

AFFORESTATION IN SCOTLAND

FOREST SURVEY OF GLEN MOR

AND A CONSIDERATION OF

Certain Problems arising therefrom

1911

BY

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AND

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EDINBURGH

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PREFACE.

IN publishing this Report, the Council of the Royal Scottish Arboricultural Society desires to convey its best thanks to Lord Lovat and Captain Stirling of Keir, and to all those who have assisted them, for the time and labour ungrudgingly given to its preparation.

This Survey is the first serious attempt to grapple with the economic difficulties which confront afforestation in that part of Great Britain where the largest extent of plantable land—that is to say, land sufficiently good and sufficiently cheap—is to be found. It would have been easy to select an area where most of these difficulties would have been avoided, and to create a forest under ideal silvicultural conditions within a ring fence. Such areas do exist, and no one will deny that they have the first claim on afforestation. But if silviculture is to become a leading industry in the Highlands of this country, as it is in those of France, Belgium and Germany, and to be an important source of national wealth and national employment, as it is in those countries, it must invade the wintering of the high sheep farms and deer forests which occupy the bulk of northern Scotland. The writers have therefore, at the request of the Council, deliberately set themselves to face the difficulties which have there to be met.

The Council cannot adopt every opinion contained in a document which raises so many new and complicated questions, but it desires to express its unreserved approval of the general method followed in this Survey, and to endorse the opinion of the writers that a Survey should aim rather at ascertaining the most favourable forest centres than at recording the number of acres fit to plant. The Council desires once more to state its conviction, which is confirmed by every page of this Report, that a general Survey of Scotland for this purpose is an urgent national need which it is the duty of the Government to meet at once.

The Council believes that the Report establishes the following propositions :—

1. That it is possible to create forests in the Highlands, even in districts where the economic conditions appear most adverse, without seriously impairing existing sources of wealth.
2. That afforested areas will, even in the early stages of the movement, gain greatly in employment and population.
3. That the actual work of planting can and ought to be cautiously begun as soon as the progress of the Survey justifies the selection of definite areas.

The Council does not underrate the necessity for forest education, and most heartily welcomes the steps which the Government is now preparing to take in that direction; but it believes that there will be a great waste of time and public money if the Survey and the first comparatively simple stages of afforestation are delayed until the educational machine has turned out a new race of experts.

The cost of printing this Report and certain out-of-pocket expenses have been defrayed by the Royal Scottish Arboricultural Society, but otherwise the undertaking has been from beginning to end a labour of love. It is impossible to enumerate all those who have assisted Lord Lovat and Captain Stirling in its preparation and revision, but the thanks of the Council are specially due to Dr Nisbet, Dr Borthwick, Mr Dawson, Mr Stebbing, Mr Munro Ferguson, Lochiel, Captain Ellice, The Countess of Seafield, Colonel Baillie, Mr Bailey of Invergloy, Mr Grant of Glenmoriston, Mr Gilbert Brown, Mr Mackenzie, Mr Garrioch and Mr Galloway.

The following members of the Council, and others, recorded valuable suggestions on the proofs :—Mr J. F. Annand, Dr Borthwick, Sir K. J. Mackenzie, Mr J. D. Crozier, Captain Ellice, Right Hon. R. C. Munro Ferguson, Mr Robert Forbes, Mr Galloway, Mr Gammell, Mr A. T. Gillanders, Mr G. U. Macdonald, Mr Frank Scott and Dr Somerville.

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Forest Survey of Glen Mor

AND

A CONSIDERATION OF CERTAIN PROBLEMS ARISING THEREFROM.

1911.

CHAPTER I.

INTRODUCTION.

A great deal of valuable evidence in matters relating to forestry has been printed in the various Reports of Royal Commissions and Departmental Committees in the course of the last twenty years. It is, however, a regrettable fact, and one which those who gave their services to the inquiries would be the first to admit, that no progress has been made in the task of collecting and recording the data required for an accurate estimate of—*(a)* the amount of land in the British Isles which is capable of being afforested, and *(b)* the proportion of such land on which forestry would not only pay but would justify itself as the best economic use to which the land could be put.

These two questions, or rather two aspects of a single question, lie at the root of the whole problem of afforestation, and until they are finally disposed of all schemes, however perfect in theory or carefully elaborated in detail, are of no practical value, based as they must be on purely hypothetical grounds.

In the absence of exact data, the estimates of the amount of land suitable for afforestation in Scotland given to and by the Commissions, have varied between very wide limits; while the second and more important aspect of the problem, its national economic side, has received very little attention, nor indeed could this be profitably considered until its first and simpler aspect had been removed from the region of doubt and conjecture.

To take one example only, the Report of the latest Forestry Commission, originally appointed to inquire into the question of Coast Erosion. This Commission undoubtedly added to the

general sum of knowledge on the possibilities of afforestation. Yet notwithstanding the excellent work done by its members and the interest it aroused in the country, the colossal schemes advocated in the Report have roused the fears of public bodies whose source of revenue, and of individuals whose means of living, were bound up in the present uses of the land indicated for wholesale afforestation. These fears were not unreasonable, and they might easily be converted into determined opposition towards any scheme of afforestation which is not founded on the recognition of the importance of the interests involved.

It is hoped that the following pages will tend to reassure those who regard afforestation in the abstract with distrust and alarm; and at the same time will show to those who are concerned with the scientific aspect of forestry alone, how existing rural industries are not necessarily incompatible with silviculture.

The aim of the writers throughout this Report has been to avoid abstractions and to give a concrete example, on a small scale, of methods which they believe are capable of application to larger areas.

Taking as the foundation of their proposals the existing economic values of a single district, they deal, as fully as space permits, with the various questions arising out of a local afforestation scheme;—to put it shortly, they aim at showing how much of the land in the district could be, and how much should be, afforested.

In addition to this example of a single forest area, which occupies by far the larger part of their Report, they have been obliged to enter into some brief discussion of principles of wider application. The very existence of a local scheme, as here set out, pre-supposes a general scheme of which the local scheme is designed to form a part, and from which, with regard to management, training, realisation of forest products, control, etc., it cannot be isolated even in imagination.

GENERAL.

A CENTRAL FOREST AUTHORITY: ITS FIRST DUTY.

In the opinion of the writers, the initiative in any scheme of afforestation must come from a Central Forest Authority

(see Appendix A) definitely constituted *ad hoc*, so composed as to command general confidence, and invested with such powers as may be found necessary to secure the carrying out in their entirety of plans which have been thoroughly considered and adopted after adequate preliminary local inquiry.

The writers consider that the first duty of the Central Forest Authority should be to ascertain, by means of a Survey, the facts on which an afforestation scheme could be founded.

This Survey should include :—

- (a) A broad general investigation of the silvicultural possibilities of Scotland as a whole.
- (b) A particular and detailed consideration of the whole economic conditions of certain selected forest centres, carefully chosen as suitable for silviculture, for the establishment of wood industries, and for the support of a permanent population.

The former, which is here called the "General" Survey, would indicate the localities in which individual forest centres might be established, rather than attempt to give the total number of isolated acres which would grow trees. The latter, and more important, here called the "Detailed" Survey, would not in any way depend on the completion of the whole of the General Survey, which would be used as a means by which proposed forest centres could be marked down for future detailed examination.

The physical and economic conditions of Scotland prevent any one scheme of afforestation from being applied to the country as a whole. Besides the differences in soil, climate, population, and systems of agriculture, between Highlands and Lowlands, and East and West coasts, there is a still stronger argument for local schemes as opposed to any one general scheme of afforestation. The land suitable for afforestation in Scotland occurs more in irregularly distributed patches than in continuous blocks. In the Highlands the suitable areas are separated by wide stretches of high, poor land; in the Lowlands the enclosed and cultivated country has the same effect of isolating the areas in which afforestation can take the leading place.

METHOD OF PROCEDURE.

When the General Survey indicates a *prima facie* case for the creation of a forest centre in any district, a Detailed Survey,

undertaken at the instance of the Central Forest Authority, and following some such lines as are indicated below, will be the next step towards the formulation of a local scheme. The heads of such an inquiry would be—

1. A detailed survey of the ground with regard to its capacity for growing a crop of trees.
2. Thorough consideration of all the existing economic factors, and the extent to which they would be modified by afforestation.
3. Recommendations as to the extent of ground which could be planted with due regard to both of the above.
4. Recommendations as to what parts of the area are proposed to be—
 - (a) Purchased by the Forest Authority.
 - (b) Leased by the Forest Authority.
 - (c) Planted in co-partnership with the landowner.
 - (d) Planted by loan to the landowner.
 - (e) Planted by the landowner at his own expense, under supervision.
5. Recommendations on points affecting the working-plan—
 - (a) Position of the local centre, including nursery, sawmills, etc.
 - (b) Holdings for workers.
 - (c) Proposed method for dealing with—
 - (1) Sheep farms.
 - (2) Deer forests.
 - (3) Grouse shootings.
 - (d) Compensation under the above headings.
 - (e) Purchase and treatment of existing wood crops.
 - (f) Utilisation of the prospective timber crop.
6. Sketch of working-plan.

With the findings of the local Inquiry Committee in their hands, the Central Authority would consider the pros and cons, if necessary listen to evidence for and against its recommendations, and decide whether or not a case had been made out for the creation of a forest centre.

By this method of procedure a thorough investigation of the facts would be ensured, and a full opportunity would be given to the opponents of afforestation, as well as to

its advocates, to bring forward their arguments, first, before the local Inquiry Committee, and afterwards, before the Central Forest Authority.¹

SURVEY OF GLEN MOR.

The Report here submitted presents the concrete example of a single Highland district exactly as it would be dealt with in the General and the Detailed Surveys under a scheme of afforestation.

It reviews the district's interests, its population or lack of population, its burdens, its systems of agriculture, and the existing opportunities for employment of labour.

It shows how, under a properly constituted Central Authority, the plantable area could be afforested to the greatest economic advantage; and the benefits which would arise from a continuous scheme of management, and from operations conducted under a thoroughly considered working-plan. It reviews the employment that could be given in the improvement and utilisation of the existing woods, and in the creation and management of new plantations, and it shows the various tenures under which a permanent population could be fixed on the soil.

After careful consideration, it has been decided to leave the question of the ownership of the land outside the body of the Report. Experience in other development schemes has shown that this subject is so absorbing as to distract discussion from the particular object on which it is wished to focus attention. As regards the various forms of ownership of land with which the Forest Authority would have to deal in any general scheme of afforestation, the opinion of the writers will be found in Appendix B.

AREA SELECTED.

Glen Mor, through which the Caledonian Canal runs, has been selected for the first Survey for the following reasons:—

- (a) It has the general approval of the Royal Scottish Arboricultural Society, eighty of whose members visited it in June 1910.

¹ For the question of appeal against the decisions of the Central Forest Authority, *vide* Appendix C.

- (b) It contains 60,000 acres of *immediately* plantable ground, without including land more than 8 miles from the main glen.¹
- (c) It presents both East coast and West coast conditions of population, climate and soil.
- (d) It is a particularly suitable area for the creation of small holdings, owing to the low elevation of the main glen, and to the considerable extent of the arable land on some of the sheep farms.
- (e) It contains tracts of natural woodland and of planted woods, and it therefore gives an opportunity of checking by actual results the calculation of crops obtainable.
- (f) It contains sheep farms, agricultural farms, crofts, common grazings, deer forests and grouse moors, and therefore gives an opportunity of dealing with all the possible economic difficulties which can arise.
- (g) The Caledonian Canal makes it possible to bring to a central depôt the forest products of the whole area, thus showing the advantages that would be gained by undertaking forest operations on a large scale, with the accompanying concentration of manufactures and subsidiary industries.
- (h) The proprietors are friendly to forestry, themselves plant on a considerable scale, and have helped this inquiry in every way in their power.

The amount of land in Glen Mor indicated by the General Survey as being at present plantable is 60,300 acres (see Map No. 1). This figure has been arrived at by taking an upper limit of 800 feet² above sea-level, except in certain sheltered hollows where the upper limit is higher; and by deducting from the total area below these limits all arable land, crofts, and common grazings, as well as any small patches suitable for the creation of new holdings, and ground which is incapable of growing a

¹ In calculating the plantable area, only that has been included on which the configuration of the ground and the existing woods indicate satisfactory silvicultural conditions. As the afforestation of a glen proceeds, however, the woodlands will gradually creep higher and higher up the hills, and the plantable area will, in consequence, become extended.

² *Vide* Chapter IX.

profitable crop of trees, including sour, undrainable land and rocky places.

This afforestable area of 60,300 acres divides itself naturally into five blocks of unequal size, which are distinguished by capital letters on the map; and they may be further described by the names of the centres round which they are respectively grouped:—

- A Dores.
- B Fort Augustus.
- C Glen Urquhart.
- D Invergarry.
- E Gairloch.

Of these, the Fort Augustus Block has been chosen for the purpose of illustrating the procedure under the Detailed Survey (see Maps Nos. 2 and 3).

In making this inquiry, every effort has been made to arrive at accurate figures, the services of experts having been obtained for each branch into which it has naturally divided itself. Full use has been made of local experience, and, as far as possible, each decision or recommendation has been referred to men who have actual local knowledge of the soil.

The extent of the plantable area (see Map No. 2, and Chapter VIII.) has been surveyed by Mr Brown, woods manager to Lady Seafield, and Mr Mackenzie, head forester to Mr Munro Ferguson of Novar, aided by foresters of great local experience, such as Mr Noble, Mr M'Lean, Mr Coupar, Mr Anderson and others. Problems connected with deer forests have been submitted to Lochiel, Mr Grant of Glen Moriston, Major Fraser Tytler of Aldourie, Mr Baillie of Dochfour and Mr Angelo, and the opinions of experienced deer stalkers have also been obtained. Questions connected with sheep farms have been considered from the points of view of the employment afforded, the present and former rents, etc.; while the difficult question of grazing values has been calculated both on present rents and on the rents of similarly situated lands in the neighbourhood.

The rating question, as affecting the County Council Districts and the various parishes concerned, has been discussed with the principal rating authorities, and the technical questions of working-plans, creation of nurseries, timber manufactures, forest roads, thinnings, crops, rotation, planting, fencing, etc., have been submitted to men who have wide experience both of

theoretical principles and of practice. Mr Dawson, the lecturer on forestry at the University of Aberdeen, working on general lines laid down by the writers, has been kind enough to deal with the working-plan (see Chapter IX.). From his extensive knowledge of the district, and his experience of East Highland conditions generally, it will probably be agreed that no better authority could be consulted.

Dr Nisbet has given most effective aid both in the shaping of the Report and the treatment of the chapter on Utilisation of Existing Woodland Produce (see Chapter X.). Apart from the position he occupies as a writer and exponent of silviculture, he speaks with great authority on West coast conditions and the handling of timber on a large scale.

The writers have also been so fortunate as to secure the co-operation of Mr Stebbing, who throughout the inquiry has given most valuable advice. Mr Borthwick has also been very helpful, both with suggestions and corrections of proof. Mr Galloway has given effective aid, at different stages of the Report, by his suggestive criticism and his legal and practical knowledge. Colonel Bailey, the Society's Hon. Editor, has materially assisted the writers in the drawing up of their Report, and in passing it through the Press.

[N.B.—When reading the Report, it must be borne in mind that the figures and other details set out in it are given for the Glen Mor area only, or for such part of that area as may be specially mentioned. They do not pretend to be of universal application in the Highlands, still less so for general use in Scotland as a whole.]

CHAPTER II.

LOCAL ECONOMICS.

WINTERING.

The wintering question—that is to say, how stock can be maintained on high-lying ground from early October to the middle of May—is the all-important question on which hill farming and, as will be shown later, silviculture in the Highlands depends. The narrowness of the glens, the steepness of the hillsides, the relatively small area capable of being planted, and the large extent of hinterland thrown out of gear by any interference with the small extent of wintering ground available, combine to make the problem a difficult one.

It is not easy to lay down any laws which are true of the wintering in all Highland districts. Broadly speaking, however, it is accurate to say that, with regard to sheep stock, the old ewes and wethers only can find a precarious existence on the lower slopes in winter; that hogs, and younger sheep generally, have to be moved sometimes for a distance of 200 miles to low-land feeding from October to April; that for cattle the higher grazings do not provide outside keep until the end of May; and that, in an average year, for weeks and frequently for months at a time, nothing except the fox and the ptarmigan can exist unhoused above the 1000-1200 feet level; while at these times even the grouse and the wild red deer leave the high ground for places where they can find food and shelter.

In bad years, and in certain districts in average seasons, deer have to be artificially fed in winter, the ewe stock has to be hayed at intervals, and Highland stirks have to be provided with shelter and food. It is not difficult to see that ground under 1200 feet—the only ground which can be planted, and the only ground which can maintain stock in winter—has not only a value of its own for feeding, but has an even greater value as the sole means by which the great expanse of high ground can be placed in a position to feed a summer stock.

This is the all-controlling law of management for all outside stock in the Highlands; and it is the absence of a clear understanding of this limiting force which has proved the destruction of so many otherwise excellent plans for the regeneration of the Highlands.

RATES.

In addition to wintering, the further question of rates has to be reckoned with. When we consider that rates in the Highlands are high, that in many districts industries are non-existent, and that sporting rents and sheep farms already pay more than half the rates, it will be realised that any interference with existing values must of necessity seriously affect the incidence of local taxation.

