. M'LEAN, Wm. John, Merchant, 1 Academy Street, Inverness.
 1898. M'LENNAN, John, The Gardens, Castle Boro, Enniscorthy, Co. Wexford.
 1874. M'LEOD, Angus A., 6 Sylvan Place, Edinburgh.
 1897. M'LEOD, Geo., Overseer, Harviestoun, Dollar, Clackmannanshire.
 1898. M'MANUS, Edmund, Timber Merchant, Randalstown, Co. Antrim.
 1895. *Macmillan, John D., Forester, 3 Milton Road, Stowmarket.*
 1899. M'NISH, John, Assistant Forester, Dalzell, Motherwell.
 1900. MACPHERSON, John, Manufacturing Forester, Novar, Ross-shire.
 1896. M'QUEEN, John, Proprietor of the *Scottish Border Record*, Galashiels.

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1890. M'RAE, Alexander, Forester, Castlecomer, Ireland.
1892. M'RAE, Alexander, *Manchester Timber Importers, Limited, 3 Cross Street, Manchester.*
1900. M'RAE, Henry, Assistant Forester, Lintmill, Cullen.
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, Duff House, Banff.
1886. MAXWELL, The Right Hon. Sir Herbert E., Bart. of Monreith, M.P., Port William, Wigtownshire.
1891. MAXWELL, James, Forester and Overseer, Ruglen, Maybole.
1896. MEIKLEJOHN, John J. R., Factor, Novar, Evanton, Ross-shire.
1889. MELVILLE, The Right Hon. Viscount, Melville Castle, Lasswade.
1899. MELVILLE, David, The Gardens, Dunrobin Castle, Golspie.
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, The Nurseries, Orwell Park, near Ipswich.
1893. MICHIE, William, Forester, Welbeck, Worksop, Notts.
1893. MIDDLEMASS, Archibald, Forester, Tulliallan, Kincardine-on-Forth.
1882. MILNE, Alex., of James Dickson & Sons, 32 Hanover Street, Edinburgh.
1899. MILNE, Alexander, Factor, Urie Estate Office, Stonehaven.
1895. MILNE, James, Land Steward, Carstairs House, Carstairs.
1899. MILNE, Ritchie, Assistant, Annandale Estate Office, Hillside, Lockerbie.
1900. MILNE, Robert Anderson, Solicitor, Peebles.
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.
1897. MILNE-HOME, J. Hepburn, Caldera, Duns, Berwickshire.
1894. MILSOM, Isaac, Gardener and Steward, Claydon Park, Winslow, Bucks.
1893. *Mitchell, Archibald, Forester, Dunraven Castle, Bridgend, Glamorgan-shire.*
1898. MITCHELL, David, Forester, Drumtochty, Fordoun.
1869. MITCHELL, James, Factor, Park House, Aldie, Fossoway.
1898. MITCHELL, James, Assistant Sawmiller, Philiphaugh, Selkirk.
1897. MITCHELL, Wm., Assistant Forester, Altyre, Forres.
1897. MOON, Frederick, Forester, Gordon Cottage, Mount Trenchard, Foynes, Co. Limerick.
1897. MORGAN, Alex., Timber Merchant, Crieff, Perthshire.

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1898. MORGAN, Hugh, Timber Merchant, Crieff, Perthshire.
1899. MORRISON, Alexander, Assistant Forester, Jerviston Lodge, Motherwell.
1895. MORRISON, Hew, Librarian, Edinburgh Public Library.
1896. MOSSMAN, Robert C., F.R.S.E., F.R.Met.Soc., 10 Blacket Place, Edinburgh.
1890. MUIRHEAD, George, F.R.S.E., Commissioner, Speybank, Fochabers.
1894. MUNRO, Alexander, Overseer, Ballinacourte, Co. Tipperary, Ireland.
1895. MUNRO, Donald, Assistant Forester, Holkham Hall, Norfolk.
1876. MUNRO, Hugh, Bailiff and 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.
1900. MURRAY, George J. B., Assistant Forester, Holylee, Walkerburn.
1896. MURRAY, Hon. A. W. C. O., M.P., Master of Elibank, Juniper Bank, Walkerburn.
1900. MURRAY, John C., F.S.I., Factor and Commissioner, Higgs Castle, Glasgow.
1900. MURRAY, William, of Murraythwaite, Ecclefechan, Dumfriesshire.
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, 28 Charlotte Square, Edinburgh.
1893. NICOL, James, Forester, Aird's Mill, Muirkirk, Ayrshire.
1895. NICOL, James, Forester, Croxteth, Liverpool.
1891. NICOLL, John, Solicitor, 10 Shandwick Place, Edinburgh.
1898. NISBETT, J. L. More, The Drum, Liberton, Midlothian.
1899. NOBLE, Charles, Forester, Elie House, Elie, Fife.
1897. NORMAND, Patrick Hill, Whitehill, Aberdour, Fife.
1900. OLIPHANT, Joseph, Assistant Forester, Chapelhill, Methven.
1875. PAGE, Andrew Duncan, Land Steward, Culzean, Maybole, Ayrshire.
1893. PAGE, Walter, Farmer, Myregornie, Kirkealdy, Fife.
1900. PATERSON, George, Timber Merchant, 8 Albyn Terrace, Aberdeen.
1879. PATON, Hugh, Nurseryman, Kilmarnock, Ayrshire.
1899. PATON, John, A.M. Inst. C.E., Factor, 299 Shields Road, Glasgow.
1894. PATTERSON, George, Forester's Office, Leinster Street, Athy, Co. Kildare, Ireland.
1897. PATTERSON, James P., Nursery Manager, Dollardstown Nursery, Athy, Ireland.
1898. PATTERSON, Thomas L., Hardengreen, Dalkeith.
1895. PAXTON, George, Richardland, Kilmarnock.
1897. PEARSON, James, Forester, Sessay, Thirsk, Yorks.

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1899. PEARSON, James, Assistant Factor, Ivy Cottage, Brodick.
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, Baldersby Park, Thirsk,
Yorks.
1898. PETER, James, Land Steward, Berkeley, Gloucestershire.
1897. PHILIP, Alexander, Solicitor, Brechin, Forfarshire.
1895. PHILIP, William Watt, Factor, Estate Office, Gigha, Argyshire.
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.
1899. PORTEOUS, George, Merchant, Poltonhall, Lasswade.
1899. PORTEOUS, Colonel James, of Turfhill, Kinross.
1892. POTTS, G. H., Fettes Mount, Lasswade, Midlothian.
1899. POWER, David F., Forester, The Gardens, Keith Hall, Inverurie,
Aberdeenshire.
1896. PRENTICE, George, Factor, Raith, Kirkcaldy, Fife.
1899. PRICE, Aaron W., Forester, Bolstone, near Ross.
1898. PRICE, W. M., Factor, Minto, Hawick.
1895. PRIEST, W., The Gardens, Eglinton Castle, Irvine.
1898. RAFFAN, James, Estate Steward, Granston Manor, Abbeyleix,
Queen's Co.
1899. RAFFN, Johannes, Tree-Seed Merchant, Skovfrøkontoret, Copenhagen, F.
1897. RALSTON, A. Agnew, Factor, Philipstoun House, West Lothian.
1870. RATTRAY, Thos., Forester, Westonbirt House, Tetbury, Gloucestershire.
1894. REID, James S., Forester, Balbirnie, Markinch, Fife.
1900. REID, John, Estate Overseer, The Mains, Lochgelly.
1897. REID, William, Forester, Lydney Park, Lydney, Gloucestershire.
1899. RIDDOCH, George, Wood Merchant, Tarryblake, Rothiemay.
1892. RITCHE, Alexander, Forester, Cavens Estate, Kirkbean, Dumfries.
1896. RITCHE, Thomas, Nurseryman, Callander, Perthshire.
1898. RITCHE, Wm., Assistant Forester, Moss-side Cottage, Lynedoch,
Perth.
1900. ROBE, John, Road Surveyor, County Buildings, Edinburgh.
1897. ROBERTSON, A. Barnett, Forester, The Dean, Kilmarnock, Ayrshire.
1897. ROBERTSON, Andrew N., Assistant Forester, Minto, Hawick.
1899. ROBERTSON, Charles, Assistant Forester, Moss-side, Lynedoch, Perth.
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.
1896. ROBERTSON, James, Assistant Forester, Dalziel, Motherwell.

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1899. ROBERTSON, James, Foreman Forester, 20 Douglas Row, Brodick.
 1900. ROBERTSON, James, Assistant Forester, Millhaugh, Methven, Perth.
 1896. ROBERTSON, John, Assistant Forester, Glenfarg Lodge, Abernethy.
 1900. *Robertson, John, Assistant Forester, Minto, Hawick.*
 1895. ROBERTSON, Thomas, Forester and Bailiff, Woodlawn, Co. Galway.
 1883. ROBERTSON, William, Assistant Forester, Ringwood, Birnam, Perth.
 1899. ROBSON, Alex., of Smith & Son, 18 Market Street, Aberdeen.
 1897. ROBSON, Charles Durie, 66 Queen Street, Edinburgh.
 1900. ROBSON, John, Assistant Forester, Baronscourt, Co. Tyrone.
 1893. RODGER, James, Forester, Morton Hall, Norwich.
 1897. RODGER, James, Factor, Keir, Dunblane, Perthshire.
 1898. RODIMER, Charles S., Factor, Benmore, Kilmun, Argyshire.
 1893. ROMANES, James, C.A., Harewood Glen, Selkirk.
 1898. ROSS, Charles D. M., Factor, Abercairney, Crieff.
 1887. ROSS, John, Forester, Hopetoun, South Queensferry, Linlithgowshire.
 1899. ROUGH, Edward D., Manure Merchant, Broxburn.
 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, Kirkealdy.
 1897. SCHMIDT, V. H. J., Forester, Hamstead Marshall, Newbury, Berks.
 1895. SCLATER, Alexander, Seed Manager, 15 Princes Street, Edinburgh.
 1870. SCOTT, Adam, Forester, Southwick Park, Fareham, Hants.
 1892. SCOTT, David, Overseer, Dumfries House, Cunnock, 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.
 1900. *Scott, Robert, Assistant Forester, Minto, Hawick.*
 1897. SHARPE, Thomas, Forester, Sherborne Castle Estate, Sherborne, Dorset.
 1893. SHAW, Andrew, Victoria Saw-mills, Perth.
 1887. SIMPSON, Anthony, Agent, Boconnoe, Lastwithiel, Cornwall.
 1893. *Simpson, Hugh, Assistant Forester, Hardwick Hall, Sedgefield, Durham.*
 1894. SIMPSON, James, of D. & W. Croll, Nurserymen, Dundee.
 1899. SIMPSON, James B., M.A., M.D., Golspie.
 1898. SINCLAIR, William, Forester, Donibristle, Aberdour, Fife.
 1900. SINGER, John G., Assistant Forester, Sharpdale, Cameron Toll, Edinburgh.
 1868. SLATER, Andrew, Land Steward, Osborne, Cowes, Isle of Wight.
 1899. SLEIGH, Charles W., M.A., Factor, Blackwood Estate Office, Lesmahagow.
 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.
 1871. SMITH, James, The Gardens, Mentmore, Leighton-Buzzard, Bucks.
 1883. SMITH, James, The Gardens, Hopetoun, South Queensferry.

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1895. SMITH, John, Cabinetmaker, Peebles.
1895. SMITH, Thomas, Overseer, The Lodge, Tring Park, Wiggington, Tring, Herts.
1896. SMITH, William, Forester, Campérdown, Dundee.
1898. SMITH, William, The Gardens, Oxenford Castle, Dalkeith.
1899. SMITH, William, Forester, Thirladean, Philiphaugh, Selkirk.
1896. SMITH, William G., Ph.D., Professor, Yorkshire College, Leeds.
1898. SPENCE, William, Assistant Forester, Clunie, Kirkcaldy.
1899. SPIERS, Adam, Timber Merchant, Warriston Saw-mills, Edinburgh.
1885. SPIERS, David, Overseer, Mugdrum, Newburgh, Fife.
1899. STALKER, Wm. J., Nurseryman, Nairn.
1897. STEELE, W. Craig, Nursery Manager, Westmoor, Kilmarnock, Ayrshire.
1895. STEVENS, Thomas, Solicitor and Land Agent, 1 Ladbroke Terrace, London, W.
1899. STEWART, Alex., Forester, Shadwell Court, Thetford.
1897. STEWART, Charles, Assistant Forester, Scone, Perth.
1898. STEWART, James, Land Steward, Moncreiffe, Bridge of Earn.
1876. STEWART, Robert, Forester, Stonefield, Tarbert, Lochfyne, N.B.
1899. STEWART, William, Land Steward, Dalhousie Castle, Dalkeith.
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.
1900. STORY, Fraser, Assistant Factor, The Glen, Innerleithen.
1899. STUART, J. Windsor, Factor, Bute Estate Office, Rothesay.
1892. SUTHERLAND, John D., Solicitor and Estate Agent, Oban, Argyle.
1869. TAIT, David, Overseer, Owston Park, Doncaster, Yorkshire.
1892. TAIT, James, Builder, Penicuik, Midlothian.
1900. TAIT, James, jun., Woodsbank, Penicuik.
1898. TAIT, William, Assistant Seedsman, 144 Princes Street, Edinburgh.
1895. TAIT, Wm. A., 13 Brandon Terrace, Edinburgh.
1900. TAYLOR, Alexander, Overseer, Kildrummy, Mossat, Aberdeenshire.
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.
1900. TULLY, James B., Assistant Forester, Royal Botanic Garden, Edinburgh.
1900. TURNBULL, Andrew, Assistant Forester, Allerwick, Alnwick.
1897. TURNBULL, Walter Scott, Estate Office, Geashill, King's County.
1898. TWEEDIE, Alexander, Forester, Faskally, Pitlochry.
1900. TWEEDIE, John M., Forester, Foulden, Berwick.
1883. UNDERWOOD, Henry E., Sub-Agent, Fornham, St Genevieve, Bury St Edmunds, Suffolk.
1896. VEITCH, Archibald, Chattapore Tea Estate, Shamsherungger, South Sylhet, India.

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1893. WADDELL, Jas., Springbank Villas, Leven.
 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 B. P., Timber Merchant, 12 Morton Street, Leith.
 1899. WANDEFORDE, R. H. Prior, of Castlecomer, Co. Kilkenny.
 1898. WANN, James J., The Gardens, Kennet, Alloa.
 1899. WARD, Edward, Assistant Forester, Altyre, Forres.
 1893. WATSON, John, Timber Merchant, Annandale Street, 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.
 1899. WEST, Robert, Assistant Forester, East Lodge, Glenearn, Bridge of Earn.
 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.
 1899. WILLIAMSON, R. F., Tea Planter, Chattapore Estate, South Sylhet, India.
 1887. WILSON, George, Forester, Penrice Castle, Reynoldston R.S.O., Wales.
 1899. WILSON, Gilbert, Timber Merchant, Dailly, Ayrshire.
 1890. WILSON, James, M.A., B.Sc., Fordyce Lecturer in Agriculture, University of Aberdeen.
 1900. WILSON, James, jun., Nurseryman, St Andrews.
 1900. WILSON, John H., D.Sc., F.R.S.E., St Andrews.
 1897. WILSON, William, Forester, Dingley, Market Harborough, Leicestershire.
 1899. WILSON, William, Timber Merchant, Auchenleck, Ayrshire.
 1898. 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.
 1899. WYLLIE, Robert, Assistant Forester, Knowsley, Prescott.
 1897. YEATS, Alexander, Assistant Forester, Durris Estate, Aberdeen.
 1875. YOUNG, William, Forester, Morrision Cottage, Earlston, Berwickshire.

