

Commission of Conservation, Canada

Constituted under "An Act to Establish a Commission for the Conservation of Natural Resources", 8-9 Edward VII. Chap. 27.

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FOREST CONDITIONS OF NOVA SCOTIA

By

B. E. FERNOW, LL.D.

Dean, Faculty of Forestry, University of Toronto, and
Member of the Commission of Conservation

Assisted by

C. D. HOWE, Ph.D. and J. H. WHITE

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OTTAWA, CANADA

1912

TO FIELD MARSHAL, HIS ROYAL HIGHNESS PRINCE
ARTHUR WILLIAM PATRICK ALBERT, DUKE OF
CONNAUGHT AND STRATHEARN, K.G., K.T., K.P.,
&C., &C., GOVERNOR GENERAL OF CANADA

MAY IT PLEASE YOUR ROYAL HIGHNESS :

The undersigned has the honour to lay before Your
Royal Highness a report on Forest Conditions in Nova
Scotia by Dr. B. E. Fernow.

Respectfully submitted,

CLIFFORD SIFTON,

Chairman

OTTAWA, June 29th, 1912

OTTAWA, June 28, 1912

SIR :

I have the honour to transmit herewith a report on Forest Conditions in Nova Scotia. The report is based on information gathered from a reconnaissance forest survey of the Province which was carried out under the direction of Dr. B. E. Fernow, Dean, Faculty of Forestry, University of Toronto. The expense entailed in making this survey was paid by the Government of Nova Scotia.

In accordance with a request made on behalf of the Commission of Conservation, the Hon. O. T. Daniels, Attorney General of Nova Scotia, courteously allowed the Commission to publish the information thus obtained.

I have the honour to be

Sir,

Your obedient servant

JAMES WHITE,

Secretary

HON. CLIFFORD SIFTON,
Chairman, Commission of Conservation

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PREFACE

It was largely through the instrumentality of the Lumbermen's Association of Western Nova Scotia that the Government of Nova Scotia was induced to undertake a forest reconnaissance of the Province. Negotiations in this direction date back to the early part of 1908, but it was not until April, 1909, that the Government decided to undertake this reconnaissance and entered into correspondence with the undersigned.

After personal consultation with the Attorney-General and Commissioner of Crown Lands, Hon. Wm. T. Pipes, it was agreed to make the reconnaissance during the two summers of 1909 and 1910. This project was also heartily endorsed by Hon. A. K. Maclean, successor to Mr. Pipes, and continued under him through the second season.

By choosing the summer season it was possible to secure the competent assistance of two members of the staff of the Faculty of Forestry at the University of Toronto, Dr. C. D. Howe and Mr. J. H. White, who are mainly responsible for the result. They devoted both seasons to the task, and deserve the highest credit for the success and unusually economical performance of the undertaking.

In addition, during the first season, Mr. H. B. Ayers, an experienced timber looker, was employed for part of the time, and in the second season, three advanced students of the Faculty of Forestry, all of whom contributed faithfully to the result.

Mr. J. B. Whitman, Provincial Forest Ranger, was detailed to assist in the survey, and rendered invaluable service from time to time during the first season.

Preface

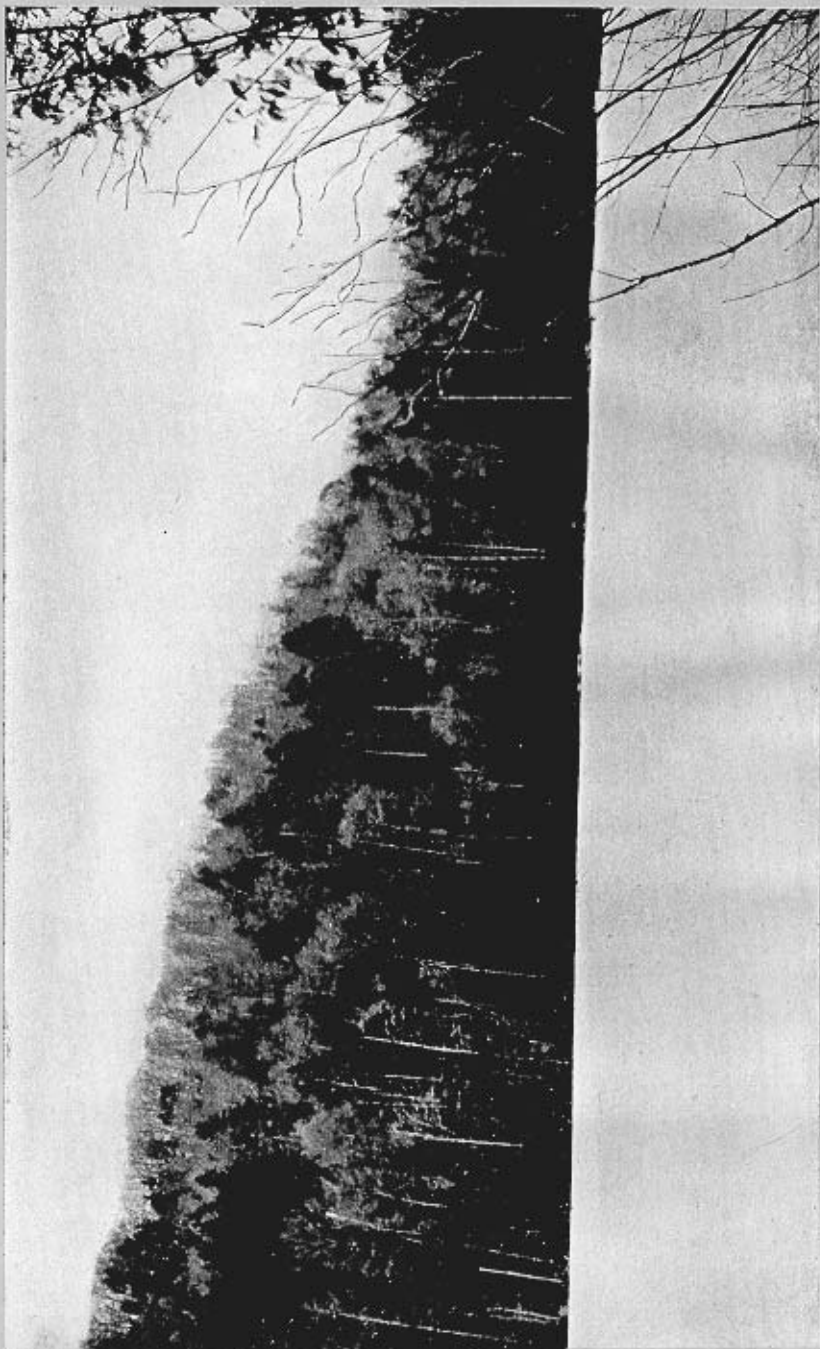
Mr. F. C. Whitman at all times furthered the progress of the work by suggestion and by reference to lumbermen for information, and in other ways.

Altogether, but for the willing assistance of timberland owners, surveyors, fire rangers, and the people generally, who seemed everywhere to take a warm interest in the undertaking, it would have been impossible to accomplish the work in so short a time and at so small an expense.

To express the obligations of the survey party to their informants by name would require the listing of hundreds. It is proper, however, to express special thanks to the Honourable Minister of Railways and Canals for the issue of passes over the Intercolonial railway for the survey party, in recognition of the value to the nation at large of this first attempt to take stock of one of the natural resources of one province.