While it is probably true that the rateable value of a district would ultimately be increased by the establishment of a forest centre, yet the effect of afforestation on local taxation during the period of development requires most careful consideration. It is certain that a scheme, however sound silviculturally, which does not take due account of the present rateable values will, from the ratepayers' point of view, be both unsound and unfair. It is proposed, therefore, to begin with a particular examination of the incidence of local taxation, and the nature of the annual values on which it falls.

In the Glen Mor district, sheep farms, deer forests and shooting rents contribute 60 per cent. of the rates. To destroy these values, therefore, would more than double the rates on the remaining subjects.

In the parish of Boleskine the valuation of sheep farms, with deer forests and shootings is £7300 out of a total of £14,940; in Invermoriston and Glen Urquhart parishes, £9570 out of a total of £14,655; in Kilmonivaig parish, £13,200 out of a total of £20,060; in Glenelg parish, £5090 out of a total of £7970; and in the landward part of Kilmaillie parish, £9545 out of a total of £13,900.

The rates for owners and occupiers in the various parishes run from 4s. to 6s. in the £; and at Fort Augustus, in the centre of the forest area, the local rates, including special water and drainage rates, run to 7s. in the £. The population of the district depends entirely on agriculture and summer visitors—tourists and sporting tenants; and while there is plenty of work for all

in the summer and the early autumn months, there is practically no outside employment during the remainder of the year.

Glen Mor is a wide glen, and the proportion of low ground in the various sheep farms and deer forests is greater than is found on many of the narrower glens in the Highlands. Still, even here, the proportion of plantable ground to high ground which is suitable only for summer grazing for sheep or deer is not more than 1 to $4\frac{1}{2}$.

From the above it is evident that :

1. The district is a poor one.
2. Reckless planting of the wintering ground would mean—
 - (a) Great loss of rent ; and
 - (b) A very large increase of the rates to all inhabitants of the district.
3. The rates at present are high for a rural district.
4. With the exception of the Foyers Aluminium Works, local industries are conspicuous only by their absence.
5. Any large increase to the existing rates would act as a bar to the establishment of new industries.

It is possible to lay down certain general laws for treating this area :—

1. That no arable land should be planted.
 It would be necessary to take certain farm lands for the creation of small holdings ; but as arable land in the district carries an average of one family to every 15 acres, the population would be diminished rather than increased by taking any land away from under the plough.
2. That sheep ground and deer forests should be planted so as least to interfere with their existing uses and rental values.
3. That existing crofter grazing, which has a value to the inhabitants quite outside its intrinsic monetary worth, should not be included in the scheme.
4. That as the prosperity of the district largely depends, both from rents and employment, on the letting of houses to summer visitors, it is important that the amenity and therefore the letting value of such houses should not be interfered with.
5. That, especially for winter employment, full consideration should be given to the existing labouring and crofter population.

CHAPTER III.

DETAILED SURVEY OF THE FORT AUGUSTUS BLOCK.

PRELIMINARY.

It is necessary to commence this chapter by reminding our readers that the methods advocated for the treatment of sheep farms and deer forests are dictated by the exigencies of the situation and not by the silvicultural preference of the writers. The suggestions are based on practical experience and results visible in the area under review, not on silvicultural laws which, though admittedly sound in themselves, do not meet the economic difficulties described in the previous chapter.

The writers can only urge against those who advocate the purchase or lease of whole subjects, and the elimination of agricultural and sporting values inside the forest area, the certainty of increased initial cost, and the not less certain opposition of the rural inhabitants, due to the increase of rates and the destruction of existing means of employment.

If methods based on purely silvicultural considerations were adopted, the writers would be the first to admit that better silvicultural conditions would prevail; but it is probable that the actual cost of the land to the State would be trebled (see Chapter IV.), and it still remains to be proved (in view of the excellent results already obtained in Glen Mor) that, under the altered conditions, the net profit on the whole scheme would increase in proportion to the expense involved.

It might have been possible to choose an area where the whole estate or farm might be purchased and planted; but such districts are not common, and the writers have preferred to select an area where they could meet the economic difficulties, some of which will certainly have to be faced in the bulk of the

land suitable for afforestation, especially in the districts which stand most in need of development.

TREATMENT OF SHEEP FARMS.

The value of sheep ground in this portion of Glen Mor is not high. Even in the best days of sheep farming, on certain forests, sheep rents did not equal a fifth of the gross rental which the same land now gives under deer. The summer grazing on some parts of the higher stretches of the Monaliadh barely exceeds a penny per acre per annum. Corriesoulagach, 2600 acres in extent, fetches a rent of £13, while £25 is paid for another block of 4000 acres in the immediate neighbourhood. Even on the low ground, the rents for hill grazing, apart from the value of houses and arable land, are low. The rent of £230 for the farm of Aberchalder covers 100 acres of arable land, a £1200 house, extensive steadings, and some 9010 acres of hill ground.

The treatment advised for sheep farms differs from that advised for deer forests. The high ground of a sheep farm has its value both as a wether-hirsel and as grouse ground, even if the greater part of the low ground be taken away.

The treatment suggested for sheep farms in the Fort Augustus Block is to begin at one end of the wintering of one farm, as shown in Map No. 3, and to plant the whole of it before entering the next farm. The arable ground taken from the sheep farm will be occupied by the small holdings of the forest workers, and the farm houses will be used to accommodate the staff, or, perhaps, will be let to summer visitors, the high ground being let for a flying stock, *i.e.* for grazing from June to mid-September.

It is not to be taken for granted that this method of dealing with sheep farms is of universal application, even throughout the whole of Glen Mor. In the Fort Augustus Block the sheep grazing is indifferent, and the sum to be debited against afforestation, as the difference between the rents returned by a flying stock and by a permanent stock, is not a large one.

From this special treatment of a selected area, it must not be supposed that planting is necessarily wholly incompatible with sheep farming. Certain rich grazing lands on the borders, which let at a rent of nearly 5s. per acre per annum, are, no doubt, for some time at all events, rightly to be

regarded as too valuable for afforestation; and there are also great stretches of high hill sheep farms which, in view of the more suitable subjects obtainable elsewhere, are too bleak and exposed to be worth experimenting upon.

There are, however, throughout the length and breadth of Scotland, tracts of what might be called "average sheep land," rented at from 9d. to 2s. per acre, which could be planted with advantage on a method exactly the same as that advised for deer forests, viz., one-third of the wintering to be afforested, and no further ground to be taken from the farm until after the ewe stock had been allowed to winter once again in the planted area.

Sufficient data are available to establish the value of the grazing in woods, especially larch woods. On three of the large estates in Glen Mor sheep are allowed into the opener woods; and in the great plantations of Lady Seafield, in the high Grantown district, sheep are regularly allowed access to all woods after the trees have reached seventeen or eighteen years of age.

Dr Nisbet, in his standard work on British Forestry, quotes land under larch, on the Castlerigg estate, Northumberland, let at the rate of 5s. per acre per annum for grazing; and Lochiel habitually winters weak ewes in his larch woods at Achnacarry with satisfactory results. While the writers wish to point out that there is a considerable value in the winter grazing of larch woods, especially in the northern districts of Scotland, where shelter constitutes such an important factor in the care of stock, they do not argue for a moment either that, by planting conifers, moderate sheep ground in Glen Mor will be raised to the value of the good sheep ground of Northumberland, or that, after taking away a third of the wintering, the value of the subjects will ever exceed two-thirds of their original value.

The preceding considerations make it clear that the Forest Authority should approach the sheep-farming problems with caution, and should be aided by the best expert advice. Taking over sheep stock at a valuation is a costly proceeding, and an "acclimatised stock," once abolished, can only be replaced after many years of labour and at no inconsiderable expense. Sheep farms in many districts pay a considerable portion of the rates, provide an appreciable percentage of the local employment, and afford a means of extracting a return, even if it be a small one, from otherwise wholly barren hill ground. It is to the economic interest of the country generally that such a well-established

industry should be interfered with as little as silvicultural demands permit.

TREATMENT OF DEER FORESTS.

The treatment of deer forests must depend largely on the extent of the wintering and on its relation to the high unplantable ground. Broadly speaking, in the Glen Mor district, the value of a stag killed represents £25 to £30, and a brace of grouse represents one sovereign. Average deer ground is worth 1s. to 3s. an acre; grouse ground is worth 1s. to 1s. 6d.; sheep summer grazing 1d. to 3d. per acre. In certain cases it might be found advisable to plant the whole of the wintering of deer forests straight away; to place the high ground under a flying stock of sheep; and to charge the difference between the sporting value of the deer forest and the rent arrived at by summer grazing plus grouse, against the woods. It is economically sound to do this only in deer forests where the extent of the wintering is large, and where the values from sheep and grouse would be considerable.

In the Fort Augustus Block (15,000 acres of plantable ground) the average aggregate rent received from deer forests is £5300, while, judging by old rentals and present rents of similarly situated ground, the rents that could be obtained for the summer grazing of sheep on the high ground, after the wintering had been withdrawn, would not exceed £500. In addition to the grazing rent, grouse to the value of £1000 are shot on this area, making a total of £1500 a year. This yield from grouse might conceivably be increased by 50 per cent., but even so the reduction of the annual rent by £3300 would be too high a charge to put to the debit of 15,000 acres of afforested land; and under such circumstances afforestation would prove a misfortune, rather than a gain, to the ratepayers of the district. It is therefore evident that a method must be devised by which the value of deer forests will be maintained at its highest, as far as is consistent with a fair standard of silviculture.

The following method is suggested as adapted to the special circumstances of the Fort Augustus Block:—

1. To divide the wintering ground of each individual deer forest into three portions, each portion to be planted separately, and not more than one portion to be closed from deer at one time.

2. To choose the first portion of each deer forest to be planted with reference to :
 - (a) Its superior compactness and consequent facility for fencing ;
 - (b) Its superior capacity for rapid tree-growth.
 - (c) Its causing the least possible interference with the wintering of deer ;—
 the object aimed at being the rapid planting of a third of the wintering, in order to allow of the admission of deer in the shortest possible time.
3. To make no further plantation in the deer forest until fifteen years have elapsed from the last year of planting in the first portion, when the whole of that area, amounting to one-third of the total wintering of the forest (less any small patches which had not grown satisfactorily) should be thrown open to the deer.
4. To commence to plant the second portion of the wintering immediately after throwing open the first portion, and to plant the remainder of the forest wintering according to the rotation laid down.
5. As soon as the area of new planting has deprived the deer of nearly one-third of the total wintering of the forest, to cultivate whins and cut bracken so as to maintain the winter food of the deer.

It is believed that this treatment of the deer forests would never lessen the value of the ground for sporting purposes by more than a third, and that, provided winter feeding were resorted to, a certain amount even of this loss might be avoided.

It is, of course, impossible to foresee the trend of fashion, but we may safely predict certain facts about the future of the sport :—

1. That with extended afforestation the size and weight of the deer will eventually increase.
2. That while the total yield of deer forests will be reduced by a third, more deer in proportion will be killed on the low ground and fewer on the "high tops," especially in the earlier part of the season.
3. That there will be sudden apparitions of big unknown twelve pointers, once the season comes round for the stags to join the hinds.

but experience has shown that, except in small, isolated woods, the damage is apt to be confined to a very few trees. The admission of deer and grazing stock into German and French forests is a recognised practice; but while, abroad, deer are *actually fenced into the woods*, in Scotland they will have the whole of the high ground to resort to, coming into the woods only at times of storm and snow. The greatest amount of damage is done to trees immediately around the open spaces to which the deer resort, but there the individual trees can quite inexpensively be protected. In dense young woods the damage done is small.

Communal rights of grazing are often exercised in continental forests from the very earliest years of the re-stocking of felled areas, and considerable damage is then done to the young crops; but under the scheme here proposed, a period of enclosure from grazing by stock or deer is provided.

The exact age at which it may be possible to admit sheep or deer into woods is a matter upon which there are very divergent views,—founded on experience of very diverse conditions. By limiting the elevation above sea-level in the first block to not more than 800 feet; by adopting the Belgian method of planting on turf in peaty ground; by carefully draining wet ground; and perhaps by the substitution of Menzies spruce for the Norwegian species, it should be possible to admit deer to plantations between the fifteenth and twentieth years. No doubt there are many who can give examples where plantations twenty-five, thirty and thirty-five years old have been destroyed, and many such plantations have been examined by the writers. It will usually be found, however, that these plantations were on ground where no other woods existed, and were, for the most part, merely shelter-belts of a very few acres in extent. On the other hand, examples can be studied in Glen Mor at Glen Moriston, Dell, Invergarry, and Loch Unagan, where deer have been admitted into plantations before the fifteenth year without much damage being done.

Instances can be given in other parts of Scotland where the wintering capability of a forest has been greatly increased by a very few hundred acres of planting; and the well-known examples of the Boblainy and Farley deer forests which, with 6000 acres of wood and 4000 acres of hill ground, annually yield fifty stags, show the value for deer of old mixed woods. But it must

not be assumed that similar results would be obtained from woods growing under a regular rotation, with gradations of ages ; the woods mentioned are all over forty-five years of age, and are for the most part of an open character.

The under-planting question is a more important one. In this particular district, where the wintering of sheep and deer is a primary consideration, the possibility of under-planting larch must be abandoned from the first. It must be pointed out, on the other hand, that at Glen Urquhart, Invermoriston, Invergarry and Achnacarry, larch woods are grown without under-planting, without disease, and, in the case of Achnacarry and Aldourie, carrying a crop sixty years of age, which, after a heavy thinning, is worth over £150 an acre.

SHOOTINGS: MOOR AND LOW GROUND.

The extent to which moor and low ground shootings will be affected by afforestation must be considered ; for the sporting value, and therefore the rent, will be modified by the new conditions. In the case of sheep farms there is usually a separate shooting rent, while the shootings are included in the rent of the deer forest.

1. *Grouse*.—It is not probable that afforestation will reduce the letting value of grouse shootings to any great extent, for the following reasons :—

- (1) The best grouse moors, which, in other districts, may be rented up to 5s. an acre, are too valuable to plant.
- (2) As a rule good grouse ground is not good for planting, and therefore, in the case of the less excellent grouse moors and shootings, which are partly deer forest and partly grouse moor, the part of the shooting which produces most grouse would remain unplanted.
- (3) The ground most suitable for planting, at present often covered with bracken and birch trees, is of very little value as breeding ground for grouse.

In the cases, which the writers believe would be rare, in which good grouse ground would be taken for planting purposes, compensation for loss of rental would obviously have to be given.

It is sometimes argued that large woods have an adverse effect upon the adjoining grouse moors. This is true only in

that large woods afford shelter to various kinds of vermin which are less easily destroyed in woods than in the open.

In the recent inquiry by the Grouse Disease Committee, the question of the value to grouse of shelter in plantations was thoroughly investigated. The Committee arrived at the conclusion that, on the whole, grouse benefited by the afforestation of the land fringing the grouse moor, provided that the vermin were destroyed. The Committee were of opinion that, both from young and from old plantations, grouse received an appreciable benefit in times of storm through feeding on the shoots and seeds of the long heather often found there, as well as through the shelter of the trees.

2. *Rabbits*.—The great amount of damage done by rabbits is now so generally recognised that few people will doubt the necessity for the condition that rabbits must be exterminated both in the plantations and on the ground adjoining them.

In deer forests no less than in sheep farms, the disappearance of rabbits brings nothing but gain. Where rabbit killing is neglected, the wintering suffers, and it will improve in proportion to the extent to which it had been eaten down and fouled by rabbits.

On grouse moors, rabbits are generally regarded as a nuisance ; and where they are numerous they do serious damage to young heather.

On the smaller shootings the case is different. Rabbits have a distinct sporting value on ground which may be of very little use for grouse or other game. Where the letting value of a shooting is reduced by the obligation to keep down the rabbits, compensation for the reduction may have to be allowed. On the other hand, the loss in sporting rent may be compensated for by the improvement of the pasture.

3. *Mountain hares*.—To avoid the great expense of fixing wire-netting to the fences between the plantations and the hill ground, the hares must be killed down. The absence of hares is a positive advantage to moors where grouse are shot over dogs, and it is certain that a heavy stock of hares does appreciable damage to young heather. It can hardly be said that the disappearance of hares will make a difference which can be expressed as a percentage of the shooting rent, except perhaps in the case of small shootings.

4. *Roe deer*.—The ordinary form of deer fencing will hardly

keep out roe deer; unless, therefore, some roe-proof fence can be found without increase of cost, it will be necessary to keep them down. In this case, again, though an occasional shot at a roe with a rifle may add to the pleasure of the shooting tenant, this cannot be considered as paid for in the rent; and owing to the great difficulty of extermination, and the distance which roe deer will travel to young plantations, it is probable that there will always be a certain number of these deer in the forest area, as there are in most of the forests in France and Germany.

5. *Black game*.—We feel a certain amount of reluctance in including black game among forest vermin. Unfortunately, it is the tendency of black game to increase rapidly where there are young plantations, and the damage done by them, usually at first confined to the Scots pine, is extended to other trees as the black game increase. Scots pine are stunted by constant destruction of the buds, larch are literally grazed down, and the only alternative to a loss of five to six years' growth is the very costly expedient of using much larger plants.