Royal Scottish Arboricultural Society.

Instituted 16th February 1854.

PATRON.

HER MOST GRACIOUS MAJESTY THE QUEEN.

THE ANNUAL MEETING.

The Forty-seventh Annual Meeting of the Royal Scottish Arboricultural Society was held in 5 St Andrew Square, Edinburgh, on Wednesday, 31st January 1900, at 2 P.M. The Right Hon. the EARL OF MANSFIELD, President of the Society, occupied the Chair.

MINUTES.

The Minutes of the General Meeting, held on 1st August last, which had been printed and circulated amongst the Members, were held as read, and approved of.

REPORT BY THE COUNCIL.

The Secretary read the Report by the Council on the work of the Society during the past year, of which the following is an abstract:—

Membership.

The death-roll of the year has been exceptionally heavy. The Council has had to deplore and record the loss of two of its most active and useful Members, Messrs Malcolm Dunn and W. M. Welsh, who were both Vice-Presidents. The names of some other Members of the Society who have passed away are Mr Wm. Erskine, Printer, and Mr Thomas Foulis, Publisher to the Society; Mr R. V. Kyrke of Pennywern, Mr Montgomery Fleming of Kelvinside, Mr Alexander Thomson, Trinity, and the Marquis of Lothian.

The following is a list of new Members admitted by the Council during the year:—

Life Members.

ELLISON, Francis Beaumont, Bragleenbeg, Kilninver, Oban.

GARRIOCH, John E., Factor, Lovat Estates, Beauly.

HAMILTON, The Hon. Gavin, of Dalzell, Dalzell House, Motherwell.

MACRAE-GILSTRAP, Major John, of Ballimore, Otter-Ferry.

- 5 MORGAN, Andrew, Assistant Factor, Glamis.
 NAIRN, Michael B., of Rankeillour, Manufacturer, Kirkealdy.
 NOBBS, Eric Arthur, B.Sc., Student, 4 Comely Bank, Edinburgh.
 ORR-EWING, Archd. Ernest, J.P., D.L., Ballikinrain Castle, Balfron.
 STEWART, Duncan D., Factor, Rossie Estate, Inchture.
- 10 WHYTE, John David Bell, Factor, Castlecraig, Dolphinton.
 YULE, Miss Amy Frances, L.A., Soc. Ant. Scot., Tarradale House,
 Muir of Ord, Ross-shire.

Ordinary Members.

- ANDERSON, Andrew Williamson, Assistant Forester, Dalmeny Park,
 Edinburgh.
- ANNANDALE, William, Land Steward, Kincaldrum, Forfar.
 BELL, Robert, Land Steward, Baronscourt, Ireland.
- 15 BISSETT, Alexander, Assistant Forester, Dunrobin, Golspie.
 BRAID, Thomas, Factor, Durris, Drumoak, Aberdeenshire.
 BROWN, John, Ground Officer, Craighall Estate, Rattray.
 BROWN, John, C.A., 2 Hill Street, Edinburgh.
 CAMPBELL, Alexander, Overseer, Dunira, Comrie, Perthshire.
- 20 CHIRNSIDE, Robert, Woodman, Wynyard Park, Stockton-on-Tees.
 COWAN, Robert, Estate Manager, Chisholm Estates Office, Erchless,
 Strathglass.
- CREERAR, David, Land Steward, Methven Castle, Perth.
 CROLL, David, Nurseryman, 63 Commercial Street, Dundee.
 CROMBIE, David, Gardener, Powercourt, Enniskerry.
- 25 DALE, Thomas, Nurseryman, Millport.
 DEWAR, John, Assistant Forester, Beaufort, Beaulieu.
 EDWARDS, Alexander W. B., Assistant Forester, Pollok Estate, Pollok-
 shaws, Glasgow.
- FAWCETT, Thomas Gibsone, Land Agent, Yarm-on-Tees.
 FERGUSON, Jabez Edward Johnson, M.P., of Springkell, Ecclefechan.
- 30 FLEMING, John, Timber Merchant, Albert Saw Mills, Aberdeen.
 FRANCE, William H. M., Assistant Forester, Ardgowan, Inverkip.
 FRASER, James, Estate Manager, Aldowrie, Dores, Inverness.
 FULTON, William, Overseer, Robertland, Stewarton.
 FYSHE, Peter, Newtonlees, Dunbar.
- 35 GORDON, George A., Civil Engineer and Land Valuer, Queensgate,
 Inverness.
- GORDON, Thomas, County Buildings, Edinburgh.
 GRANT, Philip Alex. Holland, of Druminnor, by Rhynie, Aberdeenshire.
 HAMILTON, James, Gardener, Manderston, Duns.
 HAWORTH, Alfred, Publisher, *Timber News*, 19 South John Street,
 Liverpool.
- 40 HENDERSON, Robert, Assistant Forester, Scone, Perth.
 HENDERSON, William, Chief Constable, 10 Suffolk Road, Edinburgh.
 JOHNSTON, Edward, Forester, Dalquharran, Dailly, Ayrshire.
 KENNEDY, Thomas, Assistant Forester, Lambton Park, Fence Houses,
 Durham.

- KENNEDY, Thomas, Assistant Forester, Dalzell, Motherwell.
- 45 LAIDLER, George, Assistant Factor, Ivy Cottage, Brodick.
 LAMOND, Alexander, Forester, Kerswell Cottage, Penicuik.
 LAMOND, William, Assistant Forester, Pinkhill Nursery, Murrayfield.
 MACAULAY, Alfred N., Solicitor, Land and Bank Agent, Golspie.
 MACDIARMID, Hugh, Factor, Island House, Tiree, Oban.
- 50 M'DIARMID, Hugh, Assistant Forester, Dalmeny Park, Edinburgh.
 M'GREGOR, Archibald, Forester, Airthrey Castle, Bridge of Allan.
 M'HARDY, Alexander, Chief Constable of Inverness-shire, Inverness.
 M'INTYRE, James, Foreman Forester, Cordon, Lamlash.
 M'KAY, John, Assistant Forester, Golspie Saw Mills, Golspie.
- 55 M'KENZIE, James, Wood Merchant, Inverness.
 M'LEAN, William John, 1 Academy Street, Inverness.
 M'NISH, John, Assistant Forester, Dalzell, Motherwell.
 MELVILLE, David, Gardener, Dunrobin Castle, Golspie.
 MILNE, Alexander, Factor, Urié Estate Office, Stonehaven.
- 60 MILNE, Ritchie, Assistant, Annandale Estate Office, Hillside, Lockerbie.
 MORRISON, Alexander, Assistant Forester, Dalzell, Motherwell.
 NOBLE, Charles, Forester, Elie House, Elie, Fife.
 PATON, John, Ass. M. Inst. C.E., Factor, 299 Shields Road, Glasgow.
 PEARSON, James, Assistant Factor, Ivy Cottage, Brodick.
- 65 PORTEOUS, George, Poltonhall, Lasswade.
 PORTEOUS, Colonel James, of Turfhill, Kinross.
 RAFN, Johannes, Tree Seed Merchant, Skovfrökotoret, Copenhagen, *F*.
 RIDDOCH, George, Wood Merchant, Tarryblake, Rothiemay.
 ROBB, John, Road Surveyor, County Buildings, Edinburgh.
- 70 ROBERTSON, Charles, Assistant Forester, c/o T. Allison, Stormontfield, Perth.
 ROBERTSON, James, Foreman Forester, 20 Douglas Row, Brodick.
 ROBSON, John, Assistant Forester, Baronscourt, Ireland.
 ROUGH, Edward D., Broxburn.
 SIMPSON, James Bertie, M.D., M.A., Golspie.
- 75 SLEIGH, Charles W., M.A., Factor, Blackwood Estate Office, Lesmahagow.
 SMITH, William, Assistant Forester, Dalmeny Park, Edinburgh.
 SPIERS, Adam, Timber Merchant, Warriston Saw Mills, Edinburgh.
 STALKER, William J., Nurseryman, Nairn.
 STEWART, Alexander, Forester, Shadwell Court, Thetford.
- 80 STEWART, William, Land Steward, Dalhousie Castle, Dalkeith.
 STUART, John Windsor, Factor, Bute Estate Office, Rothesay.
 WANDEFORDE, Richard H. Prior, J.P., D.L., B.A., of Castlecomer
 House, Co. Kilkenny.
 WARD, Edward, Assistant Forester, Altyre, Forres.
 WEST, Robert, Assistant Forester, East Lodge, Glenearn, Bridge of Earn.
- 85 WILLIAMSON, R. F., Tea Planter, Chatlapore Tea Estate, South Syhlet,
 India.
 WILSON, James, jun., Nurseryman, St Andrews.

The Membership of the Society is now 834, made up as follows:—
 Honorary Members, 13 ; Life Members, 191 ; Ordinary Members, 630.
 It will be seen from the note of business before the Meeting that it is

proposed to create a new order of Members, to be called Honorary Associate Members. It is believed that the creation of such an order of Members will in time add greatly to the usefulness and popularity of the Society.

Excursion.

The Excursion to Beaufort, Dunrobin, Dornoch, and Skibo Estates, which took place during the first week of August, was, as usual, well attended, there being between eighty and ninety Members present. The weather was very favourable, and the trip proved to be a very instructive and enjoyable one. The thanks of the Society were duly conveyed to Lord Lovat, the Duke of Sutherland, and Mr Andrew Carnegie for their great kindness and hospitality to the Members on that occasion.

Essay Competitions.

Twenty-four Prizes and Medals were offered in competition, but only seven Essays were received. On the recommendation of the Judges, the following awards were made :—

- A No. 2 Silver Medal to Mr HAMPTON C. LOCK, Assistant Forester, Colender, Stormontfield, Perth, for an Essay on "The Pruning of Forest Trees."
- A Bronze Medal to Mr GEORGE CADELL, National Club, London, for an Essay on "A Beech Forest in Belgium."
- A Bronze Medal to Mr FREDERICK MOON, Forester, Aden, Mintlaw, Old Deer, for an Essay on "The Injurious Effects of Smoke on Trees."

These gentlemen elected to take the converted value of the Medals in cash.

The other Essays were not considered worthy of any award.

The Syllabus of subjects for Essays in the current year was issued along with the notice calling the General Meeting in August.

Donors.

The thanks of the Society are due to the following Members, who have made or promised contributions to the funds :—Mr MUNRO FERGUSON, for the Raith Bursary; Professor BAYLEY BALFOUR, Mr JOHN METHVEN, and the late Mr W. M. WELSH, for prizes offered by them; and to Mr J. K. MILNE for his contribution to the Illustrations Fund. Professor Balfour's prize of £10, 10s. is now in the possession of the Society.

Thanks are also very specially due to the representatives of the late Mr DUNN for the gift of the *Transactions* and other publications of the Society possessed by him. This very generous gift has enabled the Council to complete the Society's set of the *Transactions*.

Malcolm Dunn Memorial.

It was mentioned at the August Meeting that the Council had joined with the Royal Caledonian Horticultural Society, the Botanical Society of Edinburgh, and the Scottish Horticultural Association in issuing an appeal for funds to perpetuate Mr Dunn's memory, and that it was proposed to erect a suitable Monument in Dalkeith Cemetery, and to devote the balance to charitable and educational objects in connection with Horticulture and Arboriculture.

A notice was issued to all the Members of the Society, and a sum of £112, 3s. 6d. has been promised to this Society. The sums received by each of the four Societies are as follows :—

Royal Scottish Arboricultural Society, . . .	£112	3	6
Royal Caledonian Horticultural Society, . . .	78	1	0
Scottish Horticultural Association, . . .	56	15	6
Botanical Society of Edinburgh, . . .	7	5	0
Total, . . .	<u>£254</u>	<u>5</u>	<u>0</u>

Designs and estimates of the cost of headstones were invited from several sculptors, and those sent in by Mr John Rhind were ultimately agreed on. The Monument is to be in the form of an Ionic cross, with a medallion of Mr Dunn in bronze, and is to bear the following inscription :—

IN MEMORY OF
MALCOLM DUNN,
27 YEARS HEAD GARDENER AT DALKEITH HOUSE.
Died 11th May 1899, Aged 62.

ERECTED BY H.S. COLLEAGUES OF THE ROYAL CALEDONIAN HORTICULTURAL
SOCIETY, THE BOTANICAL SOCIETY OF EDINBURGH, THE ROYAL
SCOTTISH ARBORICULTURAL SOCIETY, AND THE SCOTTISH
HORTICULTURAL ASSOCIATION, AND OTHER FRIENDS.

The stone will stand 9 feet high, and will cost £42. No definite decision has yet been come to regarding the charitable and educational objects to which the balance of the money will be applied, but this matter will be taken up as soon as the stone has been erected and paid for.

Foreign Visitors.

In the course of the year the Council received a visit from Sir DIETRICH BRANDIS, late Inspector-General of Forests in India, an Honorary Member of the Society, and also from Mr ELIS NILSON, of the State Forest Department, Sweden.

Very short notice was received of these visits, and it was therefore impossible to make any special arrangements in connection with them. The Council was able, however, to arrange an evening meeting for Sir D. Brandis, when he delivered a very interesting lecture on "Pure Forests and Mixed Forests," which is printed in the *Transactions*.

Mr Nilson was able to attend one of the ordinary meetings of Council, when he explained that he had come to Scotland to make investigations into the condition of the larch, with the view of experimenting in Sweden with Scottish seed, which he hoped would be hardier than that got from the Tyrol and elsewhere. Mr Nilson has since sent a letter containing his views on the subject of the larch in Scotland, which is printed in the *Transactions*.

Transactions.

At the General Meeting in August a note was read on the subject of the proposed publication by the Society of a quarterly instead of the annual *Transactions*, and the matter was remitted to the Council for further

consideration. The Council has now considered the matter, and resolved not to proceed with the proposal in the meantime, but to continue to improve the annual publication as far as possible.

Raith Working Plan.

During the past year over 260 copies of this Plan were distributed by the Society amongst the leading landowners in the three kingdoms. Specially bound copies were also sent to the Queen at Balmoral and to the Prince of Wales on the occasion of his visit to Edinburgh, and were graciously received and acknowledged by them.

MR JOHN METHVEN, Edinburgh, in moving the adoption of the Report, referred to the deaths that had taken place since the General Meeting in August. He thought special notice should be taken of the death of the Marquis of Lothian, which had occurred within the past few days, and he accordingly moved:—
“That the Members of the Royal Scottish Arboricultural Society, in General Meeting assembled, record their deep sense of the great loss sustained by the Society through the death of the Marquis of Lothian, K.T., President from 1879 to 1881, a Life Member, and created an Honorary Member for his eminent services to the Society and Forestry generally; and that they respectfully tender their deep sympathy with the Marchioness of Lothian and her family in their bereavement.”

The motion was passed unanimously, and the Secretary was instructed to send a copy of it to the Marchioness of Lothian, from whom the following reply has since been received:—

NEWBATTLE ABBEY,
DALKEITH, *February 10, 1900.*

SIR,—I have received the copy of the Resolution passed at the Annual Meeting of the Royal Scottish Arboricultural Society, and I would be much obliged if you would kindly convey to your Society my heartfelt thanks, and those of my family, for this very kind expression of their sympathy with us in our sorrow.—I am,
Sir, yours faithfully,

VICTORIA A. LOTHIAN.