B. E. FERNOW





MIXED FOREST, SUGAR MAPLE, YELLOW BIRCH, RED SPRUCE WITH FIR ON THE MARGIN OF THE LAKE. NEARLY THREE-FOURTHS OF THE FORESTS OF NOVA SCOTIA ARE OF THIS TYPE

Forest Conditions of Nova Scotia

BY B. E. FERNOW, LL.D.

Object and Aim of the Forest Reconnaissance

THE most obvious and general reason for ascertaining the extent and conditions of the forest resources of the Province—and every province should follow the same enlightened policy—is that it appears foolish to administer or prescribe regulations for a property in ignorance of what it is. This applies to public property as well as to private. Ignorance of the assets of the Province as a whole, as well as of the conditions of the remaining Crown lands, becomes, in time, inexcusable. The Government is certainly justified in ascertaining these conditions, for it alone can do so satisfactorily, and it alone is, or ought to be, concerned in every acre of the Province, be it owned by farmer or lumberman or by the Province itself.

This reconnaissance, then, is to dispel ignorance as to this important asset of the Province ; to substitute definite knowledge in place of general notions as to the conditions of timber supply, and to accentuate the necessity for more conservative use and, perhaps, for recuperative measures. It is a first clearing of the decks.

Such a survey should furnish approximately correct information regarding the extent, character and condition of the forest resources of the Province, with a view to prognosticating the future and furnishing a basis upon which the Government might formulate a policy, not only for the Crown lands still in its possession, but for the Province at large.

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When it is realized that fully two-thirds of the area of the Province consists of non-agricultural land covered with forest growth or not fit for any other use than timber growing, and that this forest resource, which furnishes not less than four to five million dollars in value of product annually, is in danger of exhaustion within the next two decades, the importance and propriety of the inquiry into the character and possibility of continuing it, can hardly be questioned.

There would have been little use in attempting a very accurate and detailed survey, which would have entailed an expenditure disproportionate to the value of the results and unnecessary for their intended use. Just as the figures of our decennial Census, even of the population, are only approximations—or, if by accident they were absolutely correct at the time of enumeration, would be wrong at the time of publication—so, with regard to the forest resources, only approximations and general averages are attainable and desirable ; for each year sees changes from virgin into culled, from culled into stripped, from stripped into burnt forest or into new young growth, so that no great accuracy is desirable, even if it were practically attainable. Yet, there is a vast difference between a systematically ascertained approximation and a haphazard guess of even the best informed. The best informed usually can have only local and partial knowledge.

Moreover, the survey has been made by foresters, who can describe conditions better than even most timber lookers. These latter approach the problem from a different point of view, than the forester, who keeps in mind that the information is to be used for the purpose of advice as to future treatment.

Perhaps it should be accentuated that such a reconnaissance cannot aim to supply detail information for private commercial purposes, not having had such purposes in view. It would be dangerous in any single case to rely on the information regarding a given lot, or from lot to

Object and Aim of Survey

lot, as to detail ; it is only the grand total or the average that is approximately correct and of value, the errors of detail compensating each other.

This point will be appreciated by practical men when it is stated that a *reconnaissance* and not a *detail* survey is involved, and that the total expenditure, including the compilation of data, map and report was not to exceed, and did not exceed, \$6,000. The field work alone had therefore to be accomplished for the remarkably low cost of 25 cents per square mile of country, while any attempt at estimating the standing timber closely would have involved an expenditure of from \$10 to \$20 per square mile.

Method of Survey

The first problem to solve was to devise a method which, with this limitation of expenditure, would still furnish satisfactory results. After looking over the general conditions of the country, the method was based on the theory that, in a country so well settled and accessible and with so many small holders, there was to be found for every lot somebody, or several persons, who were fully informed regarding its conditions. It would, therefore, be possible to find such informants, to check the information of one against that of another, and also to check it by personal inspection here and there, especially where differences of opinion existed. Thus, we would have to travel only over territory for which information could not be secured, or for the purpose of studying differences of type and making sure that the description of the interviewed and the conception of the interviewer tallied.

In this way, it was possible to reduce the amount of expensive and slow travel to a minimum ; no camp outfits and only rarely helpers were required, since accommodation could mostly be found on the road and in lumber camps. Incidentally, the good purpose of interesting the people

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in the whole proposition was served by this method of procedure.

Instead of organizing, therefore, a survey party travelling together, each member was left more or less to himself, a certain territory being assigned to him with instructions to use his own discretion as to the most suitable means of progress,—by foot, by wagon, by rail or by canoe, as the case might be.

In this way, the information possessed by timberland owners regarding their own and their neighbour's holdings, checked by personal inspection, and by information from other sources, such as surveyors, timber lookers, woodsmen, etc., was brought together. The lumbermen, especially, were most generous in imparting information, sometimes of a quite confidential character, which, of course, is utilized only in statements of averages.

It should be acknowledged here that an unusual number of intelligent and well-informed men throughout the country were encountered, and this fact, of course, did much to make the method successful.

The basis for recording the information was furnished by the survey plats of the land grants from the Department of Crown Lands, specially compiled and black-printed in sheets for this purpose. With these, it was possible to go over the ground, lot by lot, with the informants, and, by symbols, mark on the plat the condition of the lot. The information, after it had been checked, was then directly platted in the field by means of coloured pencils, numbers and letters denoting different conditions ; so that the field map forms the basis for compiling the information, as well as the basis for transfer to a map on a smaller scale for publication. These sheets, containing the plats of original surveys of granted lands, on a scale of 2 inches to a mile, filed with the Department of Crown Lands, represent probably the most detailed description of land conditions in existence for such a large territory (21,000 square miles), on this continent, at least.

Object and Aim of Survey

Unfortunately, these survey plats are, as is well known, often very inaccurate ; hence, the platting of the information could not in most cases, be more accurate than the map. This feature also accentuates the wisdom of not attempting any too great accuracy. The inaccuracies of the surveys are due to two causes : firstly, to the absence of a system of triangulation or other means of basing new surveys on definitely located standard lines, a circumstance which must have been especially troublesome because no system in locating lots was followed as in other Provinces ; and secondly, to mistakes, wilful or otherwise, of surveyors in the field. On account of the latter cause, 100-acre grants were sometimes run to contain as much as 800 acres and more, although recorded and platted on the maps as of the granted acreage. When it is stated that, in one case, a lake with its adjoining lots was found seven miles out of its actual location, the difficulty of platting information, and the uselessness of attempting too much accuracy, will be realized.

Another important point hinges on this condition of the survey work. Theoretically, whatever lands appear on the map sheets not covered by granted locations are supposed to remain in the ownership of the Crown ; but since the located surveys in the field, and the platted surveys on the map often enclose different acreage, the seemingly open lands in many cases do not exist, or are not of the size called for.

The original plan of examining the Crown lands more closely had, therefore, to be abandoned, because their location was quite uncertain. A running of survey lines would appear necessary before an investigation of the value of these lands could be undertaken. Apparently, they are to a large extent in the barrens or semi-barrens, all the good land having been covered by grants. These barrens, however, are still of value or may be made valuable eventually.