The present scheme will admit of neither alternative. When the damage done by black game becomes appreciable, they must be kept down. There are few shootings where the number of black game in the year's bag exceeds 5 per cent. of the total of winged game, and it is probable that a reduction of 5 per cent. in the letting value will cover the loss in most cases.¹

6. *Woodcock, etc.*—So much for the interference by afforestation with shootings as they now are. But there is another side to the question. A probable result of afforestation will be an increase in the number of woodcock frequenting Glen Mor, and this may improve the winter shooting. Also, as planting goes on, the capercailzie, a newcomer already known in the district, will extend its range and increase; and provided that the damage done by it does not prove serious, it may come to be a recognised addition to the sport in the woods.²

General remarks.—On the whole, it may be said that the changes due to afforestation will affect the letting value of the smaller mixed shootings, where the various items are of relatively great importance, in a much greater degree

¹ Cases have been brought to the notice of the writers in which a larger reduction than 5 per cent. would be justifiable.

² It is recognised that serious damage may sometimes be done to older woods by capercailzie.

than it will affect that of shootings where grouse form the main part of the bag. It is at once admitted that a reduction up to 10 per cent. in the letting value might have to be allowed for in the case of small mixed shootings; but in the case of larger shootings it is believed that 5 per cent. or less would suffice.

The question of the killing of vermin injurious to game in the planted areas will require careful attention. Shooting tenants and farm tenants might come to regard the forest areas as breeding ground for foxes and other vermin, and if the killing down of vermin were neglected, the damage done to adjoining shootings would be great. It will therefore be necessary to make the permanent staff of the forest responsible for the destruction of vermin on the ground under their charge, and for the forest officers to make it their business to ascertain that there is no cause for complaint under this head by shooting tenants.

CHAPTER IV.

RENT AND OTHER CHARGES.

RENT.

In calculating the rent of the ground that will be taken for forestry proper—that is to say, the ground that will actually be planted, not that which will be used for small holdings for workers, etc.—it is necessary to emphasise certain points.

If the method advocated for the Fort Augustus Block be followed, it will be seen that the whole plantable area of the deer forests will be obtained for afforestation at a cost of one-third of the gross annual rent; and that, provided always that no more than 33 per cent. of the total wintering is ever enclosed from deer at any given time, the whole of the land capable of afforestation will be planted and replanted without any increase of rent.

On sheep ground and on grouse ground, the loss in grazing value, charged to forests, will be represented by the difference between the rent obtained from a permanent sheep stock and that from a flying or summer stock, while the difference in shooting rents will be based on the principles laid down in the previous chapter.

Put into concrete form, it will be seen that the rent of the Fort Augustus Block will work out roughly as follows:—

Deer Forests:

Invermoriston (part of),
Dundreggan,
Levishy,
Port Clare,
Inchnacardoch,
Glendoe (part of).
Culachy,

Total value, . . . £5300

Annual cost to Forest Authority in rent,
 —one-third of £5300, . . . say £1770

Sheep Farms and Grazings, including difference
 between ewe stock and flying stock, sport-
 ing rents, and allowance for grouse taken
 over, on

Parts of—Aberchalder,
 „ Ardochy,
 „ Auchteraw,
 „ Borlum.

Annual rent chargeable to Forest Authority, . say £ 600

Total £2370

Less Deductions for arable land and common
 grazings on which will be settled forest
 workers who will pay rent for the said
 land, on

Auchteraw,
 Borlum,
 Aberchalder,
 Glenmoriston,

And certain improvable land on sheep
 farms and deer forests.

Total value deducted, say, . £ 300

Net rent chargeable to forestry proper £2070

That is to say, roughly, 18,000 acres (of which 15,000 acres fall within the Fort Augustus Block) will be obtained at a rental of £2070 a year; or, in other words, for 2s. 3½d. per acre, the Forest Authority will obtain a long lease over some of the best larch ground in Scotland—ground which the late Professor Mayr of Munich, and other authorities, have declared to be the best planting ground in Europe.

The German authorities have purchased land up to £15 an acre to round off a forest block. Up to 115s. an acre for waste land has recently been paid by them for land inferior to that in Glen Mor; while they have given an average of 66s. per acre for heath land which would compare unfavourably with the second grade land in the surveyed area.

In addition to the annual rent paid for loss of purely grazing

and sporting values, the Forest Authority will have to make further payments under two heads, viz. :—

1. The usual compensation for sheep valuations, including acclimatization value, tenants' waygoings, etc., as set out in Appendix C. On the Fort Augustus Block these would amount to some £3500 of capital expenditure, payable to the sitting tenants before entry into actual possession of the land could be given.

2. Payment for loss of land for natural birch crop and silvicultural purposes generally—a value quite outside that of sporting rents.

The reader will observe that up to this point there has been no mention of any payment to the landowner, other than bare compensation for the actual loss of rent which he will incur through the afforestation of his wintering.

As will be seen from Messrs Brown and Mackenzie's report, the silvicultural value of the land included in the forest area varies very considerably. And the compensation will also vary; but since it is governed by the wintering question, and is therefore to be reckoned on the loss of each subject as a whole, the compensation will not vary in the same ratio as the acreage or the quality of the soil. In other words, some of the bargains made by the Forest Authority will be better than others. None will be bad, or the Forest Authority would not make them, but some of them will be extremely good. The Forest Authority may, in some cases, pay as little as a shilling an acre for land which is capable for carrying £200 worth of larch after sixty years' growth. It may, in some cases, take land which brings in a gross return of £10 to £15 an acre for birch crop every fifty years; while, in other cases, it may include sour land on which little besides bog myrtle and scrub will grow.¹

It is evident that some payment must be made under this head, but, on the grounds both of equity and expediency, the

¹ In the Glen Mor district, the various estates either market their birch crop at irregular intervals, when it becomes ripe, or combine together to put a regular annual supply on to the market. The money got for the sale of birch-wood and birch-brooms is, as a rule, re-invested on the estate in the form of plantations, with the result that a portion of the plantable land is gradually, though slowly, being afforested. Some 14,000 acres out of 60,000 acres available in the Glen Mor area are now under coniferous woods.

writers have no hesitation in recommending that this payment should be a deferred one. It is most advisable that the proprietor of the solum should have an interest in the ultimate profits from the woods. There must always be a certain amount of give and take in dealing with the often contending interests of sheep, deer and woods; and it is certain that many expenses would be avoided, and many differences adjusted, by some understanding between the principals working with one common object in view, viz., a satisfactory ultimate return from the newly-planted ground.

A deferred payment will reward the landlord who has given up the best soil, and who has worked in the forest's interests during the growth of the crop; while the lesser return to the individual who has raised difficulties and failed to co-operate loyally, will be his diminished reward.

The payment should take the form of a percentage of the net profits after the whole expenditure by the Forest Authority has been repaid with reasonable interest. What the percentage of net profits should be, the writers do not attempt to decide; but what they do lay down is, that it should be sufficient both to secure strenuous co-operation on the part of the landlord, and to make the deal a fair one as between the Forest Authority and the various proprietors interested.

Summary.

The advantages which a Central Forest Authority with a limited income would gain by leasing forest land on the general lines indicated in the preceding pages may be summarised as follows:—

1. No large initial capital expenditure. (*N.B.*—Compensation to sitting tenants works out at a final payment of under 4s. an acre (£3500 on 18,000 acres).)
2. All the land in the district suitable for tree-growing obtained at one-third of the present rental of the subjects affected.
3. No superfluous land, and therefore no unnecessary administration expenses (the Forest Authority would deal with silvicultural interests, and with silvicultural interests only).

4. Zealous co-operation between the owner of the land and the grower of the trees.
5. A minimum disturbance of existing rates, rents and employment.

It should be noted that in the scheme of afforestation set out above, the writers have made the suggestion that the State should pay a rent based on a proportion only, namely one-third, of the subject which it means to use at one time; whereas in the case of lease or purchase of a whole subject, the State would be called on to pay three times the rent, or three times the capital value, which it has to pay under the scheme which is proposed. This may be illustrated by the example of a typical deer forest, 15,000 acres in extent, of which 3000 acres are plantable (under 800 to 1100 feet) with a rent of £1000. The same principle will apply also to sheep farms, with the necessary alterations in the figures:—

- (a) If the whole subject be bought by the State, at, say, the low valuation of 20 years' purchase, 3000 acres of plantable ground will be obtained for £20,000, and the capital required will be at the rate of £6, 13s. 4d. per acre of plantable ground.
- (b) If the whole subject be leased by the State, 3000 acres of plantable land will cost £1000 per annum, or at the rate of 6s. 8d. per acre.
- (c) If the plantable land be leased on the terms described in this chapter, 3000 acres of plantable ground will cost £333, 6s. 8d. per annum, or at the rate of 2s. 2 $\frac{2}{3}$ d. per acre.

Where the State purchases or leases the whole of a sporting or grazing estate, the same procedure as regards planting might be followed, seeing that the same interests have to be safeguarded and the same extravagances avoided. Otherwise, in the case of *a* and *b*, there remain 12,000 acres of high ground, cut off from the low ground which is used solely for silviculture and on which no grazing is allowed. For this land a rent could be obtained as grouse moor, if the hills were covered with heather; but if it were green ground, there would be practically no value for deer, as there is no wintering. There might be a rent of 1d. to 3d. per acre as summer grazing for sheep, but in the absence of low ground under sheep in the neighbourhood of the forest centre, even this return would be doubtful.

RATES.

It is not easy to deal, in a few lines, with the rating question as affecting afforestation, and in view of the frequently reiterated promise by successive Governments to take up the whole question of local taxation, it would appear inadvisable to go into the matter at any length in the course of this Report. It is necessary, however, to point out that the rating question—of considerable importance all over the British Isles—appears in a specially acute form in the Northern and Western Highlands, where a not inconsiderable portion of the plantable area and waste land is situated. In the majority of cases, the parishes in the Northern and Western Highlands are poor; assessable values are low; rates are above the normal for rural districts; and in many cases the situation is such that the expenditure of a very few tens of sovereigns, or the reduction of ratepaying subjects by a few hundred pounds, is followed by an appreciable increase of the rates.

Two aspects only of the rating question will be dealt with by the writers:—(1) The probable effects the afforestation proposals would have on the rates; and (2) the degree in which the inequality of the rates in the different districts of the Highlands would limit the advantages which afforestation might bring to the poorer parishes unless remedial action were taken.

The question of valuation for rating purposes presents difficulties, chiefly because woodlands are at present valued at the rent at which they might, in their natural state, reasonably be expected to let, from year to year, as pasture or grazing lands; and a lease of woodlands in the sense of the present proposals has hitherto been unknown in Scotland. This valuation will be set aside when a proprietor and a tenant agree upon a rent and enter into a formal lease of woodlands, because the rent in the lease must be taken as the basis for fixing the value of the woodlands, as of other subjects, for rating purposes. In the case of leases of less duration than twenty-one years, the actual rent or other consideration stipulated for in the lease must appear in the Valuation Roll. But in the case of leases of longer duration, the Assessor has power (see Sect. 6 of the Valuation Act of 1854) to set aside the rent entered in the lease, and to value the subjects at what he considers to be their fair annual value; this provision being evidently based on the assumption that the rent accepted for

such a long period is fixed at an amount which is less than the actual annual value of the subjects, in order to allow the tenant to develop the subjects at his own cost and for his own ultimate profit. In such a case, the Assessor usually endeavours, and he frequently succeeds in this, to fix a higher rent for rating purposes than that which appears in the lease. In such a case also, the tenant is entered in the Valuation Roll as owner of the subjects, and is liable, in the first instance, for rates both as owner and occupier ; but the landlord, being the real owner, must repay to the tenant the owner's rates on the rent he receives under the lease. Although there appears to be no doubt that the tenant has this right of relief against the real owner (see the Act above quoted), it might be well that the lease should set out the respective liabilities of landlord and tenant as regards rates.

It will thus be seen that by leasing the subjects as proposed, at a higher rent than the present value of woodlands for rating purposes, the Forest Authority would certainly render itself liable not only in *occupiers' rates* on the actual rent paid, and perhaps on a higher rent fixed by the Assessor, but also in *owners' rates* on the difference between the actual rent and any higher rent which the Assessor might succeed in fixing.

The effect of these proposals, so far as they affect the gross rental and the rateable value of the different subjects of which a part or the whole has been taken over by the Forest Authority, may be summarised as follows :—

- (a) *Sheep Farms*.—(1) When the whole farm is taken for afforestation, the present rent will be paid by the Forest Authority, and the rateable value will remain as at present. (2) When the wintering only is taken, the rent to be paid by the Forest Authority will be calculated by deducting the value of the summer grazing of the remaining area from the present rent of the whole subject. And again the rateable value will remain unaltered.
- (b) *Deer Forests*.—One-third of the gross rental will be paid by the Forest Authority, and this may be taken as fair compensation for the right to enclose from deer one-third of the wintering at one time, and eventually to plant the whole of it. The remaining two-thirds of the gross rental will continue to be paid by the tenant of the deer forest, and the rateable value of the whole will therefore remain unchanged.

- (c) *Shootings*.—These will be dealt with on similar lines, the rent paid by the Forest Authority being liable to assessment, so as to leave the rateable value unchanged.
- (d) *Arable Land, Houses, Etc.*—The land taken for workmen's holdings would probably be let at a slightly reduced rent, and the tenures created being crofter tenures, the houses built on the holdings would not pay rates. The farm houses, with land attached, which would either be occupied by the forest officials or be let to summer visitors, would now be separately assessed in the Valuation Roll, and would go to make up any slight loss there might be on the land let to workmen.
- (e) *Water Power, Sawmills*.—These would be new rateable subjects on which the Forest Authority and the owners would pay rates.

Eventually, the rateable value of the district would increase with the increasing population and the consequent expansion of local trades and businesses not directly connected with forestry.

It must, however, be remembered that the increase of population of the labouring type would not, in the first instance, tend to lower the rates. It will be shown in the scheme that it is not intended to create anything but economically sound holdings, that is to say, holdings on which employment is assured, with sufficient ground for the maintenance of a family. The effect of afforestation on local taxation would be felt chiefly through the parish rates. Owing to the increase of population, the school rate would no doubt be higher, but the poor rate need not necessarily rise; the county and district rates, distributed as they would be over wider areas, would be less affected than the parish rates, though the expenditure on roads would tend to increase over the whole district, as a result of the increased traffic due to afforestation. So much for the rating question in the Glen Mor district.

There remains for discussion, however, the more important aspect of the general rating question. As has been shown by the 1898-1902 Royal Commission on the Incidence of Local Taxation, the *per capita* rateable value of Scottish parishes runs from £44 to 9s. per head of population, and the recent returns of rating show a variation of 3s. to 26s. in the £. Owing to the fact that the Forest Authority has to pay occupiers' rates on the *full* rent under the lease, whereas woodland not held

under lease is rated on its value as grazing land in its natural condition only; and that, under the Agricultural Rates Act, agricultural land is rated on three-eighths of its annual value; it is not difficult to see that the Forest Authority would be tempted to give the poorer parishes of the Highlands a very wide berth.

In a west-coast parish, with rates of 10s. in the £, a rent of £2000 would entail a total disbursement of £2500 (£2000 in rent, and £500 in occupiers' rates), and in many cases would turn what might be an economic success into a financial failure. £500 per annum in rates at 3 per cent. compound interest will amount in seventy years to £118,750. If the State were to purchase, it would also be liable for owners' rates, and this sum would therefore be doubled.

Some of the best land for planting on the west coast is situated in parishes in which the rates are abnormally high; but these parishes, from their very poverty, are the localities in which forestry would confer the greatest benefit. It would be more than unfortunate if, from this very trouble, they were to be ruled out of court.

Without entering into the political side of this question, it may be suggested that when a general scheme of afforestation is under consideration, the question of State aid for a fixed period of, say, fifty years, to districts in which a large extent of forest land is taken, should also be considered. The lines of the recommendations made by Lord Balfour of Burleigh in the 1902 Rating Report, referred to above, might be followed with advantage.

CHAPTER V.

WORKMEN'S DWELLINGS AND TENURE OF HOLDINGS.

Amount of Employment and Existing Labour Supply.

In considering the labour question, the Forest Authority would consider, first of all, the amount of employment that could be given to the existing population, and secondly, how the labour supply could be increased.

It is very difficult to estimate the amount of employment which the resident population would absorb.

In Glen Mor it is generally true to say that west of Fort Augustus very few horses can be obtained at any season, and labour is available during the winter months only. In the Eastern district the labour market is not so restricted, the glen is wider, the crofts are larger, and probably the horses now in the district would meet a considerable proportion of the forest demands.

In certain portions of the Fort Augustus Block very little able-bodied labour will be found; the hunger for employment has been more acute than the hunger for land. Year after year, with little or no work to be found in winter, the more progressive of the inhabitants have left their crofts and found their way to the towns. Many crofts, including some round Fort Augustus, have passed out of cultivation, the land being poor and the cost of hired labour excessive.

It is highly probable that the certainty of steady employment during the winter months would bring some of the able-bodied back to their old homes. The small five-acre croft, which of itself cannot possibly maintain a family, constitutes an attractive home if outside labour is assured in the neighbourhood. The crofter is essentially a "worker" (with land) and not an agriculturist; and the means thus afforded of making use of otherwise uneconomic holdings, constitutes one of the strongest arguments for the development of forestry in the glens where arable land occurs in small and widely-separated patches.

It is important to note that in the Glen Mor area, containing

60,000 acres of plantable ground, only 900 acres of old arable land are scheduled in the Highlands and Islands Report of 1892 as being land which can be profitably cultivated.

Even allowing—(a) that, with employment guaranteed, crofts can be “lotted” on smaller areas of arable land than were taken into account in the Commissioners’ Report, and can still constitute economic holdings; and (b) that through the shelter afforded by afforestation, the altitude at which crops can be grown to profit may eventually be raised; it is evident that the arable land available for forest workers in the Glen Mor area is strictly limited in extent.