To R. GALLOWAY, Esq.

FINANCES OF THE SOCIETY.

The Secretary submitted the Accounts for the year ending 31st December 1899, which, after having being audited, had as usual been printed and circulated amongst the Members previous to the Meeting. He pointed out that, acting on the suggestion made at last Annual Meeting, the Accounts had been divided between Capital and Revenue.

The following is a short abstract of the Accounts:—

I.—CAPITAL.

CHARGE.

1. Funds at 31st December 1898,	£512 8 9
£336 Caledonian Railway Company 4 per cent. Guaranteed Annuity Stock, No. 2, at 189 $\frac{1}{2}$,	£467 9 2
Deposit with National Bank of Scotland, Limited,	44 19 7
2. Life Members' Subscriptions in 1899,	124 5 0
New Members,	£106 1 0
Ordinary Members by commutation,	18 4 0
	<hr/>
	£636 13 9

DISCHARGE.

1. Proportion of Life Members' Subscriptions transferred to Revenue,	£31 8 1
1 $\frac{1}{2}$ of Full Life Subscriptions,	£26 6 3
1 $\frac{1}{2}$ of Commuted Subscriptions,	5 1 10
2. Decrease in value of Railway Stock at 31st December 1899,	19 14 10
3. Funds at 31st December 1899,	585 10 10
£336 Caledonian Railway Company 4 per cent. Guaranteed Annuity Stock, No. 2, at 189 $\frac{1}{2}$,	£447 14 4
Deposit with National Bank of Scotland, Limited,	137 16 6
	<hr/>
	£636 13 9

II.—REVENUE.

CHARGE.

1. Balance in hand at 31st December 1898,	£35 15 6
2. Ordinary Members' Subscriptions,	235 15 0
3. Proportion of Life Members' Subscriptions transferred from Capital,	31 8 1
4. Donations,	6 6 0
5. Dividends, Interest, Transactions sold, and Miscellaneous,	21 6 2
	<hr/>
	£380 10 9

DISCHARGE.

1. Printing, etc., viz.:— Transactions to account,	£60 0 0
Circulars, etc., and Stationery,	37 10 1
Less Receipts for Advertisements,	£97 10 1
	<hr/>
	23 13 6
2. Bath Bursary for 1899 1900. Holder, Mr Alex. T. Crombie,	£73 16 7
3. Prizes,	30 0 0
4. Expenses of Management,	4 0 3
5. Balance carried to next Year,	91 17 8
	<hr/>
	130 16 3
	<hr/>
	£380 10 9

The Secretary explained that there was payable out of the balance carried forward the postages and balance of the cost of the *Transactions* for 1899, amounting together to about £23. The arrears of subscriptions carried forward amounted to £34, 2s. 6d.

On the motion of Mr JOHN METHVEN, Convener of the Finance Committee, the Accounts were approved of.

EXCURSION FUND.

The Secretary submitted the following Abstract of Accounts for the past year :—

RECEIPTS.

Balance from last Year,	£22 12 11
Deposits,	44 10 0
Common Purse,	152 17 0
Album and Old Photographs Sold,	1 7 6
New Photographs—Extra Copies,	2 5 0
	<hr/>
	£223 12 5

PAYMENTS.

Printing,	£5 1 0
Auditors Fee for 1898 Accounts,	2 2 0
Hotels and Driving,	158 6 6
Photographs presented to Members,	17 5 0
General Expenses,	7 14 2
	<hr/>
	£190 8 8
Balance carried forward to next Year,	<u>£33 3 9</u>

Mr D. P. LAIRD, Convener of the Excursion Committee, moved the approval of the Accounts, which was agreed to.

PRESIDENT'S ADDRESS.

The EARL OF MANSFIELD then read his Presidential Address, a full report of which will be found in the *Transactions*. On the motion of Mr ALEXANDER MILNE, Vice-President, a hearty vote of thanks was awarded to the President for his Address.

ELECTION OF OFFICE-BEARERS.

The election of Office-Bearers in room of those who retire by rotation was next proceeded with. The EARL OF MANSFIELD was re-elected President ; LORD LOVAT, and Messrs D. P. LAIRD

and D. F. MACKENZIE were elected Vice-Presidents. Messrs JOHN ANNAND, W. A. MACKENZIE, JOHN T. M'LAREN, ALEXANDER PITCAITHLEY, and JAMES ROBERTSON were elected Councillors. The Honorary Secretary, the Secretary and Treasurer, the Auditor, the Honorary Scientists, the Photographic Artist, and the Local Secretaries were re-elected. Mr A. C. FORBES was elected a Member of the "Judges and *Transactions*" Committee in place of Mr Malcolm Dunn, deceased. The other Members of the Committee were re-elected.

The Office-Bearers and Officials for the year 1900 were therefore as follows :—

PRESIDENT.

The Right Hon. the EARL OF MANSFIELD, Scone Palace, Perth.

VICE-PRESIDENTS.

Colonel F. BAILEY, R.E., Lecturer on Forestry, Edinburgh University.

ALEX. MILNE, Nurseryman, 32 Hanover Street, Edinburgh.

The Right Hon. BARON LOVAT, Beaufort Castle, Beaulieu.

D. P. LAIRD, Nurseryman, Pinkhill, Murrayfield.

D. F. MACKENZIE, Factor, Mortonhall, Liberton.

COUNCIL.

JAMES COOK, Land Steward, Arniston, Gorebridge.

ROBERT FORBES, Estate Office, Kennet, Alloa.

GEORGE MACKINNON, Overseer, Melville Castle, Lasswade.

R. V. MATHER, Nurseryman, Kelso.

JAMES MOFFAT, 48 Castle Street, Edinburgh.

JOHN BOYD, Forester, Pollok Estate, Pollokshaws, Glasgow.

CHARLES BUCHANAN, Overseer, Penicuik Estate, Penicuik.

WILLIAM GILCHRIST, Forester, Leuchars, Elgin.

WILLIAM MACKINNON, Nurseryman, 144 Princes Street, Edinburgh.

JOHN METHVEN, Nurseryman, 15 Princes Street, Edinburgh.

JOHN ANNAND, Overseer, Haystoun Estate, Peebles.

W. A. MACKENZIE, Factor, Faskally, Pitlochry.

JOHN T. M'LAREN, Factor, Polmaise, Stirling.

ALEXANDER PITCAITHLEY, Forester, Jeanie Bank, Scone.

JAMES ROBERTSON, Forester, Panmure, Carnoustie.

HON. SECRETARY.

R. C. MUNRO FERGUSON, M.P., Raith House, Kirkcaldy, Fife.

SECRETARY AND TREASURER.

ROBERT GALLOWAY, S.S.C., 5 St Andrew Square, Edinburgh.

AUDITOR.

JOHN T. WATSON, 16 St Andrew Square, Edinburgh.

TRUSTEES.

JOHN ORD MACKENZIE of Dolphinton, the EARL OF MANSFIELD,
R. C. MUNRO FERGUSON, M.P.

JUDGES AND COMMITTEE ON TRANSACTIONS.

Colonel BAILEY, R.E., Lecturer on Forestry, University of Edinburgh
(*Convener*).

Professor SOMERVILLE, University of Cambridge.

JOHN METHVEN, Nurseryman, Edinburgh.

JOHN MICHIE, Forester, Balmoral.

JOHN CLARK, Forester, Haddo House, Aberdeen.

ROBERT LINDSAY, Kaimes Lodge, Murrayfield.

A. C. FORBES, Wood Manager, Bowood, Calne, Wilts.

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.Æc., D.Sc.,
F.R.S.E., F.L.S., Professor of Agriculture, Department of Agri-
culture, Cambridge University.

Consulting Entomologist, ROBERT STEWART MACDOUGALL, M.A.,
D.Sc., Professor of Biology, New Veterinary College, 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	
<i>Aberdeen.</i>	. JOHN CLARK, Forester, Haddo House, Aberdeen. JOHN MICHIE, Forester, Balmoral, Ballater. JAMES WILSON, M.A., B.Sc., Fordyce Lecturer on Agri- culture, Aberdeen University.
<i>Argyle.</i>	. WALTER ELLIOT, Manager, Ardtornish. JOHN D. SUTHERLAND, Estate Agent, Oban.
<i>Ayr.</i>	. JOHN HAY, Overseer, Dollars Estate Office, Kilmarnock. ANDREW D. PAGE, Overseer, Culzean, Maybole.
<i>Banff.</i>	. JOHN BRYDON, Forester, Rothes, Elgin.
<i>Berwick.</i>	. WM. MILNE, Foulден Newton, Berwick-on-Tweed.

Counties.

- Bute*, . . . WM. INGLIS, Forester, Cladoch, Brodick, Arran.
 JAMES KAY, Forester, Bute Estate, Rothesay.
- Clackmannan*, . . . ROBERT FORBES, Estate Office, Kennet, Alloa.
- Dumbarton*, . . . ROBERT BROWN, Forester, Boiden, Luss.
- 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, Kirkealdy.
- Forfar*, . . . R. CAIENS, The Gardens, Balruddery, near Dundee.
 JAMES CRABBE, Forester, Glamis.
 JAMES ROBERTSON, Forester, Panmure House, Carnoustie.
- Inverness*, . . . JAMES A. GOSSIP, Nurseryman, Inverness.
- Kincardine*, . . . JOHN HART, Estates Office, Cowie, Stonehaven.
- 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*, . . . GEORGE HANNAH, Forester, The Glen, Innerleithen.
- Perth*, . . . W. HARROWER, Forester, Tomnacroich, Garth, Aberfeldy.
 W. A. MACKENZIE, Factor, Faskally, Pitlochry.
 ALEX. PITCAITHLEY, Jeanie Bank, Old Scone, Perth.
- Ross*, . . . AMY FRANCES YULE, Tarradale House, Muir of Ord.
- Roxburgh*, . . . JOHN LEISHMAN, Manager, Cavers Estate, Hawick.
 R. V. MATHER, Nurseryman, Kelso.
- Sutherland*, . . . JAMES F. HARDIE, Factor, Skibo, Dornoch.
 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.

- Beds*, . . . FRANCIS MITCHELL, Forester, Woburn.
- Berks*, . . . W. STORIE, Whitway House, Newbury.
- Bucks*, . . . JAMES SMITH, The Gardens, Mentmore, Leighton-Buzzard.
- Cambridge*, . . . Professor SOMERVILLE, University of Cambridge.
- Cheshire*, . . . WM. ELDER, Cholmondeley Park, near Malpas.
- Derby*, . . . THOMAS DOW, Forester, Bretby, Burton-on-Trent.
- Devon*, . . . JAMES BARRIE, Forester, Stevenstone Estate, Torrington.
 WM. STORIE, Forester, Gulworthy, Tavistock.
- Hants*, . . . ANDREW SLATER, Land Steward, Osborne, Cowes, Isle of
 Wight.
- Herts*, . . . JAMES BARTON, Forester, Hatfield.
 THOMAS SMITH, Overseer, Tring Park, Wiggington, Tring.
- Kent*, . . . R. W. COWPER, Gortanore, Sittingbourne.
- Lancashire*, . . . D. C. HAMILTON, Forester, Knowsley, Prescot.
- Leicester*, . . . JAMES MARTIN, The Reservoir, Knipton, Grantham.

- Counties.
- Lincoln,* . 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.
- Northumberland,* JOHN DAVIDSON, *Secretary*, English Arboricultural Society,
Haydon-Bridge-on-Tyne.
- Notts,* . W. MICHIE, Forester, Welbeck, Workop.
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,* . A. D. CHRISTIE, The Gardens, Ragley Hall, Alcester.
- Wills,* . 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.

- 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 and Bailiff, Woodlawn.
- 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.

THE RAITH BURSARY.

The Secretary reported that this Bursary of £30 per annum, the gift of Mr Munro Ferguson, M.P., had been awarded by the President to Mr ALEXANDER T. CROMBIE, Royal Botanic Garden, Edinburgh, for the current year.

LIBRARY AND MUSEUM.

The Secretary reported that the following publications had been received since the General Meeting in August last:—

LIST OF PRESENTATIONS TO THE SOCIETY'S LIBRARY.

1. *Transactions of the Botanical Society of Edinburgh*, vol. xxi., parts 1, 2, and 3.
2. *Transactions of the Massachusetts Horticultural Society*, 1898, parts 1 and 2; 1899, part 1; and 1896, part 3.
3. Agricultural Return, 1898. From Board of Agriculture.
4. *Kew Gardens Bulletin*, 1898.
5. Various Pamphlets on Agricultural Subjects. From the Department of Agriculture, Victoria.
6. *Transactions of Nova Scotian Institute of Science*, vol. ix., part 4.
7. *Journal of the Royal Horticultural Society*, London, vol. xxiii., parts 1 and 2.
8. Scale Insects (Reprint). By A. S. Gillanders.
9. Report of the Forest Department, Madras Presidency, 1897-98.
10. *Guide to Queensland*. From the Agent-General for Queensland.
11. *Journal of Society of Arts*, 24th November 1897, containing Paper on "National Forestry," by D. E. Hutchins, Conservator of Forests, Cape Colony.
12. *The Economic Proceedings of the Royal Dublin Society*, vol. i., part 2, containing Lecture on Forestry by Professor W. R. Fisher.
13. *The Forests of Western Australia and their Development*. By J. Ednie Brown, Conservator of Forests for Western Australia, 1899.
14. Forestry Conditions and Sylvicultural Prospects of the Coastal Plains of New Jersey, and other Papers. By John Gifford.

15. Abstract of Meteorological Observations made at Rothesay, year to 31st December 1898. By James Kay.
16. *Tree Planting, 1899, a Descriptive Catalogue.* By D. E. Hutchins, Conservator of Forests, Cape Colony.
17. Annual Progress Report on State Forest Administration, South Australia, 1898-99.
18. From the Representatives of the late Mr Malcolm Dunn:—
 Eight Bound Volumes of the Society's *Transactions*, besides a number of Unbound Parts.
 Complete Unbound Set of the Society's Excursion Reports.
 Eight Copies of "Arboriculturalists and others in North Germany," 1895.
 Copies of the Laws and other publications of the Society.
 Unbound Parts of the English Arboricultural Society's *Transactions*.

EXCURSION IN 1900.

Mr D. P. LAIRD, Convener of the Excursion Committee, reported that, owing to the unsettled condition of public affairs, the Council had reluctantly decided to postpone the proposed Excursion to France, and recommended that instead a visit should be made either to the north of Ireland or to Ayrshire. The matter was remitted to the Council, with powers.

GLASGOW INTERNATIONAL EXHIBITION, 1901.

The Secretary mentioned that further correspondence had taken place between himself and the Manager of the Exhibition, and that a deputation from the Council had met the Exhibition Committee in charge of the Agricultural Section in Glasgow, and had discussed with them the proposal that the Society should get space for an exhibit. A plan was submitted showing the space offered, but it was considered by the Council that the space was not suitable, and that the expense of erecting the necessary buildings—which it was stipulated by the Directors of the Exhibition should be borne by the Society—would be out of proportion to the benefit likely to be derived. He also mentioned that the Directors of the Exhibition could not see their way to enlarge their Committee by adding to it representatives of the Society. It was decided to allow the matter to drop.

MOTIONS DISPOSED OF.