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Kind of Information Gathered

In the reconnaissance, the following points were generally ascertained in detail: the composition or type of forest; the degree of culling; the extent of burnt areas; the condition of reproduction; the character of the barrens; the natural meadow lands; and the cleared lands. Incidentally, for the purpose of arriving at tenable average figures, the stumpage of different parcels was ascertained, and also some studies on the rate of growth in culled areas were made. Dr. Howe has also analyzed a series of soil samples as a basis for his discussion on their fitness for forest growth*

In large farm areas, no precise separation of the woodlots was attempted. Especially along the water front, fields and woodlots present a very mixed condition. Here a general estimate of the percentage of wooded area within the farm district was made, and added to the woodland area.

In order to reduce the great variety of forest conditions which are met wherever man has interfered with Nature's work to a manageable number for statement, three grades were usually recognized, namely "severely culled", when more than half the timber was removed, "moderately culled", when not more than one-third to one-half was removed, and "virgin", when no timber, or only the pine and heaviest spruce had been removed in earlier times. Similarly, the reproduction, that is, of conifers, was noted as good, medium, or poor, and areas of young or second growth were specially noted.

It should be acknowledged, that the distinction of severely culled and moderately culled condition could not be made a very definite one, and in given single cases the classification would often be doubtful. In the general averages, however, errors will be largely compensated, with a tendency, no doubt, to increase the acreage of the

*See p. 78, *et seq.*

Object and Aim of Survey

more favourable condition beyond the actualities. The object of the classification will, on the whole, have been attained, namely, to give an idea as to the promise of producing capacity of the forest.

On burnt areas, the recent fires, and those of earlier date were separately stated, so as to give an idea of their probable recuperation. Wherever ascertainable, the exact year of the fire was noted.

In some places, fires have repeatedly swept over the same area, creating veritable barrens. These were specially noted. In other places, fires sweeping over large areas would leave patches of timber standing,—patches which were, however, too small to make their exact situation and extent worth ascertaining. In such cases, the whole region was indicated as burned over, but with a sign denoting the existence of green patches, and an estimate of the amount of such green spots was made.

The barrens, a term applied promiscuously to territory relatively unproductive, of which there are large areas, form a most interesting object for ecologic and economic study. There are at least six types of barrens, some of them natural barrens, others made by man, some doomed forever to remain in unproductive condition, others capable of redemption, either for timber or pasture. Most of the reputed Crown lands are in this condition, and a closer investigation, and experiments to find out the best way of making them useful, would be proper.

The belief is abroad that all the barrens are the result of repeated severe fires. Dr. Howe's interesting special study, which forms part of this report, should go far to dispel this belief; for his conclusions are based on investigation, and not merely on opinion or belief. While fire is, or may be, the true explanation in some cases, and while probably all barrens have been burned over at some time, this is certainly not the cause in other cases, which are demonstrably the result of natural causes. The barrenness in these latter cases will usually be found to be due to charac-

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ter of soil and to either excessive, or deficient drainage, rock barrens, swamp barrens of several types, and real heaths. The barren region, composed mostly of ungranted lands, which is located around the common corner of the four counties, Digby, Yarmouth, Shelburne and Queens, and in the southwest corner of Annapolis, is very likely to a large extent, a result of repeated fires. It exhibits, however, the greatest variety of conditions, and, like some of the burned areas referred to, contains blocks or islands of green timber, either swamps or hardwood hills, or stands of pine, occasionally of good development. No attempt was made to locate these islands, except where owned by grantees, the lack of tie-lines forbidding the attempt.

As regards composition of the forest, the great variety was reduced to three types, namely pure hardwoods, pure conifers, and the mixed conifer and hardwood type. Purity, to be sure, is only relative, since there are rarely to be found absolutely pure stands. To constitute the last, or mixed type, an admixture of either hardwoods or conifers to the extent of at least 20 per cent. numerically (trees, not logs) would be necessary. To denote the relative prevalence of the different species in any of these types, these were noted in parenthesis, in the sequence of their predominance, so that, if needed, further differentiation into sub-types would be possible.

As regards the prevalence of certain species in different localities interesting data were gathered. Especially the three important conifers, pine, spruce, and hemlock, while they occur everywhere, exhibit more or less localization. Thus, for instance, Annapolis county can be called the hemlock region, this species forming 60 to 70 per cent. of many of the uncut stands. The interior of Digby also is largely hemlock country, while the shore lands are spruce country, this species forming perhaps as much as 75 per cent. of the forest. Shelburne and parts of Queens are largely pine country, while Cape Breton Island is a veritable fir country.



FIR AND RED SPRUCE BENEATH PAPER BIRCH REPRESENTING A PREVAILING
TYPE ON SEVERELY CULLED UNBURNED AREAS ON GRANITIC SOILS

Object and Aim of Survey

Besides the field plats, which show the distribution of the land classification in full detail, a map from which reduced maps may be made, has been prepared, showing by various hatchings in black, the location of the different conditions on the scale of 4 miles to the inch.

Dr. Howe furnishes a special chapter devoted to general description of the country, and of forest types with special reference to their distribution on different soils. He also makes a special point of discussing the problem of the barrens and the reproduction on burned areas. These studies form an important contribution to this report. While they were only incidental,—relatively little time was spent on them,—they will be found sufficiently detailed to give an insight into the character of the soils, and the relation of forest growth to them.

Physiographical Features

From the more detailed description given by Dr. Howe, we may summarize briefly the essential physiographical and geological features, soil formations and forest descriptions. We may divide the Province into three regions, differing in character in these respects, namely, the Southern (Atlantic) slope, the Northern slope—two areas of equal extent constituting the mainland—and Cape Breton Island.

The Atlantic slope is located on granite, quartzites and slate, besides glacial deposits, and is topographically much diversified, with hills and dales, lakes and swamps. Three-eighths of the western peninsula, or 3,000 square miles, and only 550 square miles on the eastern peninsula, are granitic, more or less disturbed by ice action. While, on account of rocky conditions, this granite area does not often furnish good farming ground, it furnishes good forest soils, especially where sorted by glacial movement. The thinner soils on the ridges are usually covered with coniferous growth, mainly fir; the slopes, with mixed growth; the gentler slopes and bases, with spruce and hemlock.

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Occasionally barrens, natural or fire barrens, and swamps are encountered.

The quartzite areas which enclose the centrally located granite area are formed of less easily disintegrating, harder rock, and give rise more frequently to barrens; while the slate formations and the better glacial deposits in the valleys are the farm country, or support the better character of forest growth. These two formations cover about the same extent in the western counties as the granite, but in the eastern counties the quartzite areas far exceed both the granite and the slate formations, and hence the growth conditions are, as a rule, less favourable.

The glacial deposits generally bear the best forest growth, but, even in these, when too coarse and over-drained, conditions are occasionally found favouring barrenness.

The northern slope, or drainage basin of Northumberland strait and Minas basin, although simpler in topography, is geologically, and hence as regards soil and forest growth, much more diversified, being composed not only of igneous (felsites, syenites, diorites) and metamorphic (schists) rocks, but also of sandstones, slates, conglomerates, limestones, and, to a smaller extent, glacial drift. Not only more and better developed hardwood growth, but more luxuriant forest growth generally, is found here, although all the forest types of the southern slope are repeated, and there are, moreover, some (jack pine) which are absent on that slope.