No exact figure has been given as the proportion of the required forest labour which the present inhabitants of the Glen Mor district would provide, but, in Chapter VII., it is shown that the work of felling the existing woods and manipulating the timber should absorb the existing labour supply.

Method of Increasing the Labour Supply.

There are many different systems of land tenure under which the workers on afforested land might be settled on the soil. The system put forward below does not claim to be the best or the only solution of the problem, but rather to be one which is specially suited to Glen Mor, and, not improbably, to the whole Highland area.

It will be readily agreed—

1. That it is advisable to create a resident population whose interest—at all events for the first generation—will be chiefly connected with forestry.
2. That the families so established should have sufficient land to keep them in food, including milk, and to give them work during the short periods when they are not required for forest labour.
3. That the tenure should be of such a kind as to make them as soon as possible an independent community, tied by habit and interest, rather than by compulsion, to forest employment.
4. That the crofter class, accustomed to the rigours of the climate, with some knowledge of building and outdoor employment, and a considerable ability for farming under adverse circumstances, would be the class most suited for forest work.

5. That in this particular scheme of land settlement, the object aimed at should be to tap employment at the fountain head—that is to say, to prevent the existing rural dwellers from going into the towns, rather than to correct an evil which has already developed, and attempt to transfer town-bred men to the country.

Experience in Germany and elsewhere confirms the view that the small land-holder class provides the most satisfactory as well as the most economical body of forest workers.

Having decided on a crofter population, the next step is to decide—

1. The exact tenure of the land ;
2. The size of the croft ;
3. The number of weeks' employment it is necessary to offer in addition to ordinary crofting work ; and
4. The number of men that the Glen Mor scheme will provide with certain and sufficient labour.

Houses and the Tenure of Land.

It is suggested that in all cases the building of the dwelling-house should be financed by the Forest Authority. That the forest worker should be allowed either (1) To pay for his dwelling-house rent based on a 3 per cent. charge on the total outlay by the Forest Authority ; or (2) That, if he wished to become an independent holder, he should be entitled to pay capital and interest for his house and land at the rate of 5 per cent.—that is to say, 3 per cent. on the cost of the house and 2 per cent. to a Sinking Fund. That during the time that the forest worker is paying off his debt on the house he should be a servant of the Forest Authority, dismissable on a year's notice. That in case of dismissal the portion of the Sinking Fund, less any claims there might be against him, should be returned to him, but that the interest on the cost of the house should be regarded as a rent charge. The object of this method of tenure is to have some hold over the worker during the early, or what might be called the training period. Once he had paid for the house by the instalments indicated, at the end of thirty years (or by agreement sooner), it might be presumed that the habit of working in the woods would have been established in him, and the woodman should

then be given full crofter rights, with fixity of tenure, or with an option of occupying ownership, if he should so desire.

Offices.

With regard to buildings other than dwelling-houses—that is barn, byre, etc.,—the forest worker should, after a period of satisfactory service, have an advance of not more than a third to a half of the cost of the building material for the same: this to be paid off on the same lines as the other capital and interest charges for the house. The object of not giving the forest worker the whole of his expenses for his farm buildings is to oblige him to retain an interest in the holding, and by such means to induce him to settle down on the land.

Type of the Croft and Buildings.

The area of the croft should at least be sufficient to maintain one or two cows, but not large enough to free the crofter from dependence on work in the woods, the object being to create a small holder rather than a small farmer. The type of croft would be what is known in the Highlands as a £3-£5 croft, some five to twelve acres in extent, with outrun or common grazing. In addition to the blocks of crofts created on arable land, there would be a few isolated crofts for outworkers on improvable land in deer forests and sheep farms; these would, as a rule,—especially in the steeper glens, on account of the small amount of improvable land to be found there—be more of the nature of potato plots than crofts; rent and the charge for the dwelling-house would be reduced accordingly.¹

In the first instance, at all events, it is advisable that all the crofts should not be of the same size; thirty per cent. of them should be large enough to maintain a horse as well as a couple of cows. The system of joint working of crofts is well understood in the Highlands, especially in those townships

¹ The amount of arable, old arable and improvable land in the average Highland glen is not extensive, and if it is desired to give a large percentage of the forest workers “the keep of a cow,” the most rigid economy in land must be observed from the first. It must be remembered that on the whole deer forest area of Scotland only 2482 acres of old arable were scheduled by the Highlands and Islands Commissioners as suitable for cultivation by crofters and small farmers; and that even if 30 per cent. of increase, since the time of the report, is allowed for the extension of deer forest ground, the arable land is wholly inadequate for the workers that a Forest Authority might wish to settle on the land.

where crofts are small, and where only a few of the crofters keep horses.

Plans of Buildings.

Plans of houses with suitable byre and barns are given, with a rough estimate of their cost based on practical experience in the neighbourhood. It will be noted that the houses are of three types—(a) Substantial single crofter houses; (b) similar houses placed two together to save a gable; or (c) a cheaper kind of house with galvanised iron roof and no second storey. The cost of these buildings is based on the assumption that either the crofter does the collecting and carting of stones, or that, if he has not a horse, he gives his labour free. If he provides neither horse and cart nor his own labour in collecting building material, in the one case £30, in the other £20, must be added to the cost of the building.

The rents of houses and crofts of the three classes of forest workers would probably work out roughly as follows :—

CLASS A.—*Crofter with a horse, some stock and sheep for common grazing :*

£150 house, of which, say, £110 ¹ is outlay by the Forest Authority ; at 3 per cent. interest and 2 per cent. Sinking Fund, say	£5	10	0
Loan for material for barn and byre, say £50	2	10	0
A 12-acre croft with one share of common grazing, say	5	0	0
	<u>£13</u>	<u>0</u>	<u>0</u>

CLASS B.—*Crofter with no horse, two cows, no other stock :*

Double house £240, or £120 for each house, of which, say, £90 is outlay by the Forest Authority. At 3 per cent. and Loan for material for barn and byre, say £30; total outlay by the Forest Authority, £90 + £30 = £120 at 3 per cent.	£3	12	0
Rent of croft (5 acres), say	2	10	0
	<u>£6</u>	<u>2</u>	<u>0</u>

¹ It is to the interest of the crofter to keep the capital expenditure on his dwelling-house low, as his rent is to a great extent based on the cost to the Forest Authority. The average crofter's family includes at least one member with a knowledge of one or other of the building trades.

In certain cases, the crofter might wish to own his dwelling; he would then pay to the sinking fund an additional 2 per cent., on £120.

CLASS C.—*Outworker, with cows but no other stock, on small patch of reclaimed land on a sheep farm or deer forest:*

£100 house at 3 per cent.	£3 0 0
Potato patch, 10s.	0 10 0
	£3 10 0

It will be seen from the appended plan, that the buildings on crofts are modelled on the type of the crofter houses most common in the Highlands. The rents set out above are based on the actual cost to the Forest Authority of the holdings and buildings. It must not be considered as certain, however, that in all cases the Forest Authority will be able to exact the rent indicated, at all events in the Highland area.

Judged by town standards, or by the rents paid for newly created small holdings in the south, 5s. a week (that is £13 a year) will not appear a high rent for a comfortable house, a twelve-acre holding, a share of common grazing, and, probably, free fuel in the shape of peats and unsaleable waste wood. Judged by crofter standards, however, the rents are undoubtedly high, and as the idea in the Highlands is to attract crofters, it remains to be seen whether it will not be necessary to make reductions, at all events for the first few years. It may also be necessary to make the terms of repayment more attractive by reducing the rate of interest payable to 1 per cent. or 2 per cent., the sinking fund being then raised to 3 per cent. or 4 per cent. It is impossible to lay down a law on such a subject, experience alone will show the extent to which the certainty of employment and of obtaining land at reasonable rates will attract settlers.

In Germany, where the recent policy of the State has been to create small holdings and buildings for workers, it has, on more than one occasion, been found necessary to lower the rents in order to attract labour.

Number of Weeks' Forest Work.

The crofter is very well situated as regards forest work, because, except for a week in the end of October, when he is lifting his potatoes, and a fortnight in April, when he is preparing

his croft, his farm work and his work in the forest do not clash, or at all events they can be arranged to fit in with each other. Experience shows that his croft work keeps a crofter employed for from 10 to 15 weeks; and that, provided he can get something like 30-40 weeks' work in the forest, he can fill up any unoccupied weeks in the autumn months (until he is required for planting in the last week in October) by work at shooting lodges, or by employment in connection with the tourist season, or as a harvest hand on the large low-country farms.

Number of Crofts.

Forestry is an industry in which a large proportion of the money expended goes in labour. The permanent staff, especially during the planting stage, is neither numerous nor highly salaried. Fencing material, and the cost of tools and seeds, are the only payments made outside the forest area.

It is therefore a fair calculation to make, that for every £40 per annum expended in forest work proper by the Forest Authority, a worker—that is to say, one croft—can be established. The ordinary forest labourer should draw about 18s. a week. There should be work for one horse to every ten labourers for forest carting work, and for another horse to every four crofts for agricultural purposes.

In nursery work, weeding, clearing plants, bracken switching, carrying plants to workers, etc., one boy would be employed to about every four men; and a certain number of boys at about 9s. a week would be taken on as forest apprentices in every block.

Position of Croft.

In the Fort Augustus Block twenty to thirty of the crofts would be placed on the farm of Auchteraw, in the vicinity of the nursery, and they should occupy the whole of the existing arable land, with some 100 acres of improvable land on the golf course and the east side of the low ground grazing. Outworkers would be established at Borlum, Aberchalder and Glen Moriston. As far as possible their settlements would be formed in groups or townships with a view to:—

- (a) Arrangements for common grazing, thereby cutting down expenses in fencing;

- (b) Economy in the number of horses for the cultivation of the crofts ;
- (c) Easy distribution and control of work by the gangers.

The largest forest labour settlement would be placed in the neighbourhood of the nursery, and any workers' bothies which might be found necessary in the initial stages would be erected there.

It is impossible to give more than a general opinion of how the preliminary work of nursery formation, establishment of new crofts, etc., would be proceeded with.

In the preliminary stages, it is probable that existing farm buildings would be taken over and used as bothies ; that the Forest Authority would (until crofts had been established) maintain some few pairs of heavy horses for breaking up land, farm work, and carting building materials ; and that, at the same time, facilities would be given to crofters who were able to do their own carting.

General Instructions.

Three general instructions may be indicated—

1. Full use should be made of local labour and local means of transport.
2. Crofts should be established gradually over a period of years. It is important, in the interest of the crofters as well as in that of the Forest Authority, to keep the capital expenditure low and to get the maximum assistance in labour and carting from the prospective tenants.
3. The "bothy period" should not be unduly extended.

In addition to the attractions offered by small holdings at a much cheaper rate than small holders could possibly create them for themselves, and by steady and certain employment at the times when they have least work to do on their holdings, the forest scheme should be popularised—

A. BY ELEMENTARY COURSES OF LECTURES given by the Superior Forest Staff, and open to all employees. The more promising of the men thus instructed would probably carry their education further by entering the forest school in a *Demonstration Forest*.

B. BY POSTS ON THE PERMANENT STAFF AT FIXED WAGES.

1. All promotion to the position of forest guard should be made from the crofter ranks.
2. Gangers, foremen, etc., should be promoted from the same source.
3. Opportunities should be afforded, where intelligent youths were found, of promotion, after satisfactory service, to minor posts on the staff.

CHAPTER VI.

CONTROL AND MANAGEMENT.

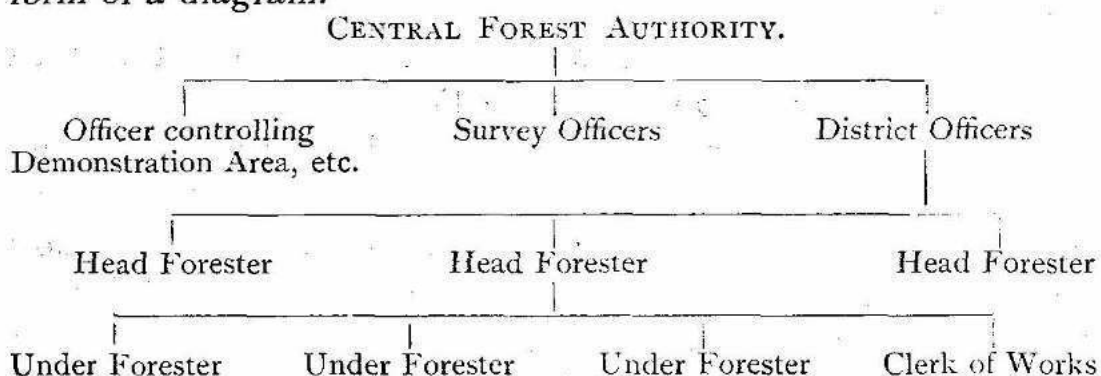
The Scheme.

It is necessary, in the first place, to define the nature of the task before the Central Forest Authority. And it will be well to clear our minds at once of continental comparisons; for we have not now to deal with the complex machinery of a great Forest Service such as France and Germany require for the control of great areas of established forests, but with the comparatively simple needs of an afforestation scheme in its infancy. This chapter will be confined to a consideration of the questions of control and management which would arise in the course of carrying out the scheme which is described in this Report.

These questions may conveniently be considered under two heads:—

1. The number and composition of the staff required in the first or planting period.
2. The material available at the present time.

It is first necessary to explain the scheme of control and chain of responsibility, and this may best be expressed in the form of a diagram.



With the Central Authority, of which the composition is indicated in Appendix A, this chapter has no concern except to note that the higher administration will be in its hands.

Under the Central Authority there will be three classes of forest officers:

1. Officers controlling Demonstration areas, Education, Research and Publications.

2. Officers appointed to Survey.
3. District Officers in charge of groups of Forest Centres.

The officers of all three classes will be men who have been educated at the Universities, and have attained a recognised standard of knowledge of silviculture in both theory and practice. It is probable that the first two classes—officers controlling Demonstration areas, etc., together with Survey officers—will absorb most of the trained men immediately available.

Here it is necessary to explain that the need for the third class, that of district officers, will not arise during the early years of afforestation, and for the following reasons:—

1. The nature of the work in the first fifteen or twenty years will be simple and uniform, and it can safely be entrusted to men of the head forester class.
2. At first the forest centres will be few and scattered, and such supervision and inspection as may be necessary can be undertaken by officers of the first or second classes.
3. Forest areas of from 15,000 to 30,000 acres, requiring the control of a district officer, are not yet in existence.

Ample time will be given for the education and training of district officers during the first fifteen to twenty years of the creation of the forests, which thereafter only will begin to need their supervision.

Foresters.

According to the scheme, one head forester will at first be required for the 15,000 acres of the Fort Augustus Block. He will have immediate control of three under foresters, one for each subdivision of 5000 acres, and it is probable that at first the Clerk of the Works and the estate workmen could be most conveniently placed under his supervision. After fifteen to twenty years, in consequence of the increase of the planted area and the approach of the first thinnings, a head forester will be required for each 5000-acre block. Men of the stamp required for the initial work of afforestation, both as head foresters and as under foresters, are already to be found in Scotland in sufficient numbers to meet the immediate demand; while, with the progress of afforestation, the number of well paid situations will be largely increased, and will attract an increasing number of good men into the profession of forestry. If young and capable men are

chosen as under foresters, and are given opportunities for study in the Demonstration area, at seasons when the work at their own centres is practically at a standstill, they should be able to qualify themselves for the higher position by the time that a head forester is required for each 5000-acre block.

Time required for Organisation.

The natural order of progress in State afforestation may be stated thus :—

1. Establishment of Central Forest Authority.
2. Demonstration areas, Education and Research.
3. Surveys, general and detailed.
4. Afforestation of Selected Centres.

But once the Central Authority is in existence, there is no reason why progress on the three latter lines of development should not be made simultaneously. Survey work need not wait for the results of education and research; nor need the commencement of afforestation be delayed until surveys of the whole of Scotland have been completed. The writers hold that such delay is unnecessary, provided always that the amount of work undertaken is adapted to the numbers of the staff immediately available.

While they do not undervalue the immense importance of silvicultural education, and the benefits to be derived from it, they consider that there is no reason for postponing practical work until the finished products of the new educational machinery are ready to hand; they are rather of opinion that, unless practical work is commenced at the same time, the educational machinery will be wasted in turning out highly-trained men for whom little or no employment will at first be found in this country. It is the writers' belief, that not only are enough men now available for the initial stages of afforestation on a reasonable scale, but that a sufficient amount of the necessary experimental work has already been done, and that the comparatively simple task of collecting and tabulating the results of a great number of most useful experiments, carried out by individuals, in planting methods, choice of species, etc., is all that is needed to put the Central Authority in immediate possession of a mass of reliable information which Demonstration areas and forest gardens cannot provide for many years to come.

CHAPTER VII.

FINANCE AND EMPLOYMENT.

Estimated Expenditure.

Initial Capital Outlay.

1. 1 Head forester's house	£500	0	0
2. 3 Under foresters' houses	900	0	0
3. 7 Forest guards' houses	1,400	0	0
4. 30 crofters' houses with byres, say £200 each	6,000	0	0
5. 30 workers' houses with byres, say £150 each	4,500	0	0
6. Sheep stock valuations, waygoings, etc., of agricultural tenants	3,500	0	0
7. Preparation of nursery—initial expenditure ¹	100	0	0
8. Tools	100	0	0
9. Office equipment	50	0	0
10. Legal expenses (leases)	100	0	0
11. Contingencies	450	0	0
	£17,600 0 0		

Note.—No estimate is made of the price to be paid for existing timber, because it is assumed that where such timber is purchased it will bring in an adequate return.