The following motions, standing in name of the Council, were submitted and unanimously adopted :—

Amendment of Law III.

1. That an additional order of Members be established, to be called "Honorary Associate Members," who shall receive the publications of the Society *gratis*, and shall not be called upon to pay any subscription.
2. That, on the recommendation of the University Lecturer, the Senior Student of the University Class in Forestry shall be made an Honorary Associate Member. This Resolution to have effect for five years from 1st January 1899, when it will be reconsidered.

The following motion, standing in name of Mr GEORGE FRASER, Factor, Dalzell, was submitted by him to the meeting, and was seconded by Mr JOHN DAVIDSON :—

That at all General Meetings of the Society the Members shall be entitled to vote by proxy.

Mr D. F. MACKENZIE moved the previous question, which was duly seconded. On a vote being taken, a majority voted for the previous question, and the motion was accordingly rejected.

DR NISBET'S ADDRESS.

At the close of the business, Mr JOHN NISBET, D.Cec., F.S.I., addressed the Meeting on "The Present Condition and the Future Prospects of Forestry in Britain." A full report of the address will be found in the *Transactions*.

MR KAY'S PAPER.

Mr JAMES KAY, Bute, followed Dr Nisbet with a short paper on the "Afforestation of Waste Lands," in which he advocated the employment of soldiers in connection with the work.

VOTES OF THANKS.

Votes of thanks were accorded to Dr NISBET and Mr KAY for their Addresses, and to the PRESIDENT for presiding. This closed the Meeting.

THE ANNUAL DINNER.

In the evening the Members and their friends dined together in the Royal British Hotel, under the presidency of the EARL OF MANSFIELD; Mr ALEXANDER MILNE, Vice-President, being Croupier. The guests of the Society on the occasion were Dr NISBET; Mr J. W. TORNØE, Consul for Norway and Sweden; Mr JOHN MACMILLAN, Master of the Merchant Company; Rev. THOMAS WHITE, Canongate Established Church; Councillor HARRISON; Mr JAMES MACDONALD, Secretary of the Highland and Agricultural Society; Mr ISAAC CONNELL, S.S.C., Secretary of the Scottish Chamber of Agriculture; Mr P. MURRAY THOMSON, S.S.C., Secretary of the Royal Caledonian Horticultural Society; and Mr D. YOUNG, of the *North British Agriculturist*. The usual toasts were duly honoured.

THE GENERAL MEETING.

A General Meeting of the Society was held at No. 5 St Andrew Square, Edinburgh, on Tuesday, 7th August 1900, at 2.30 o'clock P.M. There was a good attendance of Members, and in the unavoidable absence of the President, Lord Mansfield, Mr ALEXANDER MILNE, Vice-President, took the chair.

MINUTES.

The Minutes of the Forty-seventh Annual Meeting, held in January last, were held as read and approved of.

CHAIRMAN'S REMARKS.

The CHAIRMAN delivered an interesting address, in which, amongst other matters, he referred to the depopulation of the country districts and the afforestation of waste lands by the State. A full report of the address will be found in the *Transactions*.

Mr JOHN METHVEN, Edinburgh, in moving a vote of thanks to the Chairman for his address, drew attention to the scarcity of labour in country districts caused by the rush to the industrial centres referred to by the Chairman, and suggested that the Society should petition Parliament to appoint a Commission to inquire into the matter.

Mr MUNRO FERGUSON, M.P., seconded the motion and supported

Mr Methven's suggestion, which was accordingly remitted to the Council.

JUDGES' REPORT.

In the absence of Colonel Bailey, Convener of the Judges, the Secretary read their Report on the Essays received in competition, and the Meeting gave effect to their awards, as follows:—

CLASS I.

Description and Sketches of a Lever Appliance useful in general Forestry Work. By "Pull Tight."

No. 2 Silver Medal, awarded to JAMES RODGER, Forester, Morton Hall Estate, Norwich.

CLASS II.

The Pruning of Forest Trees. By "Nil Desperandum."

£1 awarded to GILBERT BROWN, Moss-side Cottage, Lynedoch, Almond Bank, Perth.

The Thinning of Plantations. By "Sylviculture."

Bronze Medal awarded to WILLIAM B. LEYS, Novar, Evanton, Ross-shire.

RAITH BURSARY.

The Secretary also read the following Report for 1899-1900, which he had received from Colonel BAILEY, Lecturer on Forestry in Edinburgh University:—

The Bursary for 1899-1900 was awarded to Mr ALEXANDER T. CROMBIE, a student at the Royal Botanic Gardens.

Before entering the Gardens he had received a good education, which included the study of two books of Euclid and some Algebra. While at the Gardens he followed courses in Botany, Entomology, Meteorology, Land-surveying, Mensuration, and Chemistry, and passed the examinations creditably.

On joining the University, he attended the course in Forestry, gaining a First-Class Certificate, with 82 per cent. of full marks. Acting on my advice, he joined evening classes at the Heriot-Watt College, where he obtained marks as follows:—Agricultural Chemistry, 80 per cent.; Geology, 73 per cent.; Land-surveying, 55 per cent. He also joined an extra-mural drawing-class, but he had to leave Edinburgh before the completion of the course.

I formed a high opinion of Mr Crombie's character and attainments. He has already had considerable experience in practical work, and the studies he has now undergone will, I feel sure, prove very useful to him. Since quitting the University, he has received an appointment as forester to Sir Herbert Maxwell, at Monreith.

FRED. BAILEY.

The Secretary mentioned that applications for the Bursary were now being received, and invited candidates to send in their names as soon as possible.*

THE MALCOLM DUNN MEMORIAL FUND.

The Secretary reported that the total amount collected by the several Societies was £255, and that after paying for the monument erected in Dalkeith Cemetery, there would be a balance of about £200, to be disposed of as the Societies interested might decide. Mr Robert Baxter, Dalkeith, said that much disappointment had been expressed by Mr Dunn's friends and admirers in the district that more money had not been expended on the monument. The matter was referred to the Council.

FORESTRY EDUCATION.

Mr MUNRO FERGUSON, M.P., said that he thought they must all feel that the Chairman in his address had taken up some of the most interesting questions in connection with forestry. One was the employment which would be given by the afforestation of waste lands, and the other was the provision of proper forestry training. The training at present afforded was not very elaborate, but he thought it was much to be regretted that what facilities did exist were not very well taken advantage of. There was, he thought, now, or there might be before long, an opportunity for the improvement of the forestry training, which they should all be ready to support. There had been some informal or general proposal that it would be an advantage in some respects were the India Forestry School at Coopers Hill changed to some other centre. Nothing had been formally proposed by the Government of India, but it always seemed to him a most rational method of proceeding if the Indian training were conducted in the best possible centre, which Coopers Hill certainly was not; and if the Government of India, the University of Edinburgh, the Royal Scottish Arboricultural Society, and the Highland and Agricultural Society, together with those who were privately interested in forestry, were collectively to co-operate in establishing a good centre of forestry, he thought they would achieve some of the objects which had been so ably placed before them in the address of the Chairman.

* The holder of the Bursary for 1900-1901 is Matthew Feaks.

A remit had been made to him and Colonel Bailey at a recent special meeting of the Council, and, in accordance with it, a Draft Memorial, to be presented to the Board of Agriculture, had been prepared by Colonel Bailey and sent to him, and it would be submitted to the Council for approval.

EXCURSIONS.

Mr D. P. LAIRD, Convener of the Excursion Committee, mentioned that about eighty-five members had intimated their intention of taking part in the forthcoming Excursion to Ulster. He also read a letter from Mr A. D. Page, Culzean, local secretary for the district, outlining a tour in Ayrshire for next year, which was remitted to the Council.

DAMAGE BY SPARKS FROM RAILWAY ENGINES.

The Secretary mentioned that a short Bill, backed by several private Members of Parliament, had been introduced into the House of Commons with the object of placing railway engines on an equal footing with road locomotives as regards liability to pay compensation for damage to crops, woods, etc., from fire caused by the emission of sparks; and that, with the view of supporting the Bill and supplying information to the Presidents of the Boards of Agriculture and of Trade, who had expressed their willingness to receive it, the Council had sent a circular to all the Members of the Society, and others, inviting them to send particulars regarding all fires caused by railway engines which to their knowledge had occurred in recent years, but for which no compensation had been received. A considerable number of replies had been received, and it was proposed that a digest of these should be prepared for publication in the *Transactions*, and for transmission to the Boards of Agriculture and of Trade.

LIBRARY AND MUSEUM.

The Secretary reported that the following publications had been received since the Annual Meeting in January:—

LIST OF PRESENTATIONS TO THE SOCIETY'S LIBRARY.

1. *The New Forestry*. By John Simpson.
2. *Transactions of English Arboricultural Society*, vol. iv., part 2, 1899-1900.

3. *Lightning and its Effect on Trees*. By F. J. Brodie. A Reprint.
4. *Transactions of the Highland and Agricultural Society*, 5th series, vol. xii.
5. *Journal of the Royal Agricultural Society of England*, 3rd series, vol. x.
6. Annual Report of the Clerk of Forestry, Ontario, 1899.
7. *Journal of the Royal Horticultural Society*, Hybrid Conference Report, vol. xxiv.
8. Annual Report of the Secretary for Agriculture, Nova Scotia, Year 1899.
9. Abstract of Meteorological Observations made at Rothesay, 1899. By James Kay.
10. Agricultural Returns, 1899. From Board of Agriculture.
11. *Transactions of the Nova Scotian Institute of Science*, vol. x., part 1, 1898-99.
12. *Arboreal Aphide*. By A. T. Gillanders, Alnwick. A Reprint.
13. Three French Pamphlets on Forestry (being papers read at the Forestry Congress at Paris, 1900). From George Cadell.
14. *Transactions of the Massachusetts Horticultural Society*.

PAPER READ.

The Secretary then read a paper by ALEXANDER YEATS, Assistant Forester, Durris, Aberdeenshire, on the Douglas Fir as he had observed it on the Durris estate. A discussion followed, which was taken part in by Mr Munro Ferguson, Mr Pitcaithley, Scone, and Mr Crozier, Durris.

On the motion of the CHAIRMAN, the Secretary was instructed to convey the thanks of the Society to Mr Yeats for his interesting paper.

VOTE OF THANKS.

A vote of thanks to the Chairman for presiding closed the Meeting.

Royal Scottish Arboricultural Society.

Instituted 16th February 1854.

PATRON.

HIS MOST EXCELLENT MAJESTY THE KING.

THE ANNUAL MEETING.

The Forty-eighth Annual Meeting of the Society was held in 5 St Andrew Square, Edinburgh, on Thursday, 31st January 1901, at 2 P.M. Colonel BAILEY, Senior Vice-President of the Society, occupied the Chair.

DEATH OF THE QUEEN.

On taking the Chair, Colonel BAILEY read a telegram from the EARL OF MANSFIELD, President of the Society, apologising for absence. Proceeding, he referred to the recent death of HER MAJESTY THE QUEEN, Patron of the Society, and concluded by moving that the following Address be submitted to His Majesty the King:—

“We, the Royal Scottish Arboricultural Society, humbly approach your Majesty on your accession to the Throne, and desire to offer our respectful condolence with yourself, the Queen Consort, and the other members of the Royal Family in the irreparable loss you and they have sustained by the lamented death of our revered Queen Victoria. Throughout her long reign Her Majesty devoted herself to the welfare of her people, who have not under any previous reign enjoyed prosperity, happiness, and contentment such as she by her wisdom and justice secured to them. Her name and her example will be affectionately cherished by generations of subjects in all parts of the vast Empire which your Majesty is now called to govern.

“We desire to express to your Majesty our loyal and respectful good wishes, and our trust that you may long be spared to occupy the Throne of your august mother, our late lamented Queen, in whose footsteps you have graciously declared it to be your intention to walk.

“Your Majesty has shown a warm interest in the objects of this Society, which our late Queen honoured by becoming its patron, and the prosperity of which we feel assured you will desire.

“We humbly ask permission to offer our respectful good wishes to Her Majesty the Queen Consort, who as Princess of Wales has endeared herself to all classes of your Majesty’s subjects.

Signed—MANSFIELD, *President*.

„ R. MUNRO FERGUSON, *Honorary Secretary*.

„ R. GALLOWAY, *Secretary*.”

The Address was unanimously adopted.

MINUTES.

The Minutes of the General Meeting, held on 7th August last, which had been printed, were held as read, and approved of.

ELECTION OF HONORARY MEMBER.

The CHAIRMAN next moved the election of Mr JAMES SYKES GAMBLE, M.A., C.I.E., F.R.S., F.L.S., as an Honorary Member of the Society.

He reminded the meeting that Mr Gamble was an ex-member of the Indian Forest Service, who had been Director of the Indian Forest School, Editor of the *Indian Forester*, and the Author of the *Manual of Indian Timbers*, with other important works.

Mr MUNRO FERGUSON, M.P., seconded the motion, which was unanimously adopted.

ELECTION OF HONORARY ASSOCIATE MEMBERS.

In terms of a Resolution passed at last Annual Meeting, the Chairman submitted the names of FRASER STORY, Assistant Factor, The Glen, Innerleithen, and T. ALEXANDER CROMBIE, Forester, Monreith, Wigtownshire, Senior Students at the University Forestry Class in 1899 and 1900 respectively, for appointment as Honorary Associate Members. The motion was seconded, and unanimously agreed to.

ANNUAL REPORT OF COUNCIL.

Mr ROBERT GALLOWAY, S.S.C., the Secretary, submitted and read the Annual Report of the Council, as follows :—

Membership.

At last Annual Meeting there were 834 names on the roll; 77 names have been added during the year, but there have been removed during the same period—by death, 14; resignation, 19; lapsing, 28—Total, 61: leaving a net gain of 16, and making the total membership at this date 850, composed of—Honorary Members, 14; Honorary Associates, 2; Life Members, 206; Ordinary Members, 628—Total, 850. Amongst those who have been removed by death may be mentioned the Duke of Argyll, the Earl of Airlie, Sir Kenneth Mackenzie of Gairloch, Mr Maxwell of Munches, Mr Polson of Thornley and Tranent, and Mr Daniel Dewar, forester, Beaufort.

The following is a list of the new Members admitted during the year. (For this list see Appendix A.)

Excursion.

The Excursion to Baronscourt, Clandeboye, and Castlewellan, in Ulster, was attended by from eighty to ninety Members and friends. The weather was rather variable, but the trip was nevertheless a very enjoyable one. After the return of the party, the thanks of the Society were formally conveyed to the Duke of Abercorn, the Marquis of Dufferin and Ava, and the Earl of Annesley, for their kindness to the Excursionists on that occasion. The supplementary trip to the Giant's Causeway was attended by fifty members, and although the weather was not very favourable, it did not prevent the Members from making good use of the time at their disposal in inspecting this great natural wonder.

Essay Competitions.

The Syllabus of subjects for Essays was issued in June 1899, and included twenty-five subjects, for which Medals and Prizes were offered. Only three Essays were received and submitted to the Judges, who gave the following awards, viz.:—A No. 2 Silver Medal, a Bronze Medal, and a Special Prize of £1.

The Syllabus of subjects for 1901 was issued in June last, and it is hoped that there will be a larger number of competitors this year.

Donors.

The thanks of the Society are due to the following Members who have either made or promised contributions to the Society's funds:—Mr MUNRO FERGUSON, M.P., for the Raith Bursary; and Professor BAYLEY BALFOUR and Messrs JOHN METHVEN and D. P. LAIRD for prizes offered by them.