Cape Breton Island can be subdivided into two distinct sections, the Southern peninsula, an undulating plain, and the Northern peninsula, a high plateau, with very little topographic differentiation except in the northern part, where it is broken up by hills.

The composition of the forest varies mainly according to differences of soil, climatic differences being too small except on the plateau of Cape Breton and on the higher mountains, to have much effect. Generally speaking,

Classification of Forest Trees

the forest types are mixed,—broad-leaf and conifers grading off to pure stands of conifers in mixture, or to single species, and to pure stands of broad-leaf trees in mixture. Stands of single species, or nearly so, are rare, and never of large extent, excepting where the poor soil conditions give rise to jack pine plains in Colchester county, interspersed with swamps and birch ridges, and where climate combined with soil, give rise to the fir forests of Cape Breton.

Species of Forest Trees Occurring in Nova Scotia

A. CONIFERS

White Pine (*Pinus strobus*) is a species universally distributed in mixed stands, the original stand being almost entirely cut, but in certain parts (Shelburne, Queens), it is well represented in second growth.

Red Pine (*Pinus resinosa*) is found only occasionally on gravelly soils, especially of granitic origin, and on practically all sandy plains. If, in one place more common than another, it may be said to be in Lunenburg and Queens counties.

Jack Pine (*Pinus divaricata*) is found only in special localities on poorest sites in Colchester county. It is not of commercial value.

Red Spruce (*Picea rubra*) is the principal lumber tree of the Province, found everywhere, but especially well-developed in the moister situations.

White Spruce (*Picea canadensis*) is not, as is so often believed and claimed, the principal species. It occurs in the virgin forest only in small numbers, hardly exceeding one per cent. But on pastures and openings, it rapidly takes possession of the ground, and in those conditions grows exceedingly rapidly. It occupies especially the coastal regions, and probably is most abundant in Digby and Yarmouth counties and on the Canso side of Guysborough county. The lumber is inferior to that of the Red Spruce.

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Black Spruce (*Picea mariana*) is the principal spruce of the swamps, where it grows, rarely to large size ; it is seldom found on uplands and in the lumber forest. In the swampy ground it is naturally a slow grower, and is useful only for mine props and pulpwood.

Balsam Fir (*Abies balsamea*) is often confounded with, or called, White Spruce, especially in Cape Breton. It is the most ubiquitous and, numerically, the most frequent conifer. It is found in all parts of the Province, but especially in Cape Breton, where, on the plateau, in the northern peninsula, it forms an almost pure continuous forest, with small additions of Red Spruce and White Birch. It is the species which most readily reproduces itself, being very shade-enduring, and grows as rapidly as the White Spruce, or even more so, but it is rather short-lived, and, at present, very generally liable to a disease and early rot. For pulpwood, it is as valuable as spruce.

Hemlock (*Tsuga canadensis*) is more localized in its distribution than the preceding conifers, with the exception of Red and Jack Pine. It is found in fresh soils, especially in the southwestern counties. Its value as a lumber tree is increasing.

Larch (*Larix laricina*), locally called "juniper", is associated with Black Spruce in swamps. The old growth has been destroyed by the sawfly, but the young live growth is to be seen frequently.

B. BROAD-LEAF TREES

Yellow Birch (*Betula lutea*). This valuable lumber tree stands third in abundance among the prevailing hardwoods, being outnumbered by beech and hard maple. In the eastern counties, however, it surpasses both of these in abundance.

Paper or White Birch (*Betula papyrifera*). Frequent throughout the Province, but it is most abundant in the eastern portion, especially in Guysborough county.

Classification of Forest Trees

Gray or Wire Birch (*Betula populifolia*). This is not a commercial species, except, as used locally for hoops, but it is one of the most common trees, since it generally takes possession of the burned areas.

Red Oak (*Quercus rubra*). This tree is found in deep soils along streams, especially in the western portion of the Province. It is an inferior growth that often occupies rocky or gravelly ridges.

Beech (*Fagus americana*). This is the most common hardwood forest tree in the western counties. It is less common, although frequent, in the eastern counties. It frequently forms pure stands in patches on ridges and tops of hills.

Sugar Maple (*Acer saccharum*) is, next to the beech, the most common hardwood tree in the Province.

Red or Soft Maple (*Acer rubrum*) is the common associate of fir in moist soils along the streams. It is also associated with wire birch on semi-barren areas.

American Ash (*Fraxinus americana*) is exceedingly rare.

Black Ash (*Fraxinus nigra*) is frequent in swamps.

In addition to the non-commercial trees, or those not occurring in commercial quantities, the following may be enumerated :

1. Aspen (*Populus tremuloides*).
2. Large-toothed Aspen (*Populus grandidentata*).
3. Balsam Poplar (*Populus balsamifera*).
4. Hop Hornbeam (*Ostrya virginiana*).
5. Blue Beech (*Carpinus caroliniana*).
6. Alder (*Alnus incana*).
7. Elm (*Ulmus americana*).
8. Mountain Ash (*Pyrus americana*).
9. Juneberry (*Amelanchier canadensis*).
10. Thorn (*Crataegus* sp.)
11. Black Cherry (*Prunus serotina*).
12. Choke Cherry (*Prunus virginiana*).
13. Bird Cherry (*Prunus pennsylvanica*).

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14. Sumach (*Rhus typhina*).
15. Striped Maple (*Acer pennsylvanicum*).
16. Mountain Maple (*Acer spicatum*).
17. Red Ash (*Fraxinus pennsylvanica*).
18. Dogwood (*Cornus alternifolia*).

Statistical Results of the Survey

Such difference in forest conditions was found to exist between the mainland and Cape Breton Island, that it was deemed proper to make separate statements for the two parts. The northern portion of the island, with the exception of the shores, is a continuous unsettled forest country on which man has, so far, made no impression, the forest being almost exclusively made up of balsam fir. This species is also the most prominent on the rest of the island.

Classification of Lands—Mainland

In the tables given herewith, the complete classification of the land, county by county, and the percentage proportion by which each type is represented in the county, is shown. It is necessary once more to emphasize that all these figures are merely approximations to the truth and are not to be taken as mathematically correct.

Under cleared land or farm area there are included, not only fields and pastures, orchards, etc., the actually employed area, but also abandoned farms or portions of farms, more or less growing up to wood. (It is difficult to draw the line between these and woodlands.) On the farms along water fronts, the farm woodlots interspersed with fields have been estimated by general impression and have been added to the forest area. Of woodlots of this kind, mostly severely culled, young or second growth, some 265,000 acres were estimated.

Natural meadows, which by a little drainage work could be greatly improved, are found to be of considerable extent in the western portion of the mainland. In the eas-

Statistical Results of Survey

tern counties, they are less frequent and of small extent, and hence have not been separately classified.

In western Nova Scotia, the open bogs of peaty or muck soil, which some day may be reclaimed for agricultural use, are called savannas.

A distinction has been made between young growth and second growth, the latter designation referring to culled forest of size which may now or may soon be lumbered again, while young growth refers to the younger age-classes. The distinction could not always be carefully drawn, but the figures give at least an indication of the hopeful areas for the future. Young growth is to be found also in the culled, especially the severely culled areas, where light conditions have been favourable to it, and the character of such reproduction was noted on the plats, but no numerical statement of it is possible.