The same remark applies to the purchase of horses, etc.

¹ The ground is already under cultivation.

Annual Expenditure.

1. Head forester, £200 to £250 say	£250	0	0
2. 3 Under foresters, at £75 per annum each	225	0	0
3. 7 Forest guards, at £52 per annum	364	0	0
4. 6 Rabbit killers, at 22s. per week (less price of rabbits sold)	180	0	0
5. Planting of 450 acres, clearing plants and switching bracken, at £3 ¹	1350	0	0
6. Draining	120	0	0
7. Fencing (measured average for 5 years)—			
4 miles deer fencing	260	0	0
4 miles sheep fencing	140	0	0
8. Rent for the first five years—			
Invermoriston	250	0	0
Aberchalder	50	0	0
Glendoe	200	0	0
Arable land at Borlum, Aberchalder, etc.	300	0	0
9. Rates, say	125	0	0
10. Stationery	35	0	0
11. Repairs and upkeep ; travelling and incidental	100	0	0
	<u>£3949</u>	<u>0</u>	<u>0</u>

Note.—The above sum of £3949 does not include interest on initial capital expenditure, which, at 3 %, on £17,600 = £526.

Estimated Income from Crofts (including Sinking Fund).

1. 20 crofts, at £13	£260	0	0
2. 20 crofts, at £6, 2s.	122	0	0
3. 20 crofts, at £3, 10s.	70	0	0
	<u>£452</u>	<u>0</u>	<u>0</u>

Note.—No estimate is submitted of profits which might be made from the birch and other timber at present growing on the ground.

¹ This figure is based on experience of the district. In other districts, where the cost of planting and cleaving runs up to £3, 10s. to £4, 10s., the amount of labour will be proportionately increased, and the figures given on page 46, under heading (A) will in these cases need a corresponding alteration.

During the first decade of operations at the Fort Augustus centre, the number of men permanently employed in forestry would be roughly as follows:—

A	Employed mainly in connection with Planting operations.	Head forester	1
		Under foresters	3
		Forest guards	7
		"Flying squad" of rabbit trappers	6
		Planters	30
		Fencers	3
		Boys	6
		Men clearing the planting area, and carting timber from same	10
B	Employed in connection with the erection of offices, houses on crofts, etc.	Clerk of the Works	1
		Forest estate mason	1
		Forest estate carpenter	1
		Men employed on "day's wages," not including work done by occupier	10
C	Employed in connection with existing Woods (birch, oak, fir, etc.).	Estate sawmills.	
		Treatment of existing timber crop (excluding the timber cleared off the annual planting area).	
		Manufacture of timber.	
		Erection of plant.	

Total employed under A and B = 73 men, 6 boys.

N.B.—Estimates for planting, house building, etc., can be put forward which are based on actual experience, and with all the necessary facts by which the calculations can be checked. But no estimate is submitted of the amount of employment afforded under (C). This must depend on many problematical factors: the amount of standing timber bought from the proprietors, which in turn governs, to a certain extent, the method of handling; the rotation in which the birch crop is (a) thinned, (b) felled; and the amount of birch-wood manufactured (bobbins, pulp, etc.) on the spot. That the

amount of employment would be considerable is evident from the statements made by Dr Nisbet in Chapter X. For calculating the amount of employment to be offered in the Fort Augustus Block, it may be reckoned that the treatment of existing timber crops would fully absorb the labour supply that the district could provide under present conditions.

Notes on the Employees.

Head forester.—The head forester would receive £200 to £250 (with house and garden), running up to £300 per annum.

Under foresters would receive £75 (with house and garden), running up to £150 or £200, if they qualified for the position of Head forester over a 5000-acre forest block, after that block had become a producing area.

Forest guards.—At first, two forest guards would be apportioned to each of the three divisions of the planting area (*vide* Chapter IX., Working-Plan), with perhaps one additional guard responsible for the central nursery.

The forest guards would eventually reach fifteen in number (one for every 1000 acres of woodland), and would be responsible for the care of and reports on the woods, destruction of rabbits, squirrels and other vermin, maintenance of firebreaks, suppression of fires, etc.

These men would be quartered within the forest area, on the actual ground for which they were responsible.

Flying squad of trappers.—These would gradually disappear as the forest guards reached their full number, and the planting area increased. Certain areas with rocky cairns and rough heather land would probably always require a few trappers in addition to the regular forest guards.

Planters.—The planters, who constitute the main body of the men on daily wages, would be employed as follows throughout the year:—

October 25th to the end of March.	} Planting 1,500,000 trees, including lifting plants from the nursery, carting, etc.
April to the 15th of May.	} Planting Menzies spruce, Corsican pine and Douglas fir; nursery work— “lining out,” weeding, etc.; and croft work.

15th May to the 1st of August.	}	Draining; cleaning plants; bracken switching (two years, <i>i.e.</i> 900 acres); assistance to fencers; and croft work.
1st August to the 25th of October.		Practically no work in the woods; employed at the shooting lodges and big farms; and in croft work.

In the Highlands, there is a great demand for casual labour during the shooting season; in the more fashionable districts unskilled labour commands 22s. to 35s. a week, and men for grouse driving, work on farms, etc., are almost impossible to get.

Fencers.—The fencers would have, on an average, four miles of deer fence, and four miles of sheep fence to put up annually in the first decade. In the first few years, there would also be some work to do in connection with common grazing and boundary fencing on crofts. Once the repair of fences began (a serious question on high ground liable to snow drift), the work would increase considerably.

Boys.—One boy would be employed for every 4 to 5 men during the planting season. Boys would also be employed in bracken switching, destroying beetles, and weeding in the nursery.

Men employed in clearing the planting area.—150 acres of birch would be cut per annum, 8 to 12 trees being left per acre (*vide* Chapter IX., Working-Plan). The felling, “sneeding” and carting of the crop from these 150 acres are included under (A) (employment offered under the head of Planting). The manufacture of this timber would come under head (C).

Clerk of the Works.—A competent man would be required for account-keeping, supervision of building work, care of crofts, etc.; and during the initial stages of the scheme some additional clerical assistance might be necessary.

Estate mason.—It would be advisable to have one foreman estate mason at from £75 to £85 a year, with a house and garden.

Estate carpenter.—It might be necessary to have an estate carpenter for repairs and other estate work.

Labour: Building houses on crofts.—It is difficult to estimate the number of men who would obtain regular employment under this head. The number would depend, to a considerable extent, on

the amount of work done by the crofters themselves on their own buildings. A rough method of arriving at the number of men who would be employed is to calculate how much goes in material and how much in wages on the average crofter dwelling.

In a £150 house the material should cost approximately :—

Timber,	.	.	.	.	.	£30
Lime,	.	.	.	.	.	6
Slates,	.	.	.	.	.	15
Material of plumber,	.	.	.	.	.	5
Material of plasterer,	.	.	.	.	.	8
Paint,	.	.	.	.	.	2
Sundries,	.	.	.	.	.	5
Total,						<u>£71</u>

That is to say, about half the cost of a £150 cottage would go in labour :—

1. to the crofter erecting the dwelling ;
2. to the estate workmen ; and
3. to the men on day's or weekly wages.

Realisation of Timber.

In the Fort Augustus Block there are about 7000 acres of natural timber—birch, oak, scrub and Scots pine. Annually in the first decade, the growing stock on about 150 acres would be thinned down to 8 to 12 trees per acre, and would form part of the planting area of 450 acres per annum (*vide* Chapter IX., Working-Plan).

The treatment of the remainder of the crop may be summarised under the following heads :—

1. Heavy thinnings of birch woods scheduled for planting at the end of the working-plan period (in order to allow two crops of birch to be taken off certain areas before planting them).
2. Lighter thinnings of woods due for planting in the second and third decades.
3. A short-rotation "birch-broom" crop (cut when the birch is five-eighths of an inch thick at butt).
4. Special treatment of oak-woods.

5. Thinning and manufacture of old Scots pine woods.
6. Manufacture of timber cleared from the planting area.
(*N.B.*—The cost of clearing and carting of these woods is included under Planting).

Table of Work.

The following "Table of Work" has been prepared to show how the labour required in the woods would increase from decade to decade :—

FIRST DECADE.

Planting.—Nursery work ; 450 acres of planting, including clearing plants ; bracken switching (on 900 acres), and after the first year "beating up" at the rate of 3 to 5 per cent. ; draining ; fencing ; clearing the planted area of birch and other natural crops.

Houses.—Foresters' houses, sixty crofters' houses and steadings, sawmills, etc.

Land.—Preparation and division of agricultural land ; reclamation and trenching of land where arable land is not available.

Felling.—Thinning, clear cutting and manufacture of birch, oak, fir and other natural woods.

SECOND DECADE.

Planting, for five years—as above.

Planting, from the fifteenth to the twentieth years, at 300 acres per annum.

Houses.—At the rate of 20 per decade.

Land.—Reclamation of land for new crofts.

Thinnings.—After fifteen years, stake-making, etc., from larch thinnings. First thinning of Scots pine, etc.

Felling.—Old woods, as before.

THIRD DECADE.

Planting—as above, 300 acres per annum.

Houses—as above.

Land—as above.

First thinnings.—At the rate of 450 acres per annum.

Second thinnings.—At the rate of 450 acres per annum.

Spruce crop.—Preparation of fences and roads.

Felling.—Old natural woods, as before.

Manufacture.—Posts, etc., from second thinnings.

FOURTH DECADE.

Planting—as above.

Houses—as above.

First thinnings—as above.

Second thinnings—as above.

Spruce.—Felling for wood pulping or other uses.

Manufacture.—Stakes, posts, pulp, etc., from the planted crop.

Felling—Old natural woods, as before.

FIFTH DECADE.

Probably during, but certainly after, the fifth decade, the clear-cutting of some of the faster-growing short-rotation crops will have begun. The forest will pass into the producing stage, and the employment afforded will rise steadily up to 1 man for every 60 to 100 acres, depending on the amount of timber manufactured locally.

Natural Timber Crops.

Employment would also be given under the heading of Treatment and Realisation of existing timber crops by—

1. The erection of sawmills and creosoting works, also central wood pulping, acetone works, etc., some of which works would fall within the Fort Augustus Block.
2. The manufacture or treatment of timber at these works.
3. Heavy thinning outside the planting area, felling, snedding, carting.
4. Light thinning, felling, snedding, carting, and birch brooms.
5. Working the short-rotation birch-broom crop.
6. The Scots pine (natural) crop—cutting, snedding, carting.
7. Manufacture of timber from the 150 acres of planted ground. (Cost of cutting, etc., is included under Planting.)

Employment under this head should give, for the first twenty years, at the very lowest estimate, sufficient employment to balance the existing local supply of labour.

It is important to note that employment on natural timber crops is not constant throughout the rotation. The great

majority of the 7000 acres of natural woods will be replaced by plantations by the fortieth year of the forest scheme. It is vital to the scheme that the totality of employment under A., B., and C. (p. 46), should steadily increase in amount from decade to decade; very careful estimates must therefore be framed to make certain that the yield of employment from the natural woods is not exhausted before the creation of employment by second thinnings from young plantations is established.

Wages.

It is important to show the total expenditure in wages which will be incurred in an average year of the first decade:—

Planting 450 acres per annum at the rate of £3 per acre, less deductions for cost of administration, seeds and tools	say	£1150
Draining work, not including tools, at the rate of 5s. per acre		110
Fencing 4 miles of deer fence, at £65, and 4 miles of sheep fence, at £35 = £400, of which one-third is cost of labour		133
Men clearing the planting area, 150 acres per annum, on charges based on felling, carting, birch brooms, etc. (<i>vide</i> Chapter X.)		650
Wages of forest guards at £1, and of trappers at 22s., per week	say	650
Expenditure on houses: one-tenth of £14,000, allowing 50 per cent. of total expenditure to go in wages, £700 per annum; and allowing a reduction of £200 for the work crofters themselves do on their own houses	say	500
		£3053 ¹

¹ *N.B.*—When comparing this figure £3053 with the total annual expenditure, page 45, it must be noted that wages for clearing timber off the planting area is included in the one case and not in the other.

CHAPTER VIII.

STOCKING OF THE GROUND.

SUMMARY OF OBSERVATIONS MADE BY GILBERT BROWN AND WM. MACKENZIE, FROM AUGUST 1910 TO JANUARY 1911, INDICATING THE GENERAL FEATURES OF THE VARIOUS PLANTING AREAS UNDER THE PROPOSED AFFORESTATION SCHEME.

The area of ground which is under consideration in connection with the proposed afforestation scheme amounts to 60,300 acres. It is situated in the main glen of the Caledonian Canal, and in the side valleys which join it at different points of its length.

It is evident, even to the casual observer, that in regard to the question of transport the district is well chosen. The Caledonian Canal runs through the entire length of Glen Mor; and there is a railway for about 30 miles, while good metalled roads, and rivers for water carriage, give facilities for transport in the side glens. It must, therefore, be admitted at the outset that there need be no difficulty in getting the wood either to a central dépôt or to the coast.

Climate and exposure vary with the locality; but as a rough generalisation, it may be stated that the farther west the greater the importance of shelter, the farther east the greater the danger from frost.

For the purpose of more clearly defining the various points of importance which we consider it advisable to bring to the notice of the writers of the Report, it is advisable to deal separately with each of the various estates on the line of survey.

Aldourie.

The area of land that can be afforested on this estate is covered partly with conifers and partly with birch, while a considerable area is lying waste. The whole, being on more or

less sloping ground facing the north, may be said to be a very suitable area to bring under afforestation; the soil is for the most part light, with sufficient depth, and is otherwise well adapted for growing timber. Taking the coniferous woods as a whole, they present a very healthy, vigorous appearance; the matured trees are well grown and contain a large amount of valuable timber; and with a full complement of trees to the acre the crop should be a very valuable one. Both Scots pine and larch have grown well, and taking these as specimens of what may be expected from forest trees at the east end of Loch Ness (Caledonian Canal), the prospects are splendid. In taking note of small blocks of larch throughout the woods, it is satisfactory to remark that on certain areas they contain up to 3000 cubic feet of timber to the acre. And taking into account the value of larch thinnings up to about fifty years, when the last thinning might take place, the return from this source would in many cases be such that very little, if any, of the sum realised by the final crop would be required to repay the initial expenditure with interest thereon.

Dochfour.

The plantable area on this estate may be divided as follows:— One half containing timber of various kinds and of various ages, and the remaining half being ground from which the crop has been felled a few years ago. In dealing with the area carrying timber, the position occupied is on both sides of Loch Ness, and therefore facing either north or south. The trees are of very good quality and size, and while the crop of matured timber is thinly distributed over the ground, the size of the trees shows that there are prospects of a profitable return from planting. The young crops of Scots pine and larch have also a very thriving appearance, those on the south side being, however, the more vigorous, and showing very few back-going trees. The only defect is that numbers of the larches have their stems bent by gales, and this spoils the appearance of the crop considerably. The question, therefore, of shelter-belts must be seriously considered, especially when forming larch plantations, as the greater part of these woods will be on sloping ground, and therefore greatly exposed to wind. This is rather a difficult problem, but it is one that must be attended to, the position of

the woods making it all the more difficult. The tree which shows the effects of wind in the least degree in this district is the common spruce.

Glen Urquhart.

The plantable ground within this estate covers about 1500 acres on the Loch Ness side, principally in the glen of the above name, and it extends from Loch Ness to Corriemoney; it is accordingly on sloping ground of various gradients. The ground is mostly under birch and other scrub, with certain adjacent areas lying waste; a small percentage, however, is under mixed conifers, and they indicate clearly that this locality is well suited for timber-growing; larch especially grows rapidly and forms timber of valuable proportions. The ground faces east or west; and the main part being on the west side is well sheltered from the prevailing winds, which is a favourable condition. The soil is altogether suitable for timber-growing, being generally deep and light; on some of the higher points it is somewhat rocky, but this deducts very little from the plantable area.

Invermoriston.

Here the ground suitable for afforestation is, beyond a certain area on Loch side, mainly on the slopes rising from the Moriston river to an altitude of about 900 feet, the upper limit varying according to the nature of the soil, which is here the main factor determining the elevation suitable for tree-growth. In Glen Moriston, with the shelter afforded and the fertility of the soil, no argument is needed to prove the suitability of this area for tree-growing. It would be over-sanguine to expect such a large continuous tract of land to be entirely free from wet soil; but while such soil is met with in places, it occurs nowhere to any great extent, and all except the worst parts could be put into a state suitable for tree-growing at a cost for draining not exceeding an average of 5s. per acre. The soil is mixed with broken rock in parts. The rocks are, however, principally surface blocks, and although on a level plain this might necessitate the trees being planted wide apart, it will make little difference on this steep ground. The area on the south side is mainly covered with old Scots pine about 200

to 300 years old, with a slight admixture of birch ; while on the north side of the valley the crop is mainly birch with a small quantity of oak, a small area of Scots pine, and larch of various ages. Some of the old Scots pines are of great size and are valuable trees ; but it is not at all probable that Scots pine would form the main future crop, as the conditions have altered considerably. With regard to the coniferous crop on the north side, it may be said that the trees are growing well up to about 1000 feet, the larch especially being of good proportions and strong growth. This shows conclusively that, given suitable soil and a fair amount of shelter, larch will grow to a very profitable size ; the Scots pines are also growing steadily, but are completely beaten by the larch. It may here be mentioned that one thing is everywhere apparent, namely, that far too few spruces have been planted.