Malcolm Dunn Memorial.

At the General Meeting in August, Mr BAXTER, Dalkeith Park, mentioned that great disappointment had been expressed by Mr Dunn's friends and admirers in Dalkeith and district because more money had not been expended on the monument. The Council accordingly brought the complaint before the other Societies interested, and suggested that the original Joint Committee should be re-appointed to investigate the matter, with instructions to employ an expert, if necessary, to advise them, and to report. The Joint Committee has been re-appointed, and it is anticipated that the result of their labours will be the removal of any further cause for complaint.

Forestry Education.

At the August meeting it was also mentioned that there was the possibility of the Indian Forest School at Coopers Hill being removed to some other centre, and that a remit had been made to Mr Ferguson, Hon. Secretary, and Colonel Bailey, to prepare for the approval of the Council a draft memorial, to be presented to the Board of Agriculture, setting forth the claims of Edinburgh as a suitable centre. It was afterwards found, however, that the Government of India had decided not to make any change, and it was therefore unnecessary to proceed with the proposed memorial. The Council is now considering whether anything can be done with the view of introducing some elementary facts regarding forestry into the curriculum of the Board and other schools under the Code.

International Congress on Sylviculture at Paris.

The first International Congress on Sylviculture was held in Paris in June last in connection with the Exhibition. The Council, though invited to do so, did not think it necessary to send representatives to the Congress, but arranged with Mr Gamble to write the report, which appears in the *Transactions*.

Glasgow International Exhibition.

It was reported at last Annual Meeting that the negotiations with the authorities of the Glasgow Exhibition on the subject of securing space for Forestry Exhibits, and representation on the Committee, had been very unsatisfactory, and that consequently it had been decided to allow the matter to drop. In November last, a letter was received from Messrs A. Cross & Son, asking whether the Society would apply for space in a proposed agricultural pavilion to be erected at the Exhibition, if sufficient applications for space were received. The Council considered that it was then too late to think of preparing exhibits, and Messrs Cross were informed that we did not propose to re-open negotiations.

The Novar Working Plan.

About 260 copies of this Working Plan, along with prospectuses of the Society, were distributed amongst the landowners of the three kingdoms, the immediate result being the addition of four Life Members to the roll of the Society, and the manifestation in various quarters of an increased interest in the systematic management of woodlands, which it is hoped will in time lead to the adoption of similar working plans throughout the country.

The Transactions.

The *Transactions*, of which advance copies are now on the table, are bulkier, and the contents are more varied, than those of last year. As promised at last meeting, an attempt has been made to improve the *Transactions*, and it is hoped the result will be considered satisfactory, especially by those Members who are unable to take part in the Society's Meetings and Excursions.

The Council.

In consequence of the steady increase in the Membership of the Society, and its growing influence in the country, the Council consider it desirable that the number of Councillors should be increased, so as to give a larger number of Members of the Society a share in the management of its affairs. They accordingly recommend that the number of Councillors be increased from fifteen to twenty-one, that seven should retire annually instead of five as at present, and that three in place of two be eligible for re-election. Notice of a motion to this effect will be given at to-day's meeting. This motion will be discussed and disposed of at next Annual Meeting.

The Address and the Dinner.

The Council have thought it proper, considering the melancholy circumstances under which we are met, to postpone Mr Gamble's Address and to abandon the usual Dinner.

On the motion of Mr D. F. MACKENZIE, seconded by Mr METHVEN, the Report was unanimously adopted.

FINANCES OF THE SOCIETY.

Mr METHVEN, Convener of the Finance Committee, in moving the adoption of the Accounts, which had been printed and circulated amongst the Members, congratulated the Society on being in such a prosperous condition.

(An Abstract of these Accounts will be found in Appendix B.)

Mr Methven mentioned that there was payable out of the balance carried forward the postages and the balance of the cost of the *Transactions* for 1900, amounting together to about £40.

The Accounts were approved of.

EXCURSION FUND.

The SECRETARY submitted the following Abstract of Accounts for the past year :—

RECEIPTS.

Balance from last Year,	£33	3	9
Deposits and Payments to Common Purse,	244	13	0
Amount received for Photographs, etc.,	11	3	3
	<hr/>		
	£289	0	0

PAYMENTS.

Auditor's Fee for 1899 Accounts,	£2	2	0
Printing,	4	6	0
Hotels,	146	10	6
Driving,	29	14	6
Special Trains,	57	0	0
Photographs,	10	14	5
General Expenses,	10	13	11
	<hr/>		
	£261	1	4
	<hr/>		
Balance carried forward to next Year,	£27	18	8

On the motion of Mr D. P. LAIRD, Convener of the Excursion Committee, the Accounts were approved of.

CHAIRMAN'S REMARKS.

The CHAIRMAN, in the course of his remarks on the year's work, said it seemed to him that the Report read by Mr Galloway was satisfactory.

They had not done very much during the year in Essays. The Committee and Judges were rather disappointed that only three papers should have been sent in. They were persuaded there was a wealth of resource in the way of writing ability in the Society, if it were only properly developed, and the Committee hoped that Members would give their best attention to the Essay Competitions instituted from time to time.

He was sorry, and they were all sorry, that there should have been any trouble over the Malcolm Dunn Memorial. As Con-

vener of the Committee, he might say that they considered the matter very carefully. The Committee did not think that a stone memorial was the best way to perpetuate a man's memory. They thought that part of the money at anyrate might be usefully expended in founding a Malcolm Dunn Scholarship, Bursary, Excursion Ticket, or such like. It had not, so far, been decided to which of these objects they would devote the balance of the money in hand; but the people in Dalkeith and elsewhere who subscribed so liberally towards this object, might be sure that the money would not be wasted. Of course, so far as the stone memorial was concerned, the subscribers were entitled to know that they had got their money's worth, and the Committee would see to that.

As regards forestry at the Glasgow Exhibition, it would be in the recollection of the meeting that he himself brought forward the matter, and urged that the Society should take an active part in an undertaking of that kind. They approached the authorities of the Exhibition with that view, but had not met with a very hearty response from them. Indeed, he had gone to Glasgow, and found that the Exhibition authorities could make no adequate provision for a Forestry Exhibit, and that the Society would be called upon to pay a very considerable sum in expenses before they could show anything. At a later date, when the authorities of the Exhibition seemed to have found that they had room, they approached the Society, and asked if they were willing to take part. After duly considering the matter, however, the Council came to the conclusion that they had no time to do this. The great difficulty they laboured under was that, unlike the Continental Schools of Forestry, they had no large permanent collections to draw upon, and although they could have shown objects of great interest, without a year or two to prepare they could not do justice either to the subject or to themselves at such an Exhibition.

ELECTION OF OFFICE-BEARERS.

Office-Bearers in room of those who retire by rotation were elected as follows:—The EARL OF MANSFIELD was re-elected President; Messrs W. STEUART FOTHERINGHAM of Murthly, and JAMES COOK, Arniston, were elected Vice-Presidents; and Colonel BAILEY, and Messrs JAMES CRABBE, ROBERT FORBES, G. U MACDONALD, and GEORGE MACKINNON were elected

Councillors. The Honorary Secretary, the Secretary and Treasurer, the Auditor, the Judges and *Transactions* Committee, the Honorary Scientists, the Local Secretaries, and the Photographic Artist were re-elected.

In moving the re-election of the *Transactions* Committee, Mr MUNRO FERGUSON said that it was very desirable that the Convener should have a permanent seat on the Council, so as to be there to consult and advise with the Council, and a motion was to be made to that effect, which he hoped would be agreed to when it came up for settlement at next Annual Meeting.

(The Office-Bearers and Officials for 1901 therefore stand as shown in Appendix C.)

THE RAITH BURSARY.

The SECRETARY reported that Mr Munro Ferguson's Bursary of £30 per annum had been awarded by the President to Mr MATTHEW FEAKS, Royal Botanic Garden, Edinburgh, for the year 1900-1901.

LIBRARY AND MUSEUM.

The SECRETARY reported that certain publications had been received since the General Meeting in August last. (See Appendix D.)

ANNUAL EXCURSION.

Mr D. P. LAIRD formally moved that this year's Excursion be held in Ayrshire. He mentioned that three days would probably be spent in visiting Estates in the neighbourhood of Ayr, and that a fourth day would probably be devoted to the Glasgow Exhibition. The proposal was unanimously approved of, and it was remitted to the Committee to make the necessary arrangements.

PRICES OF HOME-GROWN TIMBER.

Mr D. F. MACKENZIE, for the Committee which was appointed at a former meeting to consider Mr Kay's suggestion for getting up a table of the prices received for timber in Scotland, said they had discussed the matter, by correspondence, in all its bearings. They were unanimously of opinion that such information would be very useful if it could be got, but thought that they were not likely to get anything better than the comparative table that had

appeared in volume vii., No. 2, of *Forestry*. That table was rather too elaborate for ordinary average purposes, but if they deleted certain things, such as the third class of timber, they thought that it would meet the case. He himself had drawn up a short table, based on his own experience, which might be of use in the same connection. The Committee were of opinion that, in sending out these tables, they should rather go to local secretaries than to individual foresters. The prices varied so much that, unless they got a local man who was acquainted with the district as a whole to fill up the return, they might have difficulty in fixing what were the average prices, everything considered. Mr Kay also suggested, and he agreed with the suggestion, that they should try, if possible, to collect information as to the ultimate destination of the timber, and the prices received. This would be more difficult to get than the other information, but it might be tried. He was sorry to say that many foresters did not know what their timber was suited for, and what it was used for by buyers. If they knew that, they would have a better idea what they ought to get for it.

The CHAIRMAN said he felt very much interested in what Mr Mackenzie had said. It was important to know not only the prevailing prices of timber in Scotland, but also the best means of disposal of what they had to sell. In this connection, he had thought it would be of interest to members to include in the *Transactions* a statement of the timber imports for the last three years. That statement showed the notable fact that while the 1899 figures showed an increase of about one and a quarter millions sterling over those of 1898, those of last year showed a still further increase of the remarkable sum of three millions sterling. In other words, their imports of timber in three years had increased by about 25 per cent. With the growing exhaustion of the visible means of supply, that could not go on, and he was hopeful that those landlords who had had the foresight to put their woods in order, would by and by reap a benefit from the enhanced prices which were sure to prevail.

Mr FORBES, Masham, Yorkshire, said the table suggested by Mr Mackenzie from *Forestry* was of no use. Instead of quoting first, second, and third quality of timber, if they stated the depth of the bark and the quarter-girth, they would very soon know what class of timber it was. They had also to consider the immense differences that there was between prices, even in

adjoining districts. One estate near a station would get immensely better prices for the same class of timber than an estate a few miles farther out. They had always the bugbear of extraordinary traffic to face. Urban authorities were never slow to impose and collect rates, but immediately they started to cart a few extra trees, they dropped down on them for extraordinary traffic.

Mr MACKENZIE said he was obliged to Mr Forbes for his suggestion about measuring. The same thing had occurred to himself, and he agreed that if they had the quarter-girth measurements, the size of bark, and the like, they would not need to classify qualities so much.

The CHAIRMAN also thought Mr Forbes's suggestion about measurements a useful one, and, on his suggestion, Mr Forbes was added to the Committee, Mr Mackenzie remarking that they did their work by correspondence, and distance was therefore no obstacle.

Dr NISBET added some remarks on the subject of the collection of prices of timber in Scotland. This was a most important matter indeed. A few years ago the German Forestry Investigation Society was anxious to acquire all the knowledge possible about forestry questions in Scotland. They communicated with our Board of Agriculture, and some inquiries were set on foot. A good deal of information of a botanical nature was collected, but really nothing of the commercial aspect of the question—prices and such like. There was really nothing of this kind available. He was confident that well-ascertained data of this class would be most helpful to forestry in this country, and hoped that the Committee might be able to evolve something which would be really useful and good. He, however, thought that in sending out their forms they should stick to individual foresters rather than local secretaries. They were likely to get more information, and although it might mean a little extra work, they would get better and more reliable results. The districts, of course, would have to be properly mapped out, and the averaging properly done. He would also encourage foresters to enter freely in the "Remarks Column," which he would make as large as possible.

Mr FORBES said a difficulty about getting returns from individual foresters, was that circumstances varied so much that they might give erroneous information. A difference of

a mile or two from the station, as he had said, made a great difference in price.

Dr NISBET said he quite realised that, but all these things would have to be taken into consideration in striking the averages.

The subject then dropped, it being understood that the Committee would continue their labours.

DAMAGE BY SPARKS FROM RAILWAY ENGINES.

The SECRETARY mentioned that an Abstract of the Returns received from Members and others had been prepared by Colonel BAILEY and printed in the *Transactions*, and that it was proposed that a number of reprints should be thrown off and circulated amongst Members of Parliament, newspapers, and persons likely to support the Bill when re-introduced.

NOTICE OF MOTIONS.

The SECRETARY gave notice of the following Motions on behalf of the Council :—

That the number of Ordinary Councillors be increased from fifteen to twenty-one: that seven Senior Councillors shall retire annually, and that three shall be eligible for re-election.

That the Convener of the *Transactions* Committee be also Honorary Editor, and a Member of the Council *ex officio*.

INTIMATION.

It was intimated that at a future meeting, H. J. ELWES, Esq. of Colesborne, Gloucestershire, F.R.S., etc., would read a paper dealing with the following subjects :—

- (1) The Ripening of Tree Seeds in Great Britain, especially in the Year 1900, and their Germinating Power as compared with Foreign Seeds.
- (2) The value of Economic Planting of Seedlings as compared with Trees raised from Grafts, Cuttings, or Layers, and the best sources of supply for seeds of trees largely grown in this country.
- (3) The best methods of Raising Seeds sown *in situ* on various soils and climates.

It was explained that this intimation was made in order that Members might be prepared to take part in the discussion which would follow the reading of the paper.

VOTE OF THANKS.

On the motion of Mr MILNE a hearty vote of thanks was accorded to the Chairman for presiding, which concluded the business.

THE GENERAL MEETING.

A General Meeting of the Society was held in The King's Arms Hotel, Ayr, on Tuesday, 6th August 1901, immediately after the Annual Excursion Dinner. The Right Hon. the EARL OF MANSFIELD, President, in the chair.

MINUTES.

Minutes of the Forty-eighth Annual Meeting, held on 31st January 1901, were held as read and approved of.

DEATH OF THE QUEEN.

The SECRETARY reported that the following reply had been received to the Society's Address to the King:—

SCOTTISH OFFICE,
WHITEHALL, 27th March 1901.

MY LORD,—I am commanded by the King to convey to the Royal Scottish Arboricultural Society His Majesty's thanks for the expressions of sympathy with His Majesty and the Royal Family on the occasion of the lamented death of Her late Majesty Queen Victoria, and also for the loyal and dutiful assurances on the occasion of His Majesty's accession to the throne contained in their Address, which I have had the honour to lay before His Majesty.—I am, your obedient servant,

BALFOUR OF BURLEIGH.

THE RIGHT HON.

THE EARL OF MANSFIELD,

President of the Royal Scottish

Arboricultural Society, Edinburgh.

THE KING'S PATRONAGE.

The SECRETARY intimated that the following letter had been received from the Keeper of His Majesty's Privy Purse :—

PRIVY PURSE OFFICE,
BUCKINGHAM PALACE, 24th April 1901.