Old burns and barrens, although originally noted separately, have been lumped together in the final statement, since it is often questionable whether the barren condition is due to repeated fires, as is frequently claimed for all barrens, or whether natural causes have produced them. Somewhat less than one-half the acreage classed under this head appears to be natural barrens, destined to remain so; the other half, or about one million acres, may be capable of redemption and, indeed, even now, bears patches of timber and pulp-wood. The character and future of the barrens is discussed in another place in this report.

Areas burned over recently, say within the last fifteen years, whose future was still uncertain, were separately classed, and, where possible, the year of the occurrence of the fire was stated on the plats. The acreage of green timber left untouched on burned areas, has been estimated and the estimate included in the figures of forest growth.

In totalling up the acreage on which information is recorded in the tabulation, there appears a discrepancy from the figures given for the different counties in the Atlas of Canada, of 2,077 square miles. This is accounted

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for by waters which, in the Atlas, are included in the total land area, and, in part, by disagreements between the survey plats and the geographical survey.

There are also small areas for which information could not be obtained and which were so far from the course of survey that it would have been too expensive to visit them. This unmapped area, noted as "unclassified" in the tabulation, amounts to a little over one per cent.

The estimates of cleared land or farm area were purposely made liberal so as to include as much as possible of the potential farm area. As stated before, it was difficult to draw the line between pasture and woodlot; nevertheless, considering the differences in method, a remarkable coincidence with the figures of the Census of 1901 is found, a fact which will increase confidence in the general result of this survey. The Census figures—which, it must be understood, are also merely estimates leaning the other way—are, by somewhat less than 3 per cent., below the survey findings, *i. e.*, less favourable to the farm area. In three counties only did the survey arrive at lower figures than the Census, namely in Annapolis, Yarmouth and Antigonish, and these, especially the latter, were found to have many pastures growing up to wood, perhaps since the Census year, which would be classed under young growth. It is quite safe, then, and a liberal estimate, to state the total farm area at less than 20 per cent.

While there are still areas under forest which are fit for farm use, the present farm area includes probably as much unfit land which is gradually reverting to forest, so that, on the whole, the acreage of the farm area is not likely to change much.

As stated before, the natural meadows and savannas must eventually be added to the farm area, but they represent less than 60,000 acres.

The actual green forest area consisting of some five million acres and stated as occupying 52.5 per cent. of the area of the Province, must, on the other hand, be increased



REPRODUCTION AFTER A BURN TWENTY YEARS OLD. THE SOIL IS FINE SAND TO THE DEPTH OF ONE FOOT; BENEATH, A CLAY SUBSOIL



REPRODUCTION AFTER A BURN TWENTY YEARS OLD. THE SOIL IS FINE SAND TO A DEPTH OF THREE INCHES, THEN COARSE SAND AND GRAVEL FOR EIGHT FEET, TO A CLAY SUBSOIL

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by the potential 5.8 per cent. of recently burned area and by nearly 12 per cent. of the better class barrens which can eventually be reforested, so that the actual and potential forest area may be set down as representing 70 per cent. of the land area. The balance, only some 10 per cent., is hopeless barren. This is a rather small percentage for waste land, and only conservative treatment of the woodland area, protection against fire, and recuperative measures in the old burns and hopeful barrens, will keep it there.

Less than 100,000 acres of virgin, or semi-virgin timber remain, and, altogether, not over 1,400,000 acres, one-quarter of the green forest area, are furnishing the log supply of the present mills, with a small addition from the 2,800,000 acres of severely culled forest and the 227,000 acres of second growth.

Of the green forest area, pure hardwood forest is represented by less than 7 per cent., and pure coniferous growth by 20 per cent., the bulk of the forest, namely 73 per cent. being of mixed type. With the culling of pine, spruce and hemlock from the latter, there is, of course, the tendency to give the ascendancy to hardwood. Hence, the severely culled areas are apt to grow into hardwoods, and probably a considerable area, noted as pure hardwoods, was originally mixed growth from which the conifers have been removed. The two types of virgin and moderately culled hardwoods were combined, the differentiation being practically unnecessary.

A more comprehensive view of conditions as exhibited in figures may be gathered from the accompanying diagram and tables, which show the areas of these land classifications as percentages of the area of the Province as a whole, and by counties.

NOVA SCOTIA FOREST SURVEY, 1909-10
CLASSIFICATION OF LANDS.—MAINLAND

	KINGS		ANNAPOLIS		DIGBY		YARMOUTH		SHELBURNE		QUEENS		LUNenburg	
	Acres	Per cent.	Acres	Per cent.	Acres	Per cent.	Acres	Per cent.	Acres	Per cent.	Acres	Per cent.	Acres	Per cent.
1. Farm (cleared lands).....	168,496	34.0	148,860	20.3	139,328	23.4	51,088	10.6	16,528	3.6	49,100	8.6	153,424	22.2
2. Meadow (natural).....	160	...	2,976	...	4,576	...	1,968	...	5,872	...	1,424	...	1,936	...
3. Savanna (open bog).....	560	...	2,864	...	3,904	...	640	...	4,224	...	9,248	...	352	...
4. Forest : (a) Conifer. Virgin.....	...	...	...	...	...	...	...	...	...	...	...	...	1,360	...
Moderately culled.....	1,456	...	8,224	...	5,840	...	4,880	...	1,216	...	9,568	...	54,384	...
Severely culled.....	1,456	...	4,096	...	4,984	...	3,744	...	30,920	...	7,824	...	106,256	...
Second growth.....	...	...	...	...	3,824	...	...	...	20,496	...	9,056	...	...	...
Young growth.....	3,136	...	...	...	4,096	...	...	...	48	...	...	...	3,408	...
(b) Hardwood. Virgin and moderately culled.....	6,048	1.2	15,520	2.1	48,736	8.2	8,624	1.8	89,968	19.6	26,496	4.7	165,408	23.9
Severely culled.....	5,512	...	3,744	...	2,096	...	584	...	2,408	...	2,232	...	2,272	...
Second growth.....	5,512	...	5,824	...	2,400	...	584	...	904	...	1,384	...	656	...
Young growth.....	5,184	...	...	...	...	...	...	...	...	...	3,328	...	1,760	...
(c) Mixed Growth. Virgin.....	16,208	3.3	9,568	1.3	4,496	0.8	1,168	0.2	3,312	0.7	6,944	1.2	4,688	0.7
Moderately culled.....	...	...	32,976	...	12,448	...	1,536	...	2,368	...	6,208	...	62,008	...
Severely culled.....	45,408	...	90,984	...	57,808	...	161,896	...	13,224	...	75,576	...	56,264	...
Second growth.....	173,264	...	171,320	...	181,776	...	161,912	...	8,200	...	54,156	...	...	...
Young Growth.....	11,248	...	...	...	1,728	...	...	...	...	...	31,360	...	36,416	...
5. Recently burned.....	229,920	46.4	295,280	40.2	253,760	42.6	325,344	67.3	23,792	5.2	167,300	29.4	154,688	22.4
6. Old burns and barrens.....	51,248	10.3	41,920	5.7	25,872	4.3	11,152	2.3	27,504	6.0	77,488	13.6	7,024	1.0
7. Unclassified.....	21,600	4.4	217,520	29.6	112,864	18.9	64,960	13.4	281,600	61.5	212,482	37.3	173,328	25.1
8. Acreage surveyed.....	495,136	...	734,528	...	595,584	...	483,376	...	438,032	...	1,569,696	...	1,690,544	...