Inchnacardoch, Glendoe and Dell.

With regard to *Inchnacardoch*, the nature and composition of the soil and the general aspect are similar to those of Invermoriston. *Glendoe* :—Most of the ground lies at a very high altitude, and does not comprise much that is fit for afforestation, as it is exposed and also of a very poor and shallow quality, altogether unsuitable for planting. But the area marked off as plantable may be said to be excellent for timber-growing, the soil being of a heavy, loamy nature of great depth, and quite capable of growing any of the most exacting species. Although the plantable area is limited, the prospect of quick growth upon it is everywhere obvious.

On the *Dell* portion of this district, the conditions for afforestation are more variable than they are over the other portions. Within this area, certain blocks have been marked off as quite unfit for tree-growing, either as being on hard shallow ridges, or as being wet, boggy ground, difficult to drain ; even with extensive drainage they would be defective in the qualities necessary for timber-growing. Within this area are plantations of Scots pine and larch, all in a more or less flourishing condition, but the larch have the lead both in rate of growth and in cubic contents. It may be said that a large part of the ground will be planted with spruce, and this will probably be the largest spruce forest included in the afforestation scheme.

Cullachy.

The ground suitable for afforestation is of a mixed nature, and is confined to what is known as Glen Tarff on the one side, and the lower end of Glen Buck on the other. The ground in Glen Tarff is on steep slopes extending down to the river Tarff; and as the slope extends at the same gradient to the bed of the river, it presents a little difficulty in the way of removing timber. The soil in the glen being of a deep, loamy and consequently fertile nature, which is maintained up to a greater elevation than is common over the other districts, the upper line of demarcation varies, the highest point being at an altitude of about 1150 feet. It has good natural drainage. The soil on the more level plains in Glen Muck does not present such favourable qualities, being more of a moorland nature, interrupted by wet parts, a large area of which has been marked out as unsuitable. Other wet parts can, however, be quite easily drained without incurring excessive expense. A great deal of water comes from the higher ground, percolating through and spreading out as it gets lower down; but by confining the water to its natural courses, and cutting it off at various points where it breaks out, draining will be found to be quite a simple matter.

Invergarry.

This contains the largest area for afforestation throughout the entire Survey. In order better to show its general conditions it may be divided into two parts, viz., the south side and north side of the canal. The south side which may include Aberchaldy, Glengloy and Glenfintaig, contains soil of a much higher quality than what may be termed "forest soil," and on a level plain it would be quite fit for agricultural purposes; but as it is on a very steep slope it is only suitable for tree-planting. The highest point has been fixed at an altitude of about 1000 feet, but the line might be carried 200 feet higher, as the vegetation of fern and bracken is almost as luxuriant at this height as it is lower down; but the gradient is so steep that the possibility of planting higher is diminished. The soil is generally of the same nature throughout, with the exception of a few wet places of limited extent. Two plantations may be mentioned, growing on this area, which show pointedly its value for tree-growing. One of these, planted in 1905, consists of Scots pine, larch and

Corsican pine ; all the trees are growing well, even up to the highest level, where they undoubtedly fall off a little, but this could not be otherwise, as the strip is only a narrow one, tapering off to a point at the top, so that all the trees are more or less subjected to the full force of wind from all quarters ; the larch, it may be mentioned, are putting on yearly shoots up to 3 feet in length. The other plantation is a large one, and was planted about 1880 ; it consists of a mixed crop of larch, Scots pine and spruce ; all have grown well, especially the larch, and next in order the spruce. The trees up to about 1000 feet maintain a fair size, but above that altitude they fall off in height, this probably being due to the crop being too open.

On the north side of the canal, all the sloping ground overlooking it is more or less suitable for planting. There is a large area of ground extending from the canal up the valley of the loch and river Garry ; it is quite unnecessary to go into details regarding this portion, as it must be evident, even to the most casual observer, that tree-planting would be a profitable investment here ; the growing species which specially demonstrate this are larch and spruce.

Within this area is a small plantation formed for shelter, part of the soil being of indifferent quality and not altogether suited for forest trees. It is a noticeable fact that where Scots pine has absolutely failed Corsican pine is flourishing.

Achnacarry.

The plantable area here is on the north side of the canal, rising on a slope to various altitudes, but the average height is about 800 feet. The main part of the slope immediately overlooking the canal is suitable for tree-growing ; while on the extreme west, viz., Erracht, the soil is of exceptionally fine quality, being far superior to the general run of forest soils. At Achnacarry proper, most of the plantable area is under trees of various sorts, both hardwoods and conifers, and except certain small areas of poor peaty soil, the whole is in a condition to plant. The capabilities of the soil to grow trees is apparent from the size and general appearance of the conifers now found thereon, the larch especially is growing well ; one larch plantation about 60 years of age is now of a size to command a large sum per acre.

Auchendaul.

This area, between Spean Bridge and Banavie, rises in a gentle slope from the east and from the west to an altitude of about 750 feet. A large part of the flat ground at this level is quite unfit for planting, being peaty or sterile, and even with a great amount of labour and expense it could not be profitably utilised. On the flat ground at lower levels similar soil is found, and there is little hope of bringing it into a proper state for forest trees. The best of the land is on the slopes facing east or west, that with a western exposure being of excellent quality for silvicultural purposes. Draining is absolutely necessary, to a greater or less extent according to the character of the soil.

A small plot of about 60 acres at the extreme south of this area is planted with larch, Scots pine and spruce, and is on what may be termed a fair sample of the various soils throughout the whole area; the trees thereon may be said to fairly represent the results that may be expected from planting in this district. The larches have been planted on the best soil and have grown well, while Scots pines and spruces, planted on peaty soil, have been quite a failure; spruce planted on wet but good soil have, however, made good progress. The whole demonstrates clearly that, with fair soil, suitable for planting, profitable results will be attained.

Note—Throughout this Survey various areas occur within the boundary line that have been marked out as unsuitable for timber-growing, having either very wet or very shallow soil. There is also a large area of ground under a Scots pine crop about 300 years old; some of the trees being very fine specimens, containing a large amount of valuable timber. The soil on which these fine trees have developed has obviously deteriorated in later times, and it is doubtful whether it is now in condition to again produce a good crop of trees. A considerable amount of the soil has been washed down the slope to the lower valleys by water running along the pan; and with no improvement in the crop of trees, the soil having been open to the effects of the weather for so long a period, this part of the area is fast passing into the conditions prevailing in the remains of the old primeval forests in our Highlands; and under such adverse conditions it is impossible, in the meantime, to include it in an afforestation scheme.

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CHAPTER IX.

SKETCH OF WORKING-PLAN.

By WILLIAM DAWSON.

General Outlines.—It is unnecessary to submit a detailed working-plan for the whole area now, as many of the points with which it must deal do not affect the present question. In the abridged working-plan as here submitted, the outline of the scheme is shown, together with facts relating to the area which are of general interest. Such details as the exact position of the boundaries of each year's planting, the species, age and arrangement of the planting material for each compartment, methods of planting, the location of whin and grass meadows for deer, the location of roads, paths, loading banks, etc., are of importance in the execution of the work, and should be contained in the complete working-plan. Under any extensive scheme of afforestation detailed working-plans should be prepared for each district, and, in addition, a special Book of Instructions should be issued dealing with all details of a technical and practical nature. Part of these instructions would be common to the country as a whole, but for each district, special instructions would be issued, dealing with its special features and needs.

The area to which the present plan relates is the Fort Augustus Block. It contains 15,000 acres of afforestable land, every part of which is situated within easy distance of Fort Augustus. Practically the whole of the ground is under the 800-feet contour line. Undoubtedly it would be possible to plant at considerably higher elevations in places, though it would be inadvisable to do so in the beginning. The richer and more sheltered lower ground will give a quicker return, and therefore should be stocked first. The sole of the valley is only 100 feet above sea-level. In this district Glen Mor widens, so that a considerable portion of the available land is situated at low elevations, while the slopes are comparatively gentle. The same is true of Glen Moriston.

*Meteorological Conditions.*¹—The average annual rainfall for the period 1884 to 1903 was 44·67 inches. The highest rainfall recorded was 65·98 inches (in 1903), while the lowest was 32·67 (in 1889). The rainfall at Fort Augustus is greater than that of Inverness, and smaller than that of Fort William. There is seldom snow on the lower ground, owing to the fact that the straightness of Glen Mor facilitates the access of the air from either coast. It is a very striking fact that the snow-line in some of the side glens, e.g. Glen Tarff, is often considerably lower than that in Glen Mor itself.

The prevailing wind is south-west, and next to it in frequency comes the north-east wind. Peculiar gusty gales blow occasionally from the south-east.

The temperature is free from great extremes. The mean annual temperature (thermometers in shade) for the period 1897 to 1906 was 46·06° F. The highest temperature in the shade was recorded on the 2nd September 1906 with 86·9° F., and the lowest, quite an exception, on the 28th January 1910, with 1·9° F. For this period (1897-1906) the mean annual humidity of the atmosphere was 83·87 per cent; and in the same period the average number of hours of bright sunshine per annum was 1002·96.

*Geology.*²—The area to be afforested in Glen Moriston and along the Great Glen from the mouth of the river Moriston to Invergarry, has not yet been surveyed by the Geological Survey. But, so far as our present knowledge goes, it is believed that the rocks entering into the structure of this region belong partly to the metamorphic series of the Highlands and partly to the Old Red Sandstone. The latter form a narrow belt along the north-east side of Loch Oich, and extend north-eastwards, by Aberchalder House, towards Culachy. The remainder of the area is occupied by the metamorphic series, which comprises crystalline schists belonging to the Monic Series of the Geological Survey. These consist of quartzose flagstones, quartz-biotite-granulites and mica schists, which have an extensive development on both sides of the Great Glen. They represent sandy and clayey sediments which have been converted into crystalline schists by various

¹ The notes on the meteorological conditions were kindly supplied by Rev. Cyril von Dieckhoff, St Benedict's Abbey, Fort Augustus.

² The geological notes were kindly supplied by Dr Horne, Director of the Geological Survey, Edinburgh.

metamorphic processes. In places they are traversed by veins of granite and pegmatite, due partly to intrusion and partly to segregation.

The Old Red Sandstone strata, south-east of Loch Oich, consists of conglomerates and sandstones that rest on the old floor of metamorphic rocks, and hence belong to a later period of the geological record. There is clear evidence to prove that the crystalline schists of the metamorphic series were folded and extensively denuded before the deposition of the Old Red Sandstone.

Reference ought to be made to the great line of dislocation that runs along the Great Glen from Loch Linnhe to Inverness, which has determined this straight physical feature, and has modified the structure of the rocks on either side.

In Glen Moriston and along the Great Glen there are morainic deposits that point to the extensive glaciation of the region. The terraces between Loch Ness and Loch Oich indicate old raised beaches.

General.—The surface herbage in the open is mostly bracken and grass, but heather appears in parts. A considerable portion of the ground is already covered with trees, partly natural, and partly the result of planting. Birch is the prevailing tree, but in Glen Moriston there is a considerable area of old Scots pine.¹

The soil varies considerably throughout the area. It is mostly of a light and friable nature and of sufficient depth. Part of it is undoubtedly first-class larch ground, while a considerable portion is heavier, and is suitable for Menzies spruce and common spruce. These species with the addition of Douglas fir, where conditions are suitable, should form the crop for the first rotation at any rate. Japanese larch can be substituted for the common larch in some of the compartments. It should also be used to a considerable extent, as a "catch" or short-rotation crop, till such time as the woods are in full working order. All the species named are quick growers, and will yield early returns. The different species are not to be mixed among one another, but are to be kept in pure groups by themselves. An idea of the proportions of the ground suitable for the different species may be gathered from Map No. 2. It must not be understood, however, that larch or spruce or any other

¹ For details of existing woods, see Chapter VIII.

species will be planted in large blocks of the same age. The division of the ground into the three classes of larch ground, spruce ground and Scots-pine ground, is general, and merely intended to show the capabilities of the soil. In the Detailed Working-plan, each year's planting will be dealt with, and all particulars as to the exact proportion of the different species, etc., will be set forth at length, so that in the areas at present marked in Map No. 2 as all larch, or all spruce, larch, or spruce will form the bulk of the crop; but the principle will be rigidly followed of forming groups of species best suited to each particular part of the ground. The size of the groups will be kept within the limits demanded by good silviculture, and where larger areas are suited to a single species, a difference in age of contiguous groups must be provided for.

Fencing.—It will be necessary to erect deer fences round a considerable part of the plantations. In places a sheep fence is all that is necessary. As large areas will be enclosed at a time, the expenditure per acre will not be heavy. The deer fences must be maintained for a period of at least fifteen years. Details as to the cost of fencing in the first instance are to be found in Chapter VII. At a later period it may be possible to materially reduce the cost of protecting the plantations. Where fencing becomes necessary later on, temporary fences made from the first thinnings of the woods may be run up, as is done in Saxony.

Draining.—The natural drainage of the land is good on the whole, and much of it will need little attention. It will, however, be necessary to cut drains in some places, in order that compartments may be completed. Any areas where extensive draining would be necessary should be left unplanted meantime, as it would not be advisable to incur a heavy expenditure in this direction, till such time as the bulk of the good land is planted. These patches of wet land may be attended to at any convenient time later on. It must be understood, however, that where draining is to be done at all, it must be done thoroughly. In this comparatively moist district, half-measures in draining would be useless. The policy must be to drain properly in the small areas undertaken, and to leave the rest of the wet ground till such time as it too can be adequately dealt with. In the first period, the cost of draining should not exceed 5s. per acre on an average.

Transport Facilities.—The Caledonian Canal passes through the middle of the area. Every part of it is also served by good main roads converging on Fort Augustus. The upper end of the area in Glen Moriston is also accessible from Fort Augustus, by a good path over the hill in Port Clair deer forest, while the northmost end of the ground, on Loch Ness beyond Glen Doe, can easily be reached by water.

Further road-making will be unnecessary in the beginning. Carting roads will ultimately be necessary in some places, and the various compartments must be intersected by drag roads and inspection paths. The lines of these roads must be marked off before planting begins, and strips of the requisite breadth must be left unplanted; the making can be postponed till a later period, at which labour is easily available. It will be possible to bring the timber from much of the ground, down to the existing main roads, by means of slides or by temporary tramways. The compartment divisions should be laid down in such a way as to allow of their being used for this purpose.

Planting Scheme.—The actual planting will present few difficulties here. Deer must be fenced out, and black game kept down. Rabbits must be exterminated. The surface herbage will not be difficult to treat. Where bracken is found, it must be attacked early in the year previous to planting, and the cutting or flicking operations repeated in the same season, as often as is necessary. In a few places only will it be necessary to adopt any special methods of planting, such as planting on the tops of upturned turfs in wet places. Two-year-old seedlings can be used to a large extent, although on grassy land, where spruce will be planted, older material must be used. Existing birch-woods should be utilised to afford protection to the young crop from frost and wind. Where birch exists on ground which is to be planted, total clearance should not take place. A number of trees should be left till the young plantation is established and beyond the danger of frost. The removal of these trees at a later period will present no practical difficulty. In selected places, existing birch-woods should be left intact, in order that protection from wind may be afforded to neighbouring plantations. Birch should also be left in fairly broad strips, at intervals throughout the new woods. These will serve as fire lines as well as shelter-belts, and both the strips and blocks will provide shelter for deer, meantime. The birch will, of course, be completely removed in time.

In deciding on the extent and location of the areas to be planted annually, the economic interests,—sheep ground, deer forests and their rating values, etc., have had to be considered, as well as the fact that it will be necessary to spread the employment in, as far as possible, ever-increasing amounts, over the various periods of the rotation. It is proposed to plant the whole of the area within fifty years, and of that nearly half will be planted in the first fifteen years. This is quite in keeping with both precept and practice abroad. When extensive bare areas are to be planted, they are invariably got under crop with the least possible delay, irrespective of what the ultimate annual felling area may be. This presents no practical difficulty in the way of bringing the woods into proper rotation. It is quite a legitimate process, to shorten the rotation in parts, and to lengthen it in others, in the bringing of the whole into the normal rotation. Further, what the normal rotation will be is a point which cannot be decided at present.

It has been explained in another section, that not more than a third of the deer-forest wintering, in any forest, can be enclosed for planting at one time, while the sheep ground is available at any time, and can be planted as need arises. Of the 15,000 acres of plantable ground in this area, about two-thirds fall within the deer forests, while the remainder is sheep ground. Thus, in the first period of twenty years, there are available for planting, 5000 acres of sheep ground, and one-third of 10,000 acres of deer-forest wintering,—a total of 8300 acres. It is proposed to plant 450 acres per annum, for the first fifteen years, and 300 acres per annum thereafter up to the twentieth year. It is considered that the deer can be safely admitted to the first planted section of the deer forest between the fifteenth and twentieth years, and thus, once one-third of the planted wintering has been thrown open to the deer, the remainder of the wintering will be available, and planting can take place in it as necessary. From the twenty-first to the fortieth years, 300 acres will be planted per annum, or a total of 6000 acres in the period. The residue will fall to be planted between the forty-first and the fiftieth years. Thus 75 acres of the original ground will be planted annually; but, by this time, it will be seen in what direction extension can best take place, and new blocks can be added. Towards the end of the period, too, the clearing of some of the parts must begin, in order that the

woods may be brought into the proper rotation. After fifty years it is probable that clean cutting of certain areas can begin, particularly where spruce is grown; but the question of the length of the rotation is highly problematic, and must be reviewed at a later period in the light of experience of the particular ground, and of the direction in which timber utilisation tends.