SIR,—I have the honour to inform you that I have submitted to the King your letter of the 8th inst., and in reply I am commanded to say that His Majesty is pleased to accede to the request contained in it, to grant his patronage to the Royal Scottish Arboricultural Society.—I am, sir, your obedient servant,

J. M. PROBYN, *General*,
Keeper of H.M.'s Privy Purse.

R. MUNRO FERGUSON, Esq.

ELECTION OF HONORARY MEMBER.

On the motion of the PRESIDENT, Sir ROBERT MENZIES, Bart., of that Ilk, was elected by acclamation an Honorary Member of the Society, in consideration of his eminent services to the cause of Forestry in Scotland.

ELECTION OF HONORARY ASSOCIATE MEMBERS.

Messrs WILLIAM BRUCE and THOMAS USHER, Senior Students (equal) at the University Forestry Class during the Session 1900-1, were, on the recommendation of the Lecturer, unanimously elected Honorary Associate Members.

REPORT BY SPECIAL JUDGES.

The Report by Special Judges on "A Hingeless Field Gate" and "A Patent Tree Planter" was submitted, and, in terms of their recommendation, a Bronze Medal was awarded for "A Hingeless Field Gate" to the Inventor, Mr William Forbes, Swinton, Masham, Yorkshire. The Judges did not recommend an award for the "Tree Planter."

JUDGES' REPORT ON ESSAYS.

The Report by the Judges on the Essays received in competition was submitted, and the following awards were made, in terms of their recommendations :—

CLASS I.

- (1) "Report on the Financial Results of the Cultivation of Woods."

Award—No. 1 Silver Medal, to Mr D. F. MACKENZIE, F.S.I., Estate Office, Mortonhall.

- (2) "The Valuation of Woods or Plantations for the Purpose of Transfer."

Award—No. 1 Silver Medal, to Mr JAMES PEARSON Strabane, Brodick.

- (3) "Report on the Plantations of B—— Estate."

Award—Bronze Medal, to Mr THOMAS DOW, Forester, Belvedere Road, Woodville, near Burton-on-Trent.

- (4) "Forestry in Kent and Sussex."

Award—No. 2 Silver Medal, to Mr DAVID A. GLEN, Bedgebury Park, Goudhurst, Kent.

CLASS II.

- (1) "The Pruning of Forest Trees."

Award—Bronze Medal, to Mr GILBERT BROWN, Assistant Forester, Scone.

- (2) "The Preparation of Soil for Planting."

Award—Bronze Medal, to Mr GILBERT BROWN, Assistant Forester, Scone.

THE RAITH BURSARY.

The Report of the University Lecturer on the Raith Bursary was read as follows:—

The Bursary for 1900-1901 was awarded by the President of the Society to Mr MATTHEW FEAKS. Mr Feaks had had five years practical experience as an Assistant Forester, when, in 1898, he entered the Royal Botanic Garden, Edinburgh, as a student. He there received instruction in Botany (including Forest Botany), Entomology, Mensuration and Land-surveying, Meteorology, Physics, Chemistry, and Geology. He passed a satisfactory examination in the above subjects,

and obtained a Certificate that he had "proved a most satisfactory employé both in work and conduct."

On obtaining the Bursary, he attended the Forestry Class regularly and passed with credit, obtaining 62 per cent. of full marks. He also joined evening classes at the Heriot-Watt College, with the following results:—*Agricultural Chemistry*, 86 per cent., with the Class Medal, and passed the Laboratory Course "with much distinction." *Geology*, First-Class Certificate. *Surveying*, he attended the classes, but, owing to indisposition, was unable to present himself for examination. He also underwent private instruction in *Plan-Drawing* and in *Trigonometry*, with *Logarithms*.

Mr Feaks has proved himself to be a painstaking and satisfactory student, whose previous experience in practical work, added to the instruction he has now received, should render him well qualified to act as Forester. Since he concluded his course of instruction, he has been appointed Forester to Lady Chernside, Newstead Abbey, Nottinghamshire.

FRED. BAILEY.

13th May 1901.

FORESTRY EXHIBITION AT HIGHLAND AND AGRICULTURAL SOCIETY'S SHOW.

Mr D. P. LAIRD reported that the Forestry Section at Inverness had been a great success, and had proved a great source of interest to crowds of people who had inspected it at the Show. The thanks of the Society were due to Mr J. A. GOSSIP, the Local Secretary, for the trouble he had taken in connection with the Exhibition. He said that a Report on the Exhibits would be prepared and printed in the *Transactions*.

THE COLLEGE OF AGRICULTURE, EDINBURGH.

Mr BUCHANAN, Penicuik, reported anent the New College of Agriculture, Edinburgh, that Forestry was to be one of the subjects taught by the staff of that College. One of the co-optive members of the governing body had still to be elected, and he had hopes that someone prominently identified with Forestry would be appointed. He suggested that a letter be sent from the Society to the Interim-Secretary, Mr James Macdonald, pointing out that it was desirable that someone prominently identified with Forestry should be elected to the vacant seat as a governor. This suggestion was agreed to.

EXCURSION, 1902.

Mr D. P. LAIRD reported that the Excursion Committee had recommended that the Excursion for next year should be held in Norway. It was suggested that they might sail from Newcastle to Christiania, thence along the coast, making excursions inland, and sleeping on board their steamer. The estimated cost of such a trip for twelve days was £12. If it could be arranged, he had no doubt that the Excursion would be a very interesting and instructive one.

Mr MUNRO FERGUSON said that if they went to Christiania they would see some of the largest Norwegian forests there, and then they could go on to Gothenburg, where they would see some of the great saw-mills and timber-manufacturing works. He thought that in this way a very excellent and instructive tour could be made out. He would suggest that it be left to the President, Mr Laird, Mr Galloway, and himself to make the necessary arrangements. The suggestion was cordially agreed to.

PROPOSED CONFERENCE WITH THE PRESIDENT OF THE BOARD
OF AGRICULTURE.

Mr MUNRO FERGUSON reported that he had recently had an informal meeting with Mr Hanbury, and the impression left on his mind by that interview was that Mr Hanbury was sincerely desirous to promote the cause of Agricultural Education, and that being the case, Mr Hanbury was likely also to take an interest in Forestry Education if the matter was properly brought before him. He suggested that the Society should try to arrange a meeting with Mr Hanbury when he came up to the Agricultural Conference in Edinburgh next October, and to enlist his sympathies, not only for Forestry Education, but also for the establishment of an Experimental Forest Area in Scotland. This suggestion was cordially agreed to, and it was remitted to the President and Mr Ferguson, to arrange the matter.

THE SOCIETY'S JUBILEE, 16TH FEBRUARY 1904.

Mr JOHN METHVEN said that as the Society's Jubilee would take place in 1904, it was desirable that this event should be celebrated in a suitable manner, and suggested that an Industrial Exhibition, on a central site, and under a proper

Manager, might be organised. He moved that a small Committee be appointed to consider the advisability of holding such an Exhibition, or of adopting some other way of celebrating the Society's Jubilee. A Committee was subsequently appointed, consisting of the President, Messrs Munro Ferguson, E. P. Tennant, D. P. Laird, John Methven, and the Secretary, with power to add to their number.

RETURNS OF PRICES RECEIVED FOR HOME-GROWN TIMBER.

The SECRETARY intimated that he had received a considerable number of Reports, and that an Abstract of the information would be prepared and printed in the *Transactions*.

DAMAGE BY SPARKS FROM RAILWAY ENGINES.

Mr MUNRO FERGUSON reported that the "Sparks Bill" had no chance of being passed this session, and, indeed, owing to the congestion of Parliamentary business, it had little chance of ever being passed so long as it was introduced by a private member. It was for foresters, therefore, and agriculturists as well, to bring pressure to bear on the President of the Board of Agriculture, so as to induce the Government to bring in a Bill on the subject.

VOTES OF THANKS.

Votes of thanks were awarded to Mr GALLOWAY, Secretary, and to Mr A. D. PAGE, Land Steward, Culzean, Local Secretary, for the arrangements in regard to the Excursion; and the Meeting terminated with a vote of thanks to the Chairman for presiding.

APPENDIX A.

List of Members elected during the year ending 31st January 1901.

Honorary Member.

GAMBLE, J. Sykes, C.I.E., F.R.S., M.A., ex-Director of the Indian Forest School, Highfield, East Liss, Hants.

Honorary Associates.

CROMBIE, T. Alexander, Forester, Monreith, Wigtownshire.
STORY, Fraser, Assistant Factor, The Glen, Innerleithen.

Life Members.

- BALFOUR, Charles B., of Newton Don, Kelso.
5 BROWN, Charles, Factor, Kerse, Falkirk.
CROOKS, James, Timber Merchant, St Helens.
DALHOUSIE, The Right Hon. the Earl of, Brechin Castle, Forfarshire.
FERGUSON, James Alex., Ardnith, Partickhill, Glasgow.
GLADSTONE, Sir John R., Bart. of Fasque, Laurencekirk.
10 GODMAN, Hubert, Land Agent, Gainsborough, Yorkshire.
HALDANE, William S., of Foswell, W.S., 55 Melville Street, Edinburgh.
LOW, William, B.Sc., Tighnamuirn, Monifieth.
LYELL, Sir Leonard, Bart. of Kinnordy, Kirriemuir.
PERRINS, C. W. Dyson, of Ardross, Ardross Castle, Alness.
15 WARWICK, Charles, Land Steward, Clandeboye, Co. Down.

Ordinary Members.

- ADAIR, David Ratray, S.S.C., 24 Castle Street, Edinburgh.
AITCHISON, John, Assistant Forester, Pollok, Pollokshaws.
ANDERSON, Robert, Bailiff, Phoenix Park, Dublin.
ANGUS, Alexander, Gardener, Dalzell, Motherwell.
20 BARKER, Arthur, Assistant Forester, Lynedoch, Perth.
BELL, William, Assistant Forester, Balthayock, Perth.
BROOM, John, Wood Merchant, Bathgate.
BROWN, Gilbert, Assistant Forester, Stormontfield, Perth.
BROWN, William, Assistant Forester, Scone, Perth.
25 CAMERON, Dr James, The Fountain, Loanhead.
CAMPBELL, James S., Assistant Forester, Chatsworth, Bakewell, Derbyshire.
CARRIE, William, Assistant Forester, Drumpelzier, Coatbridge.
CAVERS, Walter, Timber Merchant, 12 East Brighton Crescent, Portobello.
CLARK, Charles, Assistant Forester, Almond Bank, Perth.
30 COLLIE, Alexander, Assistant Forester, East Lodge, Durris, Aberdeen.
CRABBE, Alfred, Assistant Forester, Bowood, Calne, Wilts.
CUMMING, John H., The Gardens, Grantully Castle, Aberfeldy.
DALGLIESH, J. Edward, Forester, The Nurseries, Market Weighton, Yorkshire.

- DRUMMOND, Dudley W., Commissioner, Cawdor Estate Office, Ferry-
side, South Wales.
- 35 DUTHIE, James A., Traveller, 1 Waterloo Place, Edinburgh.
FARQUHARSON, Sir John, K.C.B., Corrachree, Tarland, Aberdeenshire.
FEAKS, Matthew, Assistant Forester, 5 Bowhill Terrace, Edinburgh.
FRASER, Alexander, Assistant Factor, Raith Estate Office, Kirkcaldy.
GELLATLY, John, Assistant Forester, Saucher, Balbeggie, near Perth.
- 40 HEWITSON, William, Assistant Forester, Lanes Barr, Girvan.
HISLOP, William, Assistant Forester, Minto, Hawick.
HUNTER, David, of Ahlbottn & Co., 21 St Andrew Square, Edinburgh.
JEFFERIES, Wm. J., Nurseryman, Cirencester.
JOHNSTON, David, Manager, Charlestown Limeworks, Fife.
- 45 JOHNSTONE, William, Head Forester, Beil, Prestonkirk.
KING, David, Nurseryman, Osborne Nurseries, Murrayfield.
LAWRIE, James, The Gardens, Murthly Castle, Perthshire.
LUMSDEN, Robert, jun., Drinnsmittal Saw-mills, Kessock.
MACDONALD, Harry L., of Dunach, Oban.
- 50 MACGREGOR, James, Assistant Forester, Murthly Castle, Perth.
M'KECHNIE, Angus, Assistant Forester, Raith, Kirkcaldy.
MACKENZIE, Sir Kenneth J., Bart. of Gairloch, 10 Moray Place,
Edinburgh.
MACPHERSON, John, Manufacturing Forester, Novar, Evanton.
M'RAE, Henry, Assistant Forester, Lintmill, Cullen.
- 55 MATTHEWS, Robert, Land Steward, Duncrub Park, Dunning.
MILNE, Robert Anderson, Solicitor, Peebles.
MULLIN, John, Forester, Eglinton Castle, Irvine.
MURRAY, George J. B., Assistant Forester, Holylee, Walkerburn.
MURRAY, John C., F.S.I., Factor and Commissioner, Hags Castle,
Glasgow.
- 60 MURRAY, William, of Murraythwaite, Ecclefechan, Dumfriesshire.
OLIPHANT, Joseph, Assistant Forester, Chapelhill, Methven.
PATERSON, George, Timber Merchant, 8 Albyn Terrace, Aberdeen.
POLSON, John, of Thornley & Tranent, West Mount, Paisley.
REID, John, Estate Overseer, The Mains, Lochgelly.
- 65 RENNIE, Joseph, Forester, Castle Newe, Strathdon, Aberdeenshire.
ROBERTSON, James, Assistant Forester, Millhaugh, Methven, Perth.
ROBERTSON, John, Assistant Forester, Minto, Hawick.
SCOTT, Robert, Assistant Forester, Minto, Hawick.
SINGER, John G., Assistant Forester, Sharpdale, Cameron Toll,
Edinburgh.
- 70 STEWART, James, Forester, Fotheringham, Forfar.
TAIT, James, jun., Woodsbank, Penicuik.
TAYLOR, Alexander, Overseer, Kildrumny, Mossat, Aberdeenshire.
THOMSON, Major W. Anstruther, Kilmany, Cupar-Fife.
TULLY, James B., Assistant Forester, Royal Botanic Garden, Edinburgh.
- 75 TURNBULL, Andrew, Assistant Forester, Allerwick, Alnwick.
TWEEDIE, John M., Forester, Foulden, Berwick.
WILSON, John H., D.Sc., F.R.S.E., St Andrews.

APPENDIX B.

Abstract of Accounts for Year ending 31st December 1900.

I.—CAPITAL.

CHARGE.		DISCHARGE.	
1. Funds at 31st December 1899,	£585 10 10	Proportion of Life Members' Subscriptions transferred to Revenue,	£39 12 2
£336 Caledonian Railway Company 4 per cent. Guaranteed Annuity Stock, No. 2, at 133 $\frac{1}{2}$,	£447 14 4	1 $\frac{1}{2}$ of Full Life Subscriptions,	£82 9 5
Deposit with National Bank of Scotland, Limited,	137 16 6	1 $\frac{1}{2}$ of Commuted Subscriptions,	7 2 9
		Price of £150 Caledonian Railway Company 4 per cent. Guaranteed Annuity Stock, No. 2, at 134,	£201 0 0
2. Life Members' Subscriptions in 1900,	112 14 0	Expenses in connection with above purchase,	2 6 1
New Members,	£92 8 0	Decrease in value of Railway Stock at 31st December 1900,	3 11 1
Ordinary Members by commutation,	20 6 0	Funds at 31st December 1900,	652 15 6
		£486 Caledonian Railway Company 4 per cent. Guaranteed Annuity Stock, No. 2, at 132 $\frac{3}{4}$,	£645 3 3
		In National Bank of Scotland, Limited,	7 12 3
	£698 4 10		£698 4 10

II.—REVENUE.