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CLASSIFICATION OF LANDS.—MAINLAND—Continued.

	HANTS		CUMBERLAND		COLCHESTER		PICTOU		ANTIGONISH		HALIFAX		GUYSBORO		TOTALS, MAINLAND OF PROVINCE	
	Acres	Per cent.	Acres	Per cent.	Acres	Per cent.	Acres	Per cent.	Acres	Per cent.	Acres	Per cent.	Acres	Per cent.	Acres	Per cent.
1. Farm (cleared lands).....	133,948	18.9	261,440	26.9	217,132	27.0	214,992	33.9	120,812	37.1	92,240	7.5	65,328	7.1	1,832,736	19.0
2. Meadow (natural).....	2,768	...	...	...	896	...	...	...	...	...	5,040	...	7,888	...	21,680	2.2
3. Savanna (open bog).....	1,297	...	880	...	...	...	...	...	...	...	...	...	...	...	37,793	4.4
4. Forest : (a) Conifer. Virgin.....	1,920	...	176	...	2,464	...	1,603	...	...	...	9,920	...	...	...	5,052,838	52.5
Moderately culled.....	33,525	...	41,808	...	38,364	...	4,099	...	112	...	82,928	...	3,416	...	31,120	...
Severely culled.....	40,566	...	62,160	...	40,464	...	1,760	...	...	...	97,584	...	23,080	...	342,400	...
Second growth.....	...	...	4,896	...	1,760	...	1,400	...	...	...	18,896	...	59,408	...	427,345	...
Young growth.....	876	...	960	...	844	...	10,350	...	29,876	...	32,352	...	29,568	...	119,736	...
(b) Hardwood. Virgin and moder- ately culled.....	76,887	10.9	110,000	11.3	83,896	10.4	17,452	2.8	29,988	9.2	241,680	19.6	115,472	12.6	1,036,175	10.8
Severely culled.....	3,024	...	6,464	...	32,480	...	12,462	...	...	...	6,560	...	40,000	...	119,883	(20.5)
Second growth.....	3,024	...	18,464	...	23,524	...	18,113	...	14,560	...	19,808	...	23,824	...	138,581	...
Young growth.....	1,188	...	...	...	6,512	...	16,225	...	7,504	...	7,104	...	14,992	...	22,996	...
(c) Mixed Growth. Virgin.....	7,236	1.0	24,928	2.6	62,516	7.8	46,800	7.4	22,064	6.8	38,480	3.1	82,448	9.0	330,856	3.4
Moderately culled.....	496	...	...	...	5,760	...	...	...	...	...	384	...	1,200	...	63,376	(6.5)
Severely culled.....	56,181	...	57,312	...	62,600	...	211,35	...	...	...	25,440	...	41,792	...	771,364	...
Second growth.....	271,895	...	211,232	...	177,576	...	197,545	...	114,272	...	244,208	...	190,112	...	2,213,732	...
Young growth.....	24,072	...	2,912	...	48,332	...	76,267	...	37,364	...	29,584	...	3,952	...	85,404	...
5. Recently burned.....	352,644	50.0	375,664	38.7	424,736	52.9	294,947	46.3	152,260	46.8	378,000	30.7	257,472	28.0	3,685,807	38.3
6. Old burns and barrens.....	36,811	5.2	141,984	14.6	8,156	1.0	18,195	2.9	224	...	65,040	5.3	38,480	4.2	551,098	5.8
7. Unclassified.....	77,212	10.9	56,704	5.8	6,244	0.8	43,616	6.7	...	...	384,176	31.2	335,072	36.4	1,986,354	20.7
8. Acreage surveyed.....	18,128	...	...	...	...	...	...	...	...	...	26,256	...	17,504	...	137,424	1.4
9. Acreage surveyed.....	706,931	...	971,600	...	803,576	...	634,996	...	325,348	...	1,230,912	...	191,664	...	9,619,923	100.0

Percentage figures in parentheses represent the participation of each forest type in the total forest area.

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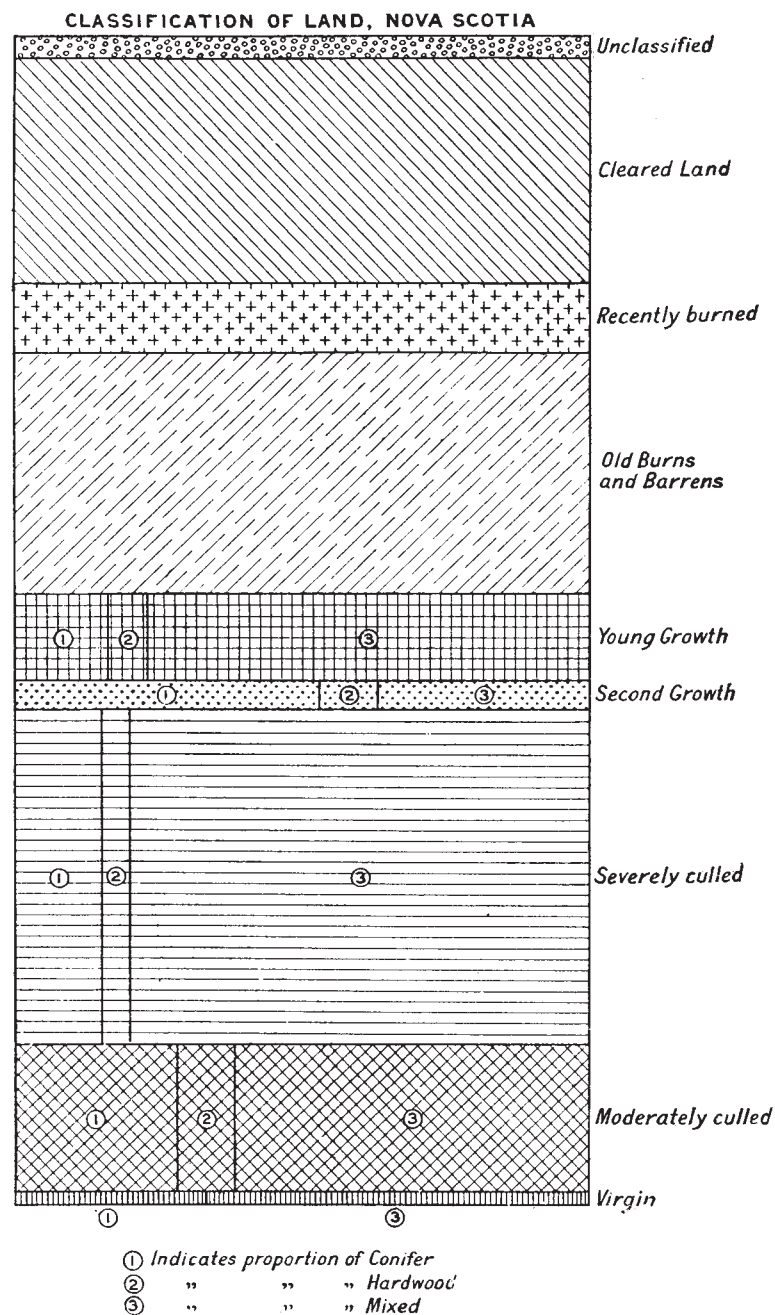
Cape Breton

As previously stated, the forest of the island of Cape Breton is of entirely different type from that of the mainland. Here the balsam fir becomes the prominent tree and hence, saw timber is scarce. Much of the woodland is of inferior character. Pulpwood and mine props are its main product.