The planting will thus proceed as follows:—

	acres.
Between the 1st and 15th years (450 acres per annum)	6750
" 16th " 30th " (300 ")	4500
" 31st " 40th " (300 ")	3000
" 41st " 50th " (at least 75 acres per annum)	750
	15,000

The whole area should be divided into three sections, which would ultimately form three separate units of management. Thus in each year the planting will go on simultaneously at three different centres within the area. To begin with, all three sections will be under the charge of one head forester, with an assistant in each of the three districts.

The position of each year's planting up to the fortieth year is shown on Map No. 3, the figures on the map signifying the year in which the planting is to take place. The different colours on the map show the positions of the three sections. The positions of the plantations from the forty-first year onwards are not shown, as in the last period the planting will consist in joining up or extending the existing plantations, in whatever direction seems most desirable.

Nursery.—The extent to which the young plants can be raised locally at the outset will depend on the labour available. About 1,500,000 plants will be required annually for the first fifteen years. The plants required will be 2-year-old seedlings and 3- and 4-year-old transplants. To raise the necessary number of young plants a nursery of at least 12 acres will be required. In the first instance, one nursery will serve, although in the course of time, when the labour question has adjusted itself, it will be found expedient to have at least three permanent nurseries, one for each of the three centres. Temporary nurseries should also be started in the more outlying districts. In Glen Moriston there is room for at least two of these. The temporary nursery is merely a patch of suitable ground within the enclosed area,

which can be brought into condition to receive young plants without much cultivation. The plants are taken from the seed-beds of the central nursery and "lined out" here, one or two years before being planted out. These temporary nurseries are of special value in serving places at a distance from the central nursery, as the material can be got at hand, in such quantities as are required at the moment, for planting out. All difficulties of transport in the busy season are thus done away with. After the district served by the temporary nursery has been planted, the nursery itself is planted up, though a small part of it should be retained for a few years, to provide plants for filling blanks in the plantation.

The most convenient site for the principal nursery is at Auchteraw, a mile to the south of Fort Augustus. The position is central, and it is easily accessible by good roads. The soil is good, and in every way suitable for the purpose. It is at present under cultivation, and can easily be brought into suitable condition. The situation is elevated sufficiently above the bottom of the valley to be beyond the most dangerous frost region. It is airy but not too exposed, as it is sufficiently protected by the higher ground around it. There is also a sufficient supply of running water.

Staff and Labour.—The question of staff and labour for the whole scheme is dealt with, at length, in another section (Chapter VII.), so here, facts relating to the forest work alone will be briefly dealt with. At the outset, the work will consist of raising the young plants, clearing birch, etc., where it exists, planting and protecting the plantations. As the work will proceed on a detailed working-plan the whole area can be put under the charge of one head forester. Under him there will be three assistant foresters or working foremen to take charge of the operations at the three centres. At a later period, when extensive areas of new plantations have been created, and when the stage is reached where the woods must be thinned, it will be necessary to divide the charge. Ultimately three head foresters will be required. At the outset, however, one head forester will be able to undertake the work for the whole area. He will be responsible for the nursery work, the execution of the planting, engagement of workers, book-keeping, etc. It will also be his duty to see that the plantations do not suffer from attacks by game, or from other causes. Rabbit trappers and

forest guards must be directly under his charge. Of these twelve or thirteen will be necessary over the whole area in the beginning. The work of planting, etc., will employ about thirty men with a number of boys to assist. In addition ten men will be employed in clearing and removing birch, etc., while three men will be required to take charge of the fencing. Thus in the first period the staff will include —

- 1 Head forester.
- 3 Assistant foresters.
- 7 Forest guards.
- 6 Rabbit trappers (temporary).
- 30 Planters.
- 6 Boys (to assist planters)
- 10 Woodcutters.
- 3 Foremen fencers.

In the season extra labour will be necessary in the nursery. The work of fencing, draining and bracken cutting can be undertaken out of the planting season, while the work of road-making can fall in any period when work is otherwise scarce. The amount of labour required will remain fairly constant for the first twenty-five or thirty years, after which it will increase considerably. The labour demanded in wood cutting, transport, road-making, etc., is at least three times that necessary in planting alone.

CHAPTER X.

UTILISATION OF THE EXISTING WOODLAND PRODUCE THROUGHOUT THE AREA DEALT WITH UNDER THE AFFORESTATION SCHEME.

By Dr JOHN NISBET.

The existing woodlands throughout the area under consideration are as follows :—

Dochfour	}	NATURAL WOODS—Acres.
Aldourie		
Glen Urquhart		
Foyers		
Dell, Glendoe, Inchnacardoch		
Cullachy	}	<i>Birch</i> , 14,021.
Invergarry		<i>Oak</i> and Scrub, 3,391.
Invergloy		CONIFER WOODS—Acres.
Achnacarry		
Glen Moriston		
		14,775.

In the disposal of part of the produce from the “natural woods” of birch and stub-grown oak and ash, the remains of coppices formerly worked in regular rotation, a market has been gradually developed in recent years; but this requires considerable extension before all the existing mature and over-mature wood can be utilised, in order to grow better crops of timber, and chiefly of the conifers likely to be most profitable. When this can be effected, it must necessarily mean a large additional sum payable locally in wages in felling and preparing, and in transport by road, railway, river and sea. But as regards the existing conifer woods, as the market for their produce is already fully established, there can be no immediate prospect of any direct increase in the employment of local labour, although in future the maturing woodlands should, under continuous good management, provide a much larger yield per acre than is now the case.

I. THE BIRCH-WOODS, aggregating over 14,000 acres, bear on the average a crop of about 10 tons of wood per acre, together with half a ton of brooms or twigs not over half an inch in diameter, as used for burning to remove the surface-scale from steel plates in foundries; for it has been found that, on the average, trees yielding 1 ton of wood give 1 cwt. of twigs. The BROOMS, which must not exceed half an inch in diameter at thick end, are made up in small bundles girthing up to 15 inches at the tying-place, and cost from 15s. to 16s. a ton to put on the railway, including a cartage of about 4 miles, costing 4s. a ton, or 1s. per ton per mile. Railway transport to the steel-works costs per ton 11s. 8d. from Gairloch station to any station in the Glasgow area, and 12s. from Fort Augustus; and 12s. 8d. and 13s., respectively, to any station in the Edinburgh area. The broom-making season extends from October till April; and at Taynuilt (Loch Etive district, Argyllshire) broom-cutters are said to be able to earn up to £3 a week during the 7-months' season. Throughout the Lorne district of Argyllshire the wages at present paid to the broom-workers for cutting and tying in bundles of 20 inches to 24 inches by 14 inches girth is 4d. per dozen bundles.¹

Of the BIRCH TREES yielding on the average 10 tons per acre, from 5 to 10 trees give 1 ton of wood, about 55 cubic feet going to 1 ton weight, or averaging about 41 lbs. per cubic foot. One man can cut and sned 3 tons a day, costing about 1s. 3d. a ton, and thus earn about 3s. 9d. per diem; while if the trees are barked, the piecework is paid at 9d. extra, or 2s. per ton. The cost of dragging and carting is found to come to about 3s. per ton for the first mile, and 6d. per ton for each additional mile beyond the first. The market already established, on a small scale, for birch is for bobbin-wood in Dundee, all sizes being taken from 4 inches in top-diameter upwards. Freight by steamer from Loch Lochy to the east coast of Fife, including dues, is £35 for a 110-ton steamer carrying from 80 to 85 tons of wood; but a returning coal-steamer can sometimes be hired for less. For shipment to Glasgow the rate is 8s. a ton, inclusive of dues. From the Invergarry estate about 400 tons of birch were sold as bobbin-wood to Messrs J. & P. Coats, Paisley, in 1909-10, the wood being

¹ Birch twigs for smelting purposes are taken by certain firms at all times of the year.

delivered f.o.b. at the Loch Oich private pier at 13s. per ton, the forester and his woodmen doing the felling and snedding, and the local crofters being employed to drag and cart the wood at an average cost of about 1s. per ton per mile.

Messrs J. & P. Coats have kindly informed me that the value of the present rough class of Highland birch as bobbin-wood would certainly not exceed 19s. per ton, delivered at their works in Paisley; but they have also added that "it is impossible to say what quantity of wood could be used, as from recent tests made, the spools from home birch are inferior in colour, are much heavier, and show unsatisfactory results after dyeing." These drawbacks can, however, be to a great extent overcome by growing the birch closely in future.

There is also a limited market for birch firewood in Inverness, where sawn blocks sell at from 13s. to 15s. a ton, of which from 9s. to 11s. is the cost of felling, sawing, carting to sawmill and railway station, railway freight, and delivery in Inverness, leaving only about 4s. a ton as the net income from the wood.

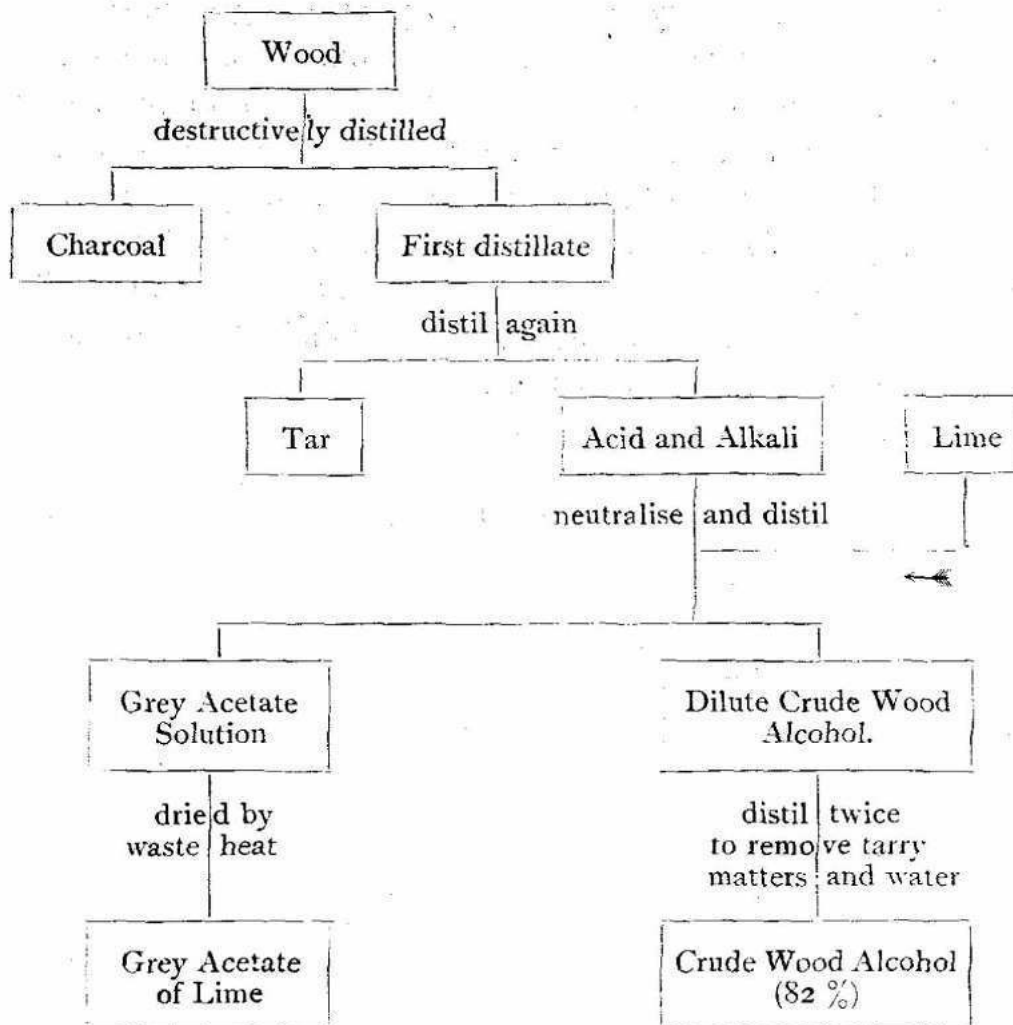
Thus, for each acre of the very thin existing mature birch-woods, for which any market has been found, local employment is given to the extent of at least 7s. 6d. for brooms, and 44s. for felling, snedding and carting, or 51s. 6d. per acre, exclusive of all the further cost of transport by railway or steamer. (*See also III. below.*)

II. THE OAK-WOODS, stub-grown from old coppices, interspersed with ash, alder and birch, and aggregating over 3300 acres, produce a very hard, heavy and tough class of wood, though usually of small dimensions. At present there is little or no demand for the produce of these woodlands, and measurements have not been made of the tonnage available per acre on the average. Some of the smaller stuff is sold as firewood in Inverness at 8s. 6d. per cart load of about 18 cwts., and it is also suitable for pitwood. The 1700 acres on Achnacarry estate "range from about 30 years old upwards. Very few of the trees are as yet of a profitable size, but all have fine long clean stems, and promise to become valuable. The timber is of excellent quality with very little sapwood." Wood of this description seems particularly suitable for making into arms for telegraph and telephone posts, if the Postmaster-General can be persuaded to give a trial order for some (in place of the foreign timber now imported for this purpose).

III. TO ENABLE THE EXISTING NATURAL BIRCH AND THE STUB-GROWN OAK-WOODS TO BE CLEARED PROFITABLY, with a view to gradual replantation according to a definite scheme of operations, it is essential that new markets be developed for utilising the produce of the crops, such as these now are. If large areas be planted annually, a considerable quantity of fencing will have to be done, and much of the oak can thus be utilised; and also birch, Scots pine, etc., if creosoting tanks be made for treating the wood to increase its durability to about 16 years or more. The very cheapest form of fencing against hill-cattle and sheep costs £33 to £35 per running mile, or 4½d. a yard, while a deer-fence (5½ feet high) costs £60 to £65 a mile, or nearly 8¼d. a yard; and in either case over one-third of the total outlay, *i.e.* over £11 and over £20 per mile, respectively, is spent on labour employed in the construction of the fence, and in addition to the sums already paid for felling and pointing the straining posts and stobs, cartage and hauling.

With special regard to birch, which comes up freely and grows well wherever sheep and cattle are taken off the land and rabbits are kept down, the present poorly-grown crops unfortunately do not yield first-class bobbin-wood of clean growth and free from knots, which can be used from 3 to 4 inches top-diameter upwards. Scottish birch is heavier than Canadian, and heavier still than Finnish; and in the case of a very large thread business, such as Messrs J. & P. Coats of Paisley, the extra weight of the bobbins makes a considerable difference in the firm's freight and transport bill during the course of a year.

One new industry capable of being introduced locally, and of utilising both the birch and the oak and other hardwoods growing among them, is the destructive distillation of wood for the preparation of pyroligneous acid, grey acetate of lime, crude wood alcohol, and charcoal, as roughly outlined in the following process of treatment:—



Messrs Turnbull & Co., who have wood-distilling works at Glasgow and at Balmaha (Loch Lomond), have kindly informed me that the quantity of wood needed to be guaranteed annually for a small factory of 6 retorts is from 1200 to 1500 tons' weight (green). They pay from 9s. to 10s. a ton for the wood at Balmaha, and 10s. to 12s. in Glasgow, the wood being in each case delivered at the works. Oak, beech and birch are taken at that price, and peeled oak is preferred to any other wood. If the oak were ringed to free it from bark and season it, a better price would be paid for it. The capital needed for a 6-retort factory would be from £2000 to £3000; and it would give constant employment in the factory for 8 or 9 men—not counting any of the employment given in the woods in felling, and in transport and delivery to the factory. And Mr Turnbull kindly told me he would willingly co-operate, though not himself prepared to erect new factories elsewhere than he has them at present (Glasgow and Balmaha).

IV. THE CONIFER WOODS AND PLANTATIONS, aggregating

14,775 acres, and varying up to 140 years of age, consist mainly of larch and Scots pine, sometimes pure, sometimes mixed; while spruce also occurs here and there, either in pure patches or interspersed occasionally among the pine and larch. The details obtained regarding all these conifer crops will be found in Chapter VIII., as to their age, composition, average number of stems, and average cubic contents per acre. Their general character may perhaps be sufficiently indicated by summarising the details for the Aldourie estate:—

Kind of Crop.	Young Plantations (under 35 years old).	Old Woods (over 35 years old ; mostly from 80 to 140 years).	Total.
	Acres.	Acres.	Acres.
1. Larch, pure or mainly pure,	40	110	150
2. Scots Pine, pure or mainly pure, . .	28	350	378
3. Larch and Scots Pine, mixed,	5	390	395
Total,	73	850	923

As already remarked, steady markets being already secured for the produce from these conifer woods, their exploitation will not provide *additional* employment for the local population, though it is expected that the new crops to be grown on the land when these mature and are cleared will be considerably larger, and will, therefore, in course of time, give larger employment in felling and logging, hauling and carting, sawing and converting, and transport and distribution. There should then be a larger out-turn per acre than at present both for pitwood of the usual dimensions (3, 5 and 7 inches top-diameter, up to 8 and 9 inches at the butt), and for the larger stem-pieces sawn into boarding for boxes, sarking, etc.