CHARGE.		DISCHARGE.	
1. Balance in hand at 31st December 1899 (<i>Less</i> 10s. Raith Bursary interest credited below),	£130 6 3	1. Printing, Stationery, etc.,	£101 1 6
2. Ordinary Members' Subscriptions,	233 13 0	Balance of cost of <i>Transactions</i> , Part 1 of Vol. XVI.,	£16 12 6
Arrears at 31st December 1899,	£34 2 6	To account of cost of <i>Transactions</i> , Part 2 of Vol. XVI.,	75 0 0
<i>Deduct</i> Cancelled and written off as irrecoverable at 31st December 1900,	19 5 6	Maps and Plates for do.,	10 14 9
		General Printing, Binding, and Stationery,	23 17 3
Subscriptions for 1900,	£14 17 0	<i>Less</i> Receipts for Advertisements in <i>Transactions</i> ,	25 3 0
<i>Less</i> Received in 1899,	243 17 6		£101 1 6

Subscriptions for 1901 and 1902 received in 1900,	6 13 0				30 0 0
<i>Deduct</i> Arrears at 31st December 1900,	<u>£265 7 6</u>				1 17 3
	31 14 6				96 5 8
	<u>£235 13 0</u>				
3. Proportion of Life Members' Subscriptions transferred from Capital,				39 12 2	
4. Donation from R. C. Munro Ferguson, Esq., M.P., for the Raith Bursary, and 10s. interest from last Account,				30 0 0	
5. Dividends and Interest,				23 13 10	
6. <i>Transactions</i> , etc., sold,				3 15 0	
7. Miscellaneous,				0 8 10	
					<u>£461 9 1</u>
2. Raith Bursary for 1900-1901. Holder, Mr Matthew Feaks,					30 0 0
3. Prizes (Money, £1; Medal, 17s. 3d.),					1 17 3
4. Expenses of Management,					96 5 8
Rent,				£3 13 6	
Reporter,				2 2 0	
Auditor,				3 3 0	
Secretary and Treasurer,				50 0 0	
Advertising, Insurance, and Premium on Secretary's Bond of Caution,				4 11 2	
Postages and Miscellaneous Outlays, viz.:—					
Postage of 1899 <i>Transactions</i> , £11 2 0					
Postages of Billets of January and August meetings,				3 13 0	
General Postages, Commission on Cheques, and Petty Outlays,				18 1 0	
				<u>32 16 0</u>	
				£96 5 8	
5. Balance carried to next year (being sum in National Bank of Scotland, Limited),					232 4 8
Consisting of—					
1. Prof. Bayley Balfour's Prize,				£10 10 0	
2. Surplus Revenue, subject to payment of balance of cost and postage of 1900 <i>Transactions</i> ,				221 14 8	
				<u>£232 4 8</u>	
					<u>£461 9 1</u>

EDINBURGH, 16th January 1901.—I hereby certify that I have examined the Accounts of the Treasurer for the year to 31st December 1900, of which the foregoing is an Abstract, and have found them correct. The Securities, representing the Society's Funds, as above, have also been exhibited to me.

JOHN T. WATSON, Auditor.

APPENDIX C.

Office-Bearers for 1901:—

PRESIDENT.

The Right Hon. the EARL OF MANSFIELD, Scone Palace, Perth.

VICE-PRESIDENTS.

The Right Hon. LORD LOVAT, Beaufort Castle, Beaulieu.

D. P. LAIRD, Nurseryman, Pinkhill, Murrayfield.

D. F. MACKENZIE, Factor, Mortonhall, Liberton.

JAMES COOK, Estate Office, Arniston, Gorebridge.

W. STEUART FOTHRINGHAM of Murthly, Perthshire.

COUNCIL.

JOHN BOYD, Forester, Pollok Estate, Pollokshaws, Glasgow.

CHARLES BUCHANAN, Overseer, Penicuik Estate, Penicuik.

WILLIAM GILCHRIST, Forester, Leuchars, Elgin.

WILLIAM MACKINNON, Nurseryman, 144 Princes Street, Edinburgh.

JOHN METHVEN, Nurseryman, 15 Princes Street, Edinburgh.

JOHN ANNAND, Overseer, Haystoun Estate, Peebles.

W. A. MACKENZIE, Factor, Faskally, Pitlochry.

JOHN T. M'LAREN, Factor, Polmaise, Stirling.

ALEXANDER PITCAITHLEY, Forester, Jeanie Bank, Scone.

JAMES ROBERTSON, Forester, Panmure, Carnoustie.

Colonel F. BAILEY, R.E., Lecturer on Forestry, Edinburgh University.

JAMES CRABBE, Forester, Glamis, Forfarshire.

ROBERT FORBES, Estate Office, Kennet, Alloa.

G. U. MACDONALD, Forester, Raith, Kirkcaldy.

GEORGE MACKINNON, Overseer, Melville Castle, Lasswade.

HON. SECRETARY.

R. C. MUNRO FERGUSON, M.P., Raith House, Kirkcaldy, Fife.

SECRETARY AND TREASURER.

ROBERT GALLOWAY, S.S.C., 5 St Andrew Square, Edinburgh.

AUDITOR.

JOHN T. WATSON, 16 St Andrew Square, Edinburgh.

JUDGES AND TRANSACTIONS COMMITTEE.Colonel BAILEY, R.E., Lecturer on Forestry, University of Edinburgh
(*Convener*).

Professor SOMERVILLE, University of Cambridge.

JOHN METHVEN, Nurseryman, Edinburgh.

JOHN MICHIE, Forester, Balmoral.

JOHN CLARK, Forester, Haddo House, Aberdeen.
 ROBERT LINDSAY, Kaimes Lodge, Murrayfield.
 A. C. FORBES, Wood Manager, Bowood, Calne, Wilts.
 ROBERT GALLOWAY, S.S.C., *Secretary*, 5 St Andrew Square, Edinburgh, *ex officio*.

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.Ce., D.Sc., F.R.S.E., F.L.S., Professor of Agriculture, Department of Agriculture, Cambridge University.
Consulting Entomologist, ROBERT STEWART MACDOUGALL, M.A., D.Sc., Professor of Biology, New Veterinary College, 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.

TRUSTEES.

JOHN ORD MACKENZIE of Dolphinton, the EARL OF MANSFIELD, and
 R. C. MUNRO FERGUSON, M.P.

LOCAL SECRETARIES.

<i>Counties.</i>	<i>Scotland.</i>
<i>Aberdeen,</i>	JOHN CLARK, Forester, Haddo House, Aberdeen. JOHN MICHIE, Forester, Balmoral, Ballater. JAMES WILSON, M.A., B.Sc., Fordyce Lecturer on Agriculture, Aberdeen University.
<i>Argyle,</i>	WALTER ELLIOT, Manager, Ardtornish. JOHN D. SUTHERLAND, Estate Agent, Oban.
<i>Ayr,</i>	JOHN HAY, Overseer, Dollars Estate Office, Kilmarnock. ANDREW D. PAGE, Overseer, Culzean, Maybole.
<i>Banff,</i>	JOHN BRYDON, Forester, Rothes, Elgin.
<i>Berwick,</i>	WM. MILNE, Foulden Newton, Berwick-on-Tweed.
<i>Bute,</i>	WM. INGLIS, Forester, Cladoch, Brodick. JAMES KAY, Forester, Bute Estate, Rothesay.
<i>Clackmannan,</i>	ROBERT FORBES, Estate Office, Kennet, Alloa.
<i>Dumbarton,</i>	ROBERT BROWN, Forester, Boiden, Luss.
<i>Dumfries,</i>	D. CRABBE, Forester, Byreburnfoot, Canonbie. JOHN HAYES, Dormont Grange, Lockerbie. JOHN NEWBIGGING, Nurseryman, Dumfries.

Scotland.

<i>Counties.</i>	
<i>East Lothian,</i>	W. S. CURR, Factor, Ninewar, Prestonkirk.
<i>Fife,</i>	EDMUND SANG, Nurseryman, Kirkcaldy.
<i>Forfar,</i>	R. CAIRNS, The Gardens, Balruddery, near Dundee. JAMES CRABBE, Forester, Glamis. JAMES ROBERTSON, Forester, Panmure House, Carnoustie.
<i>Inverness,</i>	JAMES A. GOSSIP, Nurseryman, Inverness. S. MACBEAN, Forester, Bunchrew.
<i>Kincardine,</i>	JOHN HART, Estates Office, Cowie, Stonehaven.
<i>Kinross,</i>	JAMES TERRIS, Factor, Dullomuir, Blairadam.
<i>Lanark,</i>	JOHN DAVIDSON, Forester, Dalzell, Motherwell. JAMES WHITTON, Superintendent of Parks, City Chambers, Glasgow.
<i>Moray,</i>	WM. GILCHRIST, Forester, Leuchars, Elgin. D. SCOTT, Forester, Darnaway Castle, Forres.
<i>Peebles,</i>	GEORGE HANNAH, Forester, The Glen, Innerleithen.
<i>Perth,</i>	W. HARROWER, Forester, Tomnacroich, Garth, Aberfeldy. W. A. MACKENZIE, Factor, Faskally, Pitlochry. ALEX. PITCAITHLEY, Jeanie Bank, Old Scone, Perth.
<i>Ross,</i>	JOHN J. R. MEIKLEJOHN, Factor, Novar, Evanton. MISS AMY FRANCES YULE, Tarradale House, Muir of Ord.
<i>Roxburgh,</i>	JOHN LEISHMAN, Manager, Cavers Estate, Hawick. R. V. MATHER, Nurseryman, Kelso.
<i>Sutherland,</i>	JAMES F. HARDIE, Factor, Skibo Castle, Dornoch. DONALD ROBERTSON, Forester, Dunrobin, Golspie.
<i>West Lothian,</i>	JAMES SMITH, Hopetoun Gardens, South Queensferry.
<i>Wigtown,</i>	JAMES HOGARTH, Forester, Culhorn, Stranraer. H. H. WALKER, Monreith Estate Office, Whauphill.

England.

<i>Beds,</i>	JOHN ALEXANDER, 11 Alexandra Road, Bedford. FRANCIS MITCHELL, Forester, Woburn.
<i>Berks,</i>	W. STORIE, Whitway House, Newbury.
<i>Bucks,</i>	JAMES SMITH, The Gardens, Mentmore, Leighton-Buzzard.
<i>Cambridge,</i>	Professor SOMERVILLE, Cambridge University.
<i>Cheshire,</i>	WM. ELDER, Cholmondeley Park, near Malpas.
<i>Derby,</i>	THOMAS DOW, Belvedere Road, Woodville, Burton-on-Trent.
<i>Devon,</i>	JAMES BARRIE, Forester, Stevenstone Estate, Torrington. WM. STORIE, Forester, Gulworthy, Tavistock.
<i>Hants,</i>	ANDREW SLATER, Estate Office, Osborne, Cowes, Isle of Wight.
<i>Herts,</i>	JAMES BARTON, Forester, Hatfield. THOMAS SMITH, Overseer, Tring Park, Wiggington, Tring.
<i>Kent,</i>	R. W. COWPER, Gortanore, Sittingbourne.
<i>Lancashire,</i>	D. C. HAMILTON, Forester, Knowsley, Prescott.
<i>Leicester,</i>	JAMES MARTIN, The Reservoir, Knipton, Grantham.
<i>Lincoln,</i>	W. B. HAVELOCK, The Nurseries, Brocklesby Park.

England.

Counties.	
<i>Middlesex,</i>	Professor BOULGER, 56 Mount Ararat Road, Richmond. GEORGE CADELL, c/o The Secretary, Surveyor's Institution, 12 Great George Street, Westminster, S. W.
<i>Norfolk,</i>	H. MUNRO, Garden Cottage, Holkham Hall. JAMES RODGER, Forester, Morton Hall, Norwich.
<i>Northumberland,</i>	JOHN DAVIDSON, <i>Secretary</i> , English Arboricultural Society, Haydon-Bridge-on-Tyne.
<i>Notts,</i>	W. MICHIE, Forester, Welbeck, Worksop. WILSON TOMLINSON, Forester, Clumber Park, Worksop.
<i>Salop,</i>	FRANK HULL, Forester, Lillieshall, Newport.
<i>Stafford,</i>	ROBERT T. COLLINS, Forester, Trentham, Stoke-on-Trent.
<i>Suffolk,</i>	ANDREW BOA, junior, Agent, Great Thurlow.
<i>Surrey,</i>	PHILIP PEEBLES, Estate Office, Albury, Guildford.
<i>Warwick,</i>	A. D. CHRISTIE, The Gardens, Ragley Hall, Alcester.
<i>Wilts,</i>	A. C. FORBES, Wood Manager, Bowood, Calne.
<i>York,</i>	WM. FORBES, Forester, Swinton, Masham. ADAM MAIN, Forester, Rose Cottage, Loftus. D. TAIT, Estate Bailiff, Owston Park, Doncaster.

Ireland.

<i>Antrim,</i>	JOHN SCRIMGEOUR, Land Steward, Shane's Castle.
<i>Galway,</i>	THOMAS ROBERTSON, Forester and Bailiff, Woodlawn.
<i>Kildare,</i>	ROBERT M'KERROW, Manager, Carton, Maynooth.
<i>Kilkenny,</i>	ALEX. M'RAE, Forester, Castlecomer.
<i>King's County,</i>	ARCH. HENDERSON, Forester, Clonad Cottage, Tullamore.
<i>Monaghan,</i>	JAMES BRODIE, Land Steward, Glaslough.
<i>Tipperary,</i>	DAVID G. CROSS, Forester, Kylisk, Nenagh.
<i>Wicklow,</i>	ADAM JOHNSTONE, Forester, Coollattin, Shillelagh.

PHOTOGRAPHIC ARTIST.

GEORGE PAXTON, Richardland, Kilmarnock.

APPENDIX D.

Note of Presentations to the Library since the General Meeting on 7th August 1900.

1. *Journal of the Royal Horticultural Society*, vol. xxiii., part 3, August 1900.
2. Report of the Forest Department of the Madras Presidency, 1898-99.
3. *Transactions of the Massachusetts Horticultural Society*, part 2, 1899.
4. Wine-Making in Hot Countries. Roos. From the Department of Agriculture, Victoria.
5. Fungus Diseases of Citrus Trees in Australia. M'Alpine. From the Department of Agriculture, Victoria.
6. *Transactions and Proceedings of the Botanical Society, Edinburgh*, vol. xxi., part 4.
7. First Steps in Ampelography. By M. Mazade. From the Department of Agriculture, Victoria.
8. *Journal of the Royal Horticultural Society*, vol. xxv., parts 1 and 2.
9. *Our Forests and Woodlands*. By Dr John Nisbet.
10. *Veitch's Manual of Conifera*. Second Edition. By A. H. Kent.
11. *Journal of the Royal Agricultural Society of England*. Third Series, vol. xi.
12. *The Forester*, for September, November, and December. From the American Forestry Association.

Important New Work for Naturalists, Sportsmen, & Agriculturists.

BOTANICAL SURVEY OF SCOTLAND

By ROBERT SMITH, B.Sc.