The northern peninsula, especially, consisting of Inverness and Victoria counties, is an almost unbroken pure balsam fir forest, with only 15 per cent. to 25 per cent. of spruce, except in the black spruce swamps, and about three per cent. of paper birch. This part of the island, which is not subdivided into lots, was not investigated, since a private inspection had been made by the writer a few years ago for commercial purposes, and the information then gained was sufficient for the present purpose. The area distribution here, cannot claim a great degree of accuracy, since the total area involved is open to considerable doubt. The upper portion of the plateau is occupied by a continuous chain of moss barrens or muskegs from which the many small rivers take their source. The total area of these barrens was estimated as 375 square miles and apportioned in the proportion of 5 to 7 to the two counties of Inverness and Victoria. Similarly, the remaining forest area, with a deduction for other waste land, black spruce swamps, alder brush, etc., estimated at 650 square miles, was so apportioned.

Much of the cleared land in Cape Breton county consists not of farms, but of mine dumps, mine areas, towns, etc.

It will be observed that the total forest area of the island, 1,535,000 acres, is in somewhat larger proportion to the total area than the mainland, and that the distribution in types also varies considerably.



NOVA SCOTIA FOREST SURVEY, 1909-10
CLASSIFICATION OF LANDS—CAPE BRETON ISLAND

	Richmond		Cape Breton		Victoria		Inverness		TOTAL	
	Acres	Per cent.	Acres	Per cent.	Acres	Per cent.	Acres	Per cent.	Acres	Per cent.
1. Cleared Land.....	30,944	11.3	139,136	23.6	67,808	9.7	199,680	22.	437,568	17.9
2. Forest.....	.....	.....	.....	.....	.....	.....	.....	.....	1,536,456	62.7
(a) Conifers	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Virgin.....	.....	.....	544	.....	292,736	.....	132,416	.....	425,696	.....
Moderately culled.....	.....	.....	1,104	.....	.....	.....	.....	.....	1,104	.....
Severely culled.....	15,888	.....	2,000	.....	4,312	.....	11,472	.....	33,672	.....
Second growth.....	3,792	.....	61,024	.....	4,544	.....	13,952	.....	83,312	.....
Young growth.....	107,888	.....	132,000	.....	13,424	.....	40,528	.....	293,840	.....
Inferior.....	11,136	.....	3,184	.....	.....	.....	7,760	.....	22,080	.....
(b) Hardwood :	138,704	50.8	199,856	33.9	315,016	46.6	206,128	23.	859,704	35.1
Virgin and moderately culled.....	.....	.....	.....	.....	.....	.....	.....	.....	(55.9)	.....
Severely culled.....	3,072	.....	672	.....	9,296	.....	20,448	.....	30,416	.....
Young growth.....	.....	.....	1,280	.....	7,056	.....	136,016	.....	147,424	.....
Inferior.....	.....	.....	.....	.....	.....	.....	3,152	.....	3,152	.....
(c) Mixed Growth :	3,072	1.1	1,952	.3	18,768	2.6	12,560	.....	14,976	.....
Virgin.....	.....	.....	.....	.....	.....	.....	.....	.....	195,968	8.0
Moderately culled.....	.....	.....	2,144	.....	.....	.....	172,176	20.	(12.8)	.....
Severely culled.....	.....	.....	3,632	.....	15,192	.....	4,848	.....	6,992	.....
Second growth.....	9,040	.....	108,720	.....	78,760	.....	118,208	.....	18,824	.....
Young growth.....	.....	.....	16,480	.....	.....	.....	29,808	.....	314,728	.....
Inferior.....	.....	.....	.....	.....	19,312	.....	36,704	.....	29,808	.....
3. Recently burned.....	9,040	3.3	130,976	.....	33,040	.....	4,896	.....	72,496	.....
4. Old burns and green barrens.....	1,872	.7	4,320	23.5	146,304	21.	194,464	22.	37,936	19.6
5. Unclassified.....	89,328	32.8	91,728	15.	149,184	20.1	688	.....	480,784	(31.3)
Acreage surveyed.....	272,960	.....	20,816	3.	.....	.....	118,336	13.	6,880	0.3
			588,784		697,080		.....	.....	448,576	18.3
							891,472	.....	20,816	0.8
									2,450,296	100.0

Percentage figures in parentheses represent the participation of each forest type in the total forest area.

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Estimating Timber Standing

Having ascertained the areas of timber of different type and their condition, we may, for the sake of arriving at a general statement of the amount of timber available for the axe, assign an average stumpage figure to each type. For this purpose, the cruisings of actual properties would furnish a good basis. We have been fortunate in having had an opportunity to inspect estimates covering nearly one million acres in various parts of the Province, and of perusing various descriptions, in addition to those based on the personal observations of the survey party. Since these estimates cover almost 15 per cent. of the total forest area, while in detail work by the strip system usually 2 to 5 per cent. are considered sufficient, the basis for the following estimates may be considered ample.

The different parts of the Province show, to be sure, a different development, the forest growth of the western portion being undoubtedly superior in quality and quantity per acre to that of the eastern part. We have, nevertheless, not attempted to make separate estimates for the different sections, but have chosen an average for each type in the whole Province, excluding, however, Cape Breton island, which stands in a class by itself, the greater part of it being without saw timber.

Saw Timber

The following figures refer to coniferous timber alone.

While the best acres of mixed growth in which conifers prevail will rarely overrun 15 M feet B. M., and, while a single lot of pure conifer growth may furnish as much as 30 M feet, the average for the virgin type over the whole area, may not be figured at over 12 M feet B. M. per acre.

The same differences will appear in the other types. Some of the lightly culled smaller areas may still contain as much as 6 M feet, and the better acres, even on larger areas, may average 4 M, but the general average can not

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be placed at more than 3 M feet. To this we may add the small area of second growth with the same rate, although this is somewhat too high.

Still more variable are the remnants on severely culled and burned areas, many of which contain no saw timber at all. Yet we may make an allowance of 1,000 feet per acre on the average, which would be liberal.

The barrens and old burns also contain patches of green timber besides pulpwood, and from the cruisings of a considerable acreage of these it would appear that, on the better class of green barrens, an average of as much as 400 feet might be found; the general average, however, could hardly be placed at over 300 feet.

We have then the following calculation, leaving out the pure hardwood areas:

ESTIMATE OF CONIFEROUS TIMBER ON THE MAINLAND

94,496 acres of virgin and semi-virgin.	at 12 M =	1,133,952 M ft.
1,318,964 " " moderately culled and second growth	at 3 M =	3,956,892 M ft.
3,192,175 " " severely culled and burned.	at 1 M =	3,192,175 M ft.
1,138,730 " " green barrens and old burns.	at 300ft. =	341,619 M ft.
<hr/>		
5,744,365 acres	Total.	8,624,638 M ft.

It is then, tolerably certain that the mainland of the Province contains less than ten billion feet of coniferous timber, and the saw timber to be found in Cape Breton would not swell the figure beyond this maximum.

These figures, it is to be understood, are based upon as low a standard of log diameter as possible. Anything that will make a 2 x 4-inch stick is being cut, the market, especially of the western counties shipping to the West Indies and South America, permitting this.