V. IF NEW AND GREATLY EXTENDED CONIFER PLANTATIONS BE FORMED in accordance with this afforestation scheme, the present small estate mills will have to be enlarged, or a large central sawmill may be erected at Fort Augustus, together with a creosoting plant, a bobbin-mill, and other works, all of which must both directly and indirectly add greatly to the amount of

work provided for an increased local population. Without attempting to make forecasts having an appearance of exactness, but being possibly misleading, it may be more appropriate here to give a summary of actual results obtained within the last ten years from the sale of larch growing on rough grazing land on a hillside in the West of Scotland, but the exact locality of which I am not at liberty to state. The hillside has a north aspect, and is exceptionally favourably situated close to a sea-loch with easy and very exceptionally cheap transport by ship to the Clyde. The wood was felled at 41 years of age, and gave 380 trees per acre, with the following financial result:—

Income.

943 cub. ft. sold at 1/3 ¹	.	.	£58	18	3
85 „ for home use at 1/-	.	.	4	5	0
7188 lin. ft. 5 in. pitwood at 32 ¹ / ₂ %			115	0	0
1638 „ 4 „ 19/6 %			15	19	3 ¹ / ₂
1200 „ 4 „ 18 ¹ / ₂ %			5	8	0
4188 „ 3 „ 8 ¹ / ₂ %			18	6	4 ¹ / ₂

Total, £217 16 11

Expenditure.

Felling, Logging and Carting	.	£32	13	6
Freight and Lighters; and Railway charges on 102 tons.	.	26	14	2

Total, 59 7 8

giving a *net Income* per acre of . . . £158 9 3

In this case both the expenditure on carting and also that on transport to the place of consumption happened to be exceptionally low; but they serve to show how large may be the sums payable to local labour, in respect of the utilisation of woodland produce, and in addition to wages paid for planting, thinning, tending, etc. These figures have been given by the forester who felled and sold the timber, and with the sanction of the estate factor; and I desire here to thank them both for kindly placing such interesting and instructive data at my disposal.

With regard to the prospects of establishing wood-pulp and

¹ Is. a foot for good larch timber *in situ* is the usual market price.

cellulose factories near the woods later on, when much larger supplies and more suitable material may become available, it would seem unwise to attempt to make anything like detailed estimates. And the probability is that the pitwood and timber value of the good conifer crops that Scotland can easily produce under proper management, will always be greater than what pulp or cellulose may yield.

Mechanical or ground wood-pulp could easily be produced locally by utilising the ample water-power to be found on the hillsides; but the impression of the pulp-firms I have consulted is that, even in the future, it may probably be cheaper to buy foreign pulp, as at present. Time alone, however, can prove whether this opinion be correct or not. As regards cellulose-making at some central factory the case may be different, though no useful purpose can be served by making financial forecasts of this sort about timber crops that have as yet not been planted. It may be mentioned, however, that for making paper of the kind used for the daily newspaper press, the materials used are in the proportion of 30 per cent. unbleached sulphite pulp and 70 per cent. mechanical pulp; and to produce 100 tons of sulphite pulp about 300 tons of wood are needed (preferably spruce). A paper mill can only pay if it turn out 200 tons of paper weekly, the raw material required for which would be from 400 to 500 tons of wood weekly, or at least 20,000 tons of wood per annum. But, of course, this minimum total quantity for profitable paper-milling could be cut and pulped at several different localities, to supply the central paper mill.

The amount of labour that cellulose factories would provide can be judged of from the fact that the poles used have to be hand-spokeshaved to remove the bark (loss 8 per cent., against 15-16 per cent. if mechanical apparatus used) and all knots punched out, before chipping the wood previous to boiling and macerating it with calcium sulphite.

VI. TO SUMMARISE BRIEFLY, without attempting to give detailed forecasts, any extensive afforestation scheme will, besides giving much work in draining and other soil preparation, fencing, rabbit exterminating, nursery-work, planting and tending (see Chapter IX., Working-Plan), provide new or greatly increased sources of employment throughout the district. There will be much more labour needed for felling, logging, extracting and preparing the timber for market, and in trans-

porting it to its place of consumption; while new industries, such as wood-distillation, will have to be created locally to clear the natural birch and old stub-grown oak woods before the soil can be suitably prepared for planting. In this respect a reference may here well be made to the Memorandum issued, on 14th February 1911, by the Management Committee of the General Federation of Trade Unions in the United Kingdom, in which it was urged that—

“To absorb surplus labour, an appeal is made for afforestation. The employment furnished by the present uses—mostly sheep-farming—to which the land is devoted may be taken, it is stated, to average one man per 1000 acres. This does not represent one-tenth of the permanent employment afforded by the maintenance of a similar area under forest. A special advantage of forestry in relation to labour is that it offers new sources of employment. The labour connected with timber and timber products imported into the country is performed abroad; the labour incidental to home-grown timber would be performed in the country, and would afford maintenance for many thousands of families.”

What the actual labour bill in extensive forests amounts to can be well judged of from the returns published regarding the Prussian State forests. With a total area of about 7,000,000 acres, they yielded, in 1904, over 412,000,000 cubic feet of wood, equal to a fall of about 65 cubic feet per acre actually stocked; and of this more than one-half was used as timber, and nearly one-half as fuel. The gross income was over £5,854,400, THE EXPENDITURE £2,755,230 (OR AVERAGING 7s. 10½d. PER ACRE), and the net income £3,099,107, showing a net revenue of 9s. 7d. per acre actually culturable. During the year 32,000 acres were naturally regenerated, sown, or planted at a cost of £43,500; and EMPLOYMENT WAS GIVEN TO 156,772 HANDS FOR A TOTAL OF 10,479,589 DAYS.

CHAPTER XI.

CONCLUSION.

In submitting this Report to the Council of the Royal Scottish Arboricultural Society, the writers are well aware that individual members of the Council will not be able to accept every detail in a statement which deals almost exclusively with the special circumstances of the Glen Mòr district.

Minor points of "local variation," though interesting in themselves, do not affect the main issues under discussion; and if the writers may ask a single favour of their readers, it is that criticism should be directed, not to detail, but to the main principles involved in the scheme described in this Report.

In framing their proposals, the writers have endeavoured to show how a State-aided and State-controlled scheme of afforestation might be initiated on the line of least resistance, and how the best results could be obtained from any given expenditure. Their aim throughout has been to present a solution fair both to the State and to all of those whose interests are touched by afforestation; and with this end in view, they have taken as the determining factor in all matters of compensation or leasing, the minimum which trustees would be justified in accepting in the case of a property held on trust. They have, so far as possible, avoided debatable points on which the attention of party politicians is mainly focussed, believing that nothing could be more fatal to the policy of afforestation than to allow it to become, as it were, the private property of any one party in the State.

In concluding their Report, the writers wish to recapitulate and emphasise certain convictions which have been formed in their minds during the course of this inquiry.

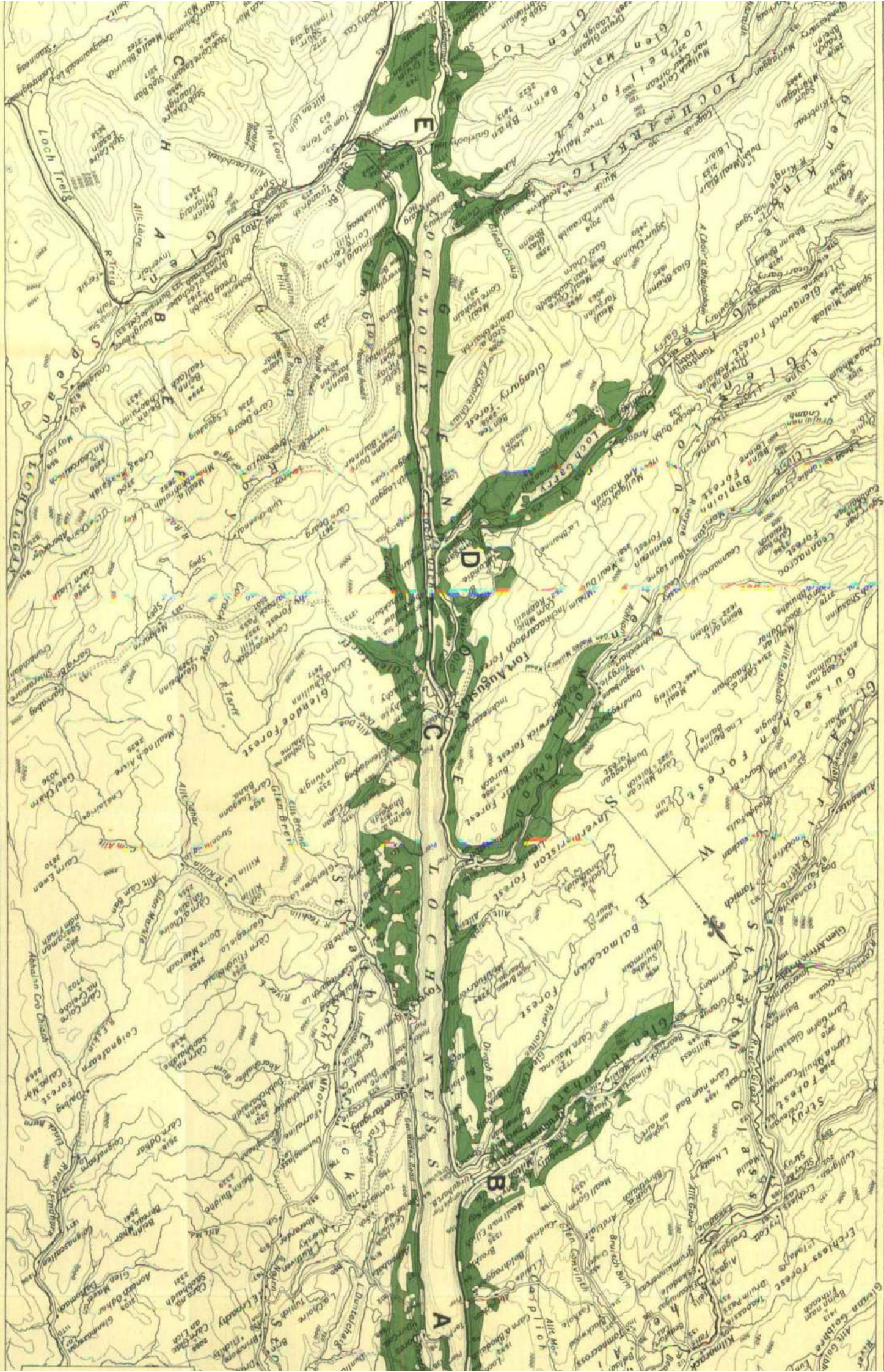
1. The survey of Glen Mor tends to prove that there exists in Scotland a large extent of land admirably fitted for afforestation.

2. Under a well-framed scheme large areas of land can be afforested without serious injury to existing interests and means of employment, and without imposing any undue burden on the local rate-payers.
3. Afforestation on the lines suggested would, eventually, not only pay its way, but bring in a considerable return to the Forest Authority. [The writers have refrained from making any forecast of ultimate profits. They prefer to rely on the incontestable evidence of results already obtained at Aldourie, Dochfour, Glenmoriston, Invergarry, Invergloyle and Achnacarry to prove that profitable crops of timber can be grown in the district. It is a fair deduction from the results yielded by, or now visible in, plantations not always scientifically managed, and in no case under continuous control that improved silvicultural methods, practised under a regular working-plan, will give returns even more satisfactory than those already realised.]
4. A great deal of permanent and periodic employment will be given by the establishment of Forest Centres, and the periodic employment will be at the time of year and of a nature especially suited to small holders.
5. There is no reason for delay either in the commencement of the Surveys (General and Particular) or in the establishment of one or more Forest Centres.
6. The final and conclusive test of the value of afforestation must be its ability or inability to improve the existing condition of a given district as to population, employment and economic returns. If, by means of afforestation on a financially sound basis, land which is too poor to cultivate can be made to give more employment, and support a larger population than it is capable of doing under pastoral or sporting conditions, then the future of afforestation,

as a means of increasing the prosperity of the Highlands, will be assured.¹

7. The progressive decrease of rural population in Scotland revealed by the Census returns is causing grave anxiety to all who are concerned for the national welfare. Silviculture offers a remedy which (as it has been the object of the writers to show) can be put to the proof on a considerable scale at no prohibitive expense; and a united demand on the part of the foresters of Scotland is the first step towards securing such a trial.

¹ The Highlands and Islands Commission (1892) scheduled in Glen Mor 900 acres of old arable land as suitable for cultivation, and for extension of existing holdings or creation of new ones. If 10 acres are taken as the average holding capable of supporting a family by agriculture alone, 90 families over and above the existing population can be established in Glen Mor; if 20 acres, then 45 families. The present Survey shows 60,000 acres of land immediately afforestable. Within the first 20 years 1 family to each 200 acres of forest area, or 300 families, could be supported by afforestation. After the 40th year 600 families could be supported.



10 Miles

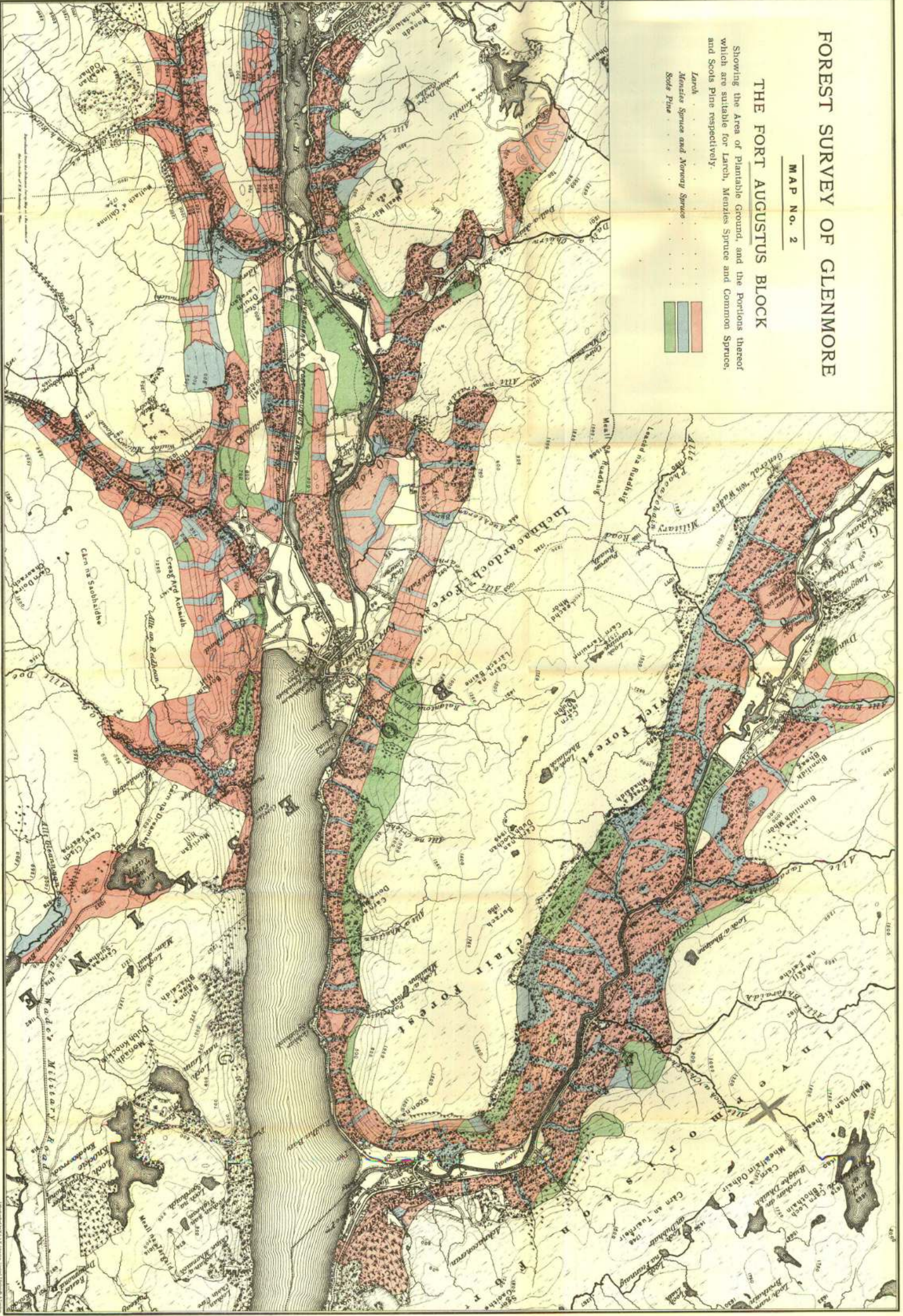
FOREST SURVEY OF GLENMORE

MAP No. 2

THE FORT AUGUSTUS BLOCK

Showing the Area of Plantable Ground, and the Portions thereof which are suitable for Larch, Menzies Spruce and Common Spruce, and Scots Pine respectively.

- Larch
- Menzies Spruce and Norway Spruce
- Scots Pine



Scale 1:50,000

FOREST SURVEY OF GLENMORE

MAP No. 3

THE FORT AUGUSTUS BLOCK

Showing the Order of Planting in the Three Sections into which the Block is divided. The numbers signify the years of Planting.

GLEN MORISTON SECTION

To be Planted from 1st to 10th year (N^o 1 to 15)
 " 16th " 80th " (N^o 16 - 30)
 " 31st " 40th " (N^o 31 - 40)

FORT AUGUSTUS, NORTH SECTION

To be Planted from 1st to 10th year
 " 16th " 80th "
 " 31st " 40th "

FORT AUGUSTUS, SOUTH SECTION

To be Planted from 1st to 10th year
 " 16th " 80th "
 " 31st " 40th "