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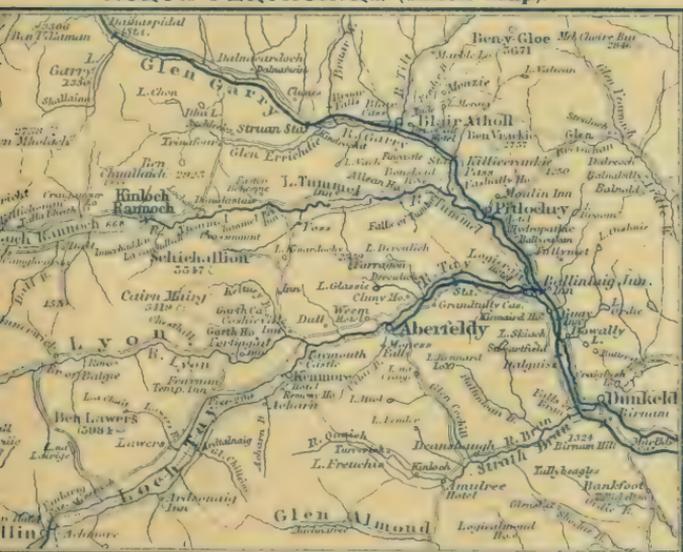


Each Sheet is mounted on cloth and inserted in case for pocket.



Other Sheets, to be edited by W. G. Smith, Ph.D., of the Yorkshire College, Leeds, are in preparation.

NORTH PERTSHIRE (Index Map).



JOHN BARTHOLOMEW & CO.

The Edinburgh Geographical Institute

BOTANICAL SURVEY OF SCOTLAND.

By ROBERT SMITH, B.Sc.



WITHIN recent years the distribution of the detailed or topographical aspects of vegetation has been the subject of increased attention. The meteorologist has been attracted by the connection between the distribution of plant life and climate, the geologist by the connection between the vegetation and the nature of the subjacent soil and rock, and the general geographer by the conspicuous part that the vegetation plays in the landscape; whilst the agriculturist and forester recognise the value of the study of the natural vegetation in deciding what cultivated plants may be expected to yield fruitful crops over any particular area.

The present work, so far as it goes, is altogether due to the energy and scientific enthusiasm of the late Mr Robert Smith, B.Sc., of the University College, Dundee, who may indeed be said to have taken a martyr's realisation of his ideal. Inspired by a course of work with Professor Flabault, of the Botanical Institute of Montpellier, on his return to Scotland in 1896, he commenced a systematic survey of the Forth and Tay Basins, to which he devoted himself with untiring energy for the past four years. These two maps of the Edinburgh District and Central Perthshire are the first fruits of his labours, and he died immediately after their publication. Other sheets were left by him nearly finished, and they will be completed for publication by his brother, Dr W. G. Smith, of the Yorkshire College, Leeds, who has also made a special study of this subject.

The actual survey may be briefly stated to represent in detail the existing plant associations in the wild state of nature, and as modified by men. We have, firstly, the various types of uncultivated land, the regions of hill pasture, moorland, virgin woodland, and the littoral region of sea links and shore vegetation; secondly, the region of cultivation, crops, and tree planting. These groupings form the starting point for further differentiation, such as character of crops, various kinds of trees, various kinds of hill pasture, moorland, or other uncultivated land. The mapping of these features in detail represents the essential part of the survey, while the descriptive text supplies a more detailed list of names of plants, and draws scientific deductions arising from a consideration of the climatic, geologic, human, and other influences determining and effecting the existing distributions. The study is one of absorbing scientific interest, and the practical possibilities and issues are of no less material value.

NATURALIST'S MAP OF SCOTLAND.

By J. A. HARVIE-BROWN, F.Z.S., and J. G. BARTHOLOMEW, F.R.S.E.

Scale 10 miles to an inch. Among many features of special value and interest to the Naturalist and Sportsman, this map shows the Faunal Areas as divided by watersheds, the Height of Land, the Distribution of Deer Forests, Woodland, Heather and Moorland, also the Salmon Rivers and Lochs, Sea Fisheries, &c., &c. *In cloth case, price 1s. On cloth, price 2s.*

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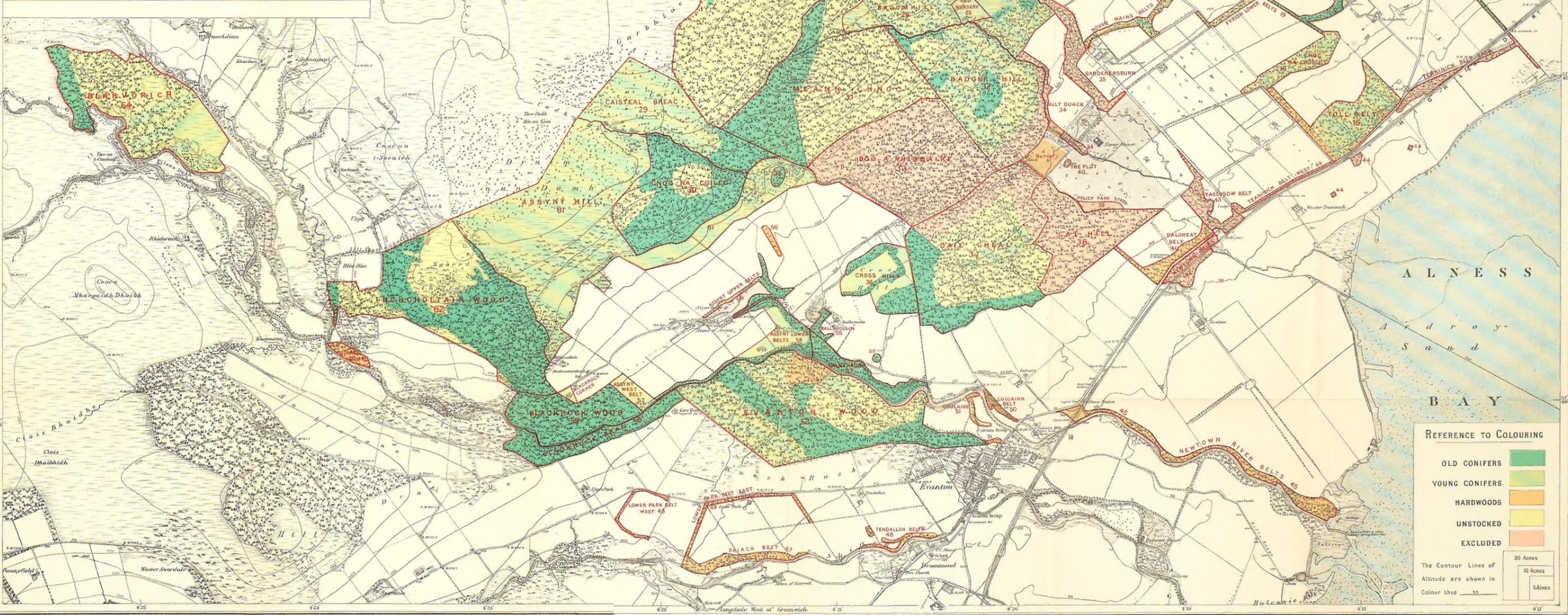
The Edinburgh Geographical Institute

MAP OF PART OF NOVAR ESTATE

SHOWING THE
WOODS INCLUDED IN THE WORKING PLAN
1899

AREA STATEMENT.

No.	NAMES.	OLDER WOODS.		YOUNGER WOODS.		TOTAL.	Sheets of the 25' Ordnance Map on which the Woods are shown.	
		CONIFERS.	HARDWOOD.	CONIFERS.	HARDWOOD.			
1	Acharn Wood	4750	139 012	139 012	4750	139 012	III-12, 16; III-9, 13.	
2	Ardoch Wood	1500	51 291	51 291	1500	51 291	III-13, 14	
3	Lealty Belt	1500	51 291	51 291	1500	51 291	III-13	
4	Dalroch	471 000	471 000	471 000	471 000	471 000	III-35, 14, 15; Irv-2	
5	Baldans Belt	19 420	19 420	19 420	19 420	19 420	III-34	
6	Cnoc Duhaire	108 788	108 788	108 788	108 788	108 788	Irv-2, Irv-3, Irv-4, Irv-5, Irv-6, Irv-7, Irv-8, Irv-9, Irv-10, Irv-11, Irv-12, Irv-13, Irv-14, Irv-15, Irv-16, Irv-17, Irv-18, Irv-19, Irv-20, Irv-21, Irv-22, Irv-23, Irv-24, Irv-25, Irv-26, Irv-27, Irv-28, Irv-29, Irv-30, Irv-31, Irv-32, Irv-33, Irv-34, Irv-35, Irv-36, Irv-37, Irv-38, Irv-39, Irv-40, Irv-41, Irv-42, Irv-43, Irv-44, Irv-45, Irv-46, Irv-47, Irv-48, Irv-49, Irv-50, Irv-51, Irv-52, Irv-53, Irv-54, Irv-55, Irv-56, Irv-57, Irv-58, Irv-59, Irv-60, Irv-61, Irv-62, Irv-63, Irv-64, Irv-65, Irv-66, Irv-67, Irv-68, Irv-69, Irv-70, Irv-71, Irv-72, Irv-73, Irv-74, Irv-75, Irv-76, Irv-77, Irv-78, Irv-79, Irv-80, Irv-81, Irv-82, Irv-83, Irv-84, Irv-85, Irv-86, Irv-87, Irv-88, Irv-89, Irv-90, Irv-91, Irv-92, Irv-93, Irv-94, Irv-95, Irv-96, Irv-97, Irv-98, Irv-99, Irv-100	
7	Claisruin	2000	70 827	70 827	2000	70 827	Irv-2	
8	Moultar's Belt	2000	20 000	20 000	2000	20 000	Irv-2	
9	Contullich Belt	130 000	30 828	30 828	130 000	30 828	Irv-2	
10	Contullich Wood	45 000	58 000	123 000	45 000	123 000	Irv-2, 3, 5, 7	
11	Black Park	1000	49 000	49 000	1000	49 000	Irv-2, 6	
12	Black Park Corner	1000	1000	1000	1000	1000	Irv-6	
13	Balshraggan Belts	4 410	3 168	7 578	4 410	7 578	Irv-7	
14	Teasmich Belt, East	3 027	26 870	29 897	3 027	29 897	Irv-7, 10, 11	
15	Toll Belt	4 630	16 127	20 757	4 630	20 757	Irv-4, 10	
16	Cnoc-na-Croige	4 630	16 127	20 757	4 630	20 757	Irv-4	
17	Clash-na-buao	600	600	600	600	600	Irv-4	
18	Clash-na-buao Clump	3 310	3 310	3 310	3 310	3 310	Irv-4	
19	Fyriah Lower Belts	875	1 722	2 597	875	2 597	Irv-4, 10	
20	Novar Main Belts	20 000	64 000	84 000	20 000	84 000	Irv-4	
21	Fyriah Upper Belts	130 000	130 000	260 000	130 000	260 000	Irv-4	
22	Cnoc Fyriah	38 000	38 000	76 000	38 000	76 000	Irv-4	
23	Cnoc-an-eilknadh	3 000	3 000	6 000	3 000	6 000	Irv-4	
24	Temple Park	3 000	3 000	6 000	3 000	6 000	Irv-4	
25	Old Nursery	3 000	3 000	6 000	3 000	6 000	Irv-4	
26	Broom Hill	3 000	3 000	6 000	3 000	6 000	Irv-4	
27	Bullocheshan	3 000	3 000	6 000	3 000	6 000	Irv-4	
28	Craig Ruadh	20 000	185 000	205 000	20 000	205 000	Irv-9	
29	Caisteal Breac	15 000	50 916	65 916	15 000	65 916	Irv-31, Irv-9	
30	Cnoc-na-Collie	67 228	107 023	174 251	67 228	174 251	Irv-31, Irv-9	
31	Meann Cnoc	80 000	92 823	172 823	80 000	172 823	Irv-9	
32	Badger Hill	15 000	20 000	35 000	15 000	35 000	Irv-9, 10	
33	Bog-s-Phoblair	108 000	108 000	216 000	108 000	216 000	Irv-9, 10	
34	Allt Duack	7 000	7 000	14 000	7 000	14 000	Irv-9, 10	
35	Gardener's Burn	16 438	16 438	32 876	16 438	32 876	Irv-6, 10	
36	Cross Hills	31 129	31 129	62 258	31 129	62 258	Irv-9	
37	Dalghel	40 997	130 900	171 897	40 997	171 897	Irv-9, 10, 13	
38	Ca' Hill	31 000	31 000	62 000	31 000	62 000	Irv-10	
39	Policy Park Strip	2 000	2 000	4 000	2 000	4 000	Irv-10	
40	The Plot	314	314	628	314	628	Irv-35	
41	Dalghel Belt	7 960	7 960	15 920	7 960	15 920	Irv-10	
42	Newton Belts	7 130	7 130	14 260	7 130	14 260	Irv-10	
43	Tallysow Belt	4 535	4 535	9 070	4 535	9 070	Irv-10	
44	Teasmich Belt West	6 972	6 972	13 944	6 972	13 944	Irv-10	
45	Newton River Belts	13 971	991	14 962	13 971	14 962	Irv-10	
46	Teasmich Belts	3 285	3 285	6 570	3 285	6 570	Irv-11	
47	Skilack Belt	9 969	9 969	19 938	9 969	19 938	Irv-13	
48	Lower Pk. Belt, West	1 792	1 792	3 584	1 792	3 584	Irv-13	
49	Lower Pk. Belt, East	3 145	3 145	6 290	3 145	6 290	Irv-13	
50	Outairn Belt	721	721	1 442	721	1 442	Irv-13	
51	Coullags	900	3 912	4 812	900	4 812	Irv-13	
52	Evanton Wood	44 000	60 000	104 000	44 000	104 000	Irv-13	
53	Dalmahoun	14 997	14 997	29 994	14 997	29 994	Irv-13	
54	Assynt Lower Belts	10 884	7 990	18 874	10 884	18 874	Irv-9, 13	
55	Balavoulin	3 181	3 181	6 362	3 181	6 362	Irv-9, 13	
56	Assynt Upper Belts	9 902	1 297	11 199	9 902	11 199	Irv-9	
57	Assynt West Belts	4 835	4 835	9 670	4 835	9 670	Irv-16; Irv-13	
58	Blackrock Brae	23 932	23 932	47 864	23 932	47 864	Irv-16; Irv-13	
59	Blackrock Wood	41 206	41 206	82 412	41 206	82 412	Irv-16; Irv-13	
60	Blackrock Corner	1 300	1 300	2 600	1 300	2 600	Irv-16	
61	Assynt Hill	247 666	247 666	495 332	247 666	495 332	Irv-13, 16; Irv-9	
62	Inchochclair	40 236	40 236	80 472	40 236	80 472	Irv-13, 16	
63	Cottage Wood	3 794	3 794	7 588	3 794	7 588	Irv-16	
64	Blarvorich	10 000	42 501	52 501	10 000	52 501	Irv-7, 11, 12	
TOTALS		867 563	55 142	1813 932	5 957	488 794	565 537	309 785



REFERENCE TO COLOURING

- OLD CONIFERS
- YOUNG CONIFERS
- HARDWOODS
- UNSTOCKED
- EXCLUDED

The Contour Lines of Altitude are shown in Colour thus

20 ACRES
10 ACRES
5 ACRES

Scale 5 inches to 1 mile