The character of the timber may be judged to some extent by mill tallies. At one of the larger mills such a tally had been kept for three years on a cut of around 5.5 million feet of rather a good class of timber, showing the spruce to run 17.5 logs to the M feet, the pine only slightly better, and the hemlock nearly 11 logs to the M feet. In the 84,000 logs involved, which probably represent the

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average cut in the region, in *numbers*, spruce was represented with 62 per cent., hemlock with 25 per cent., and pine with 13 per cent. Owing to the better size of the hemlock, however, the proportions in *volume* were 53 per cent., 36 per cent. and 11 per cent. respectively. The average spruce log would measure about 11 inches, and the average hemlock log about 14 inches.

If we apply the relative proportion developed by these mill tallies to the timber standing, there would, in round figures, be some five billion feet of spruce, and three billion feet of hemlock, with nearly one billion feet of white pine in existence, but, probably less than this.

Pulpwood

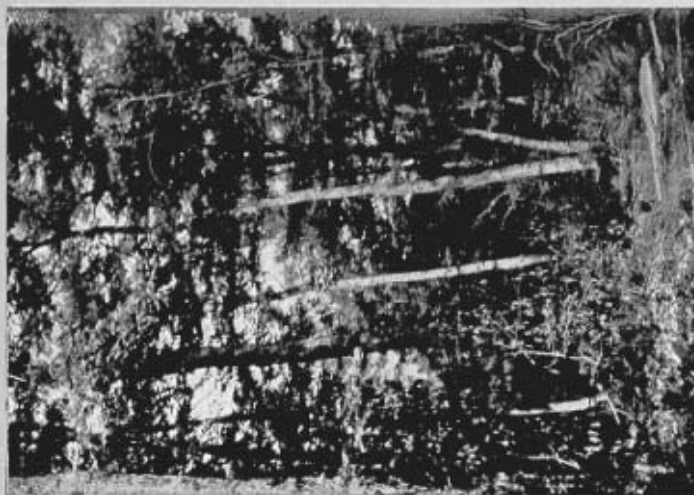
In addition, a considerable amount of pulpwood swells the value of the forest resource. Here again wide differences exist. Cape Breton leads in quantity per unit, and on the whole. The plateau portion of Victoria and Inverness counties is a pulpwood or mine prop forest, consisting almost exclusively of balsam fir, with about 15 per cent. spruce and 3 per cent. paper birch ; a small amount of saw timber, spruce and white pine being found in the northern portion. Only on the seaward slopes not in farms are hardwoods, sugar maple and yellow birch found.

In this balsam forest the trees run from 6 to 14 inches in diameter, occasionally up to 18 inches, with 36 to 40 feet log length, and 10 trees to the cord. The crest being largely occupied by moss barrens in addition to alder swales and black spruce swamps, the productive area of the 1,200 square miles of plateau must be reduced by at least 35 per cent., and may be set down as around 500,000 acres in a solid body. In a private survey undertaken by the writer for commercial purposes some years ago, some 180 sample areas were measured, many running 50 to 60 cords to the acre. The average may be safely set at 20 cords per acre; or, say, 12 million cords in all.

Other parts of the island may add two million cords.



MODERATELY CULLED RED SPRUCE FOREST IN NOVA SCOTIA. NOTE THE TWO GENERATIONS INDICATING TWO FUTURE CROPS



THE INTERIOR OF A PURE STAND OF DECREPID HARDWOODS FORMED BY THE REMOVAL OF RED SPRUCE, BEECH, HARD MAPLE AND YELLOW BIRCH. CHARACTERISTIC CON-DITIONS ON SOILS OF MEDIUM DEPTH ON THE MOUNTAINOUS REGIONS THROUGHOUT NOVA SCOTIA

Statistical Results of Survey

In the western portion of Nova Scotia proper, if conservative lumbering practices were followed, often as much as 15 to 20, and even 30, cords of pulpwood might be recovered in addition to the saw timber, but, under present methods of lumbering, most of this is lost. The eastern portion contains much smaller timber and, hence, more pulpwood. The data for a close estimate are not at hand, but, if we might be allowed to guess, we would place the available pulpwood contents of the mainland at less than 2 cords per acre or ten million cords.

Of hardwoods, no estimate was attempted. The pure hardwood area comprises only 330,866 acres. The timber, generally, is of mediocre development. An allowance of six million cords for this portion would be ample. In Cape Breton, however, an additional two million cords of birch spoolwood might be found. In addition, the hardwood of the mixed type which runs frequently to 50 per cent. of the composition, would furnish considerable quantities—perhaps as much as twenty-five million cords—if it were not destroyed in the logging operations.

Consumption

No attempt has been made to secure new data as to cut, as this is a matter, not of fieldwork, but of statistical inquiry for which this survey was not equipped. However, by combining census data for 1900 and 1906 with published and unpublished data for 1910, kindly placed at my disposal by the Dominion Forestry Branch, we are enabled to secure a very complete basis for estimating the wood consumption of the Province.

From the following tabulations we find that the annual cut for lumber is about three hundred million feet B.M., which, in 1900, was valued in the log at less than two million dollars, but, in 1910, was valued as lumber, lath and shingles (240 mills reporting) at nearly three and one-half million dollars. In this cut, spruce participates to the extent of 62 per cent. and hemlock, 20 per cent. Pine represents still

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about 10 per cent. of the cut ; hardwoods furnished only 4.5 per cent., worth \$158,706.

At least 80 per cent. of the cut was shipped out of the country, one-half by water.

Minor products, like railway ties, telegraph poles, cooperage stock, etc., and firewood, added, in the Census year, about one and one-half million dollars to the value of the annual forest product.

Wood using industries :

(a) Furniture and car industries used 17,306,000 feet, costing \$323,497. About 20 per cent. of this was grown in the Province ; 57 per cent. yellow pine ; 13.7 per cent. oak (imported) ; 5.2 per cent. douglas fir.

(b) Agricultural implement and vehicle industries—small—only 394,000 feet used, costing \$10,640 ; practically all home-grown.

Pulpwood : In 1910, 29,606 cords costing \$135,965, were manufactured into pulp in the Province.

Altogether, we are justified, from these figures, in estimating the total value directly to be credited to the forest resources as on the average, an even \$5,000,000 per year. The present cut for home consumption and export, estimated at not less than 400 million feet, when set against our estimate of eight to ten billion feet standing, indicates 20 to 25 years' supply for such a cut, if what young growth may contribute towards lengthening the supply is left out of consideration.

Practically, however, the life of the milling industry at its present rate of consumption will be limited by the timber standing on the moderately culled and virgin areas, with some of the second growth. These amounts have been estimated at little more than five billion feet, and hence this estimate halves the life of this resource as stated above, accentuating the importance of the immediate adoption of conservative use and recuperative measures.

Statistical Results of Survey

Lumber Product of Nova Scotia, 1910*

SPECIES	M FEET	VALUE
CONIFERS		
Spruce.....	161,998	\$2,133,311
Hemlock.....	52,211	540,025
White Pine.....	25,432	385,669
Balsam.....	4,938	58,101
Red Pine.....	2,843	38,586
Jack Pine.....	1,040	10,944
Tamarack.....	153	1,692
Total.....	248,615	\$3,168,328
HARDWOODS		
Birch.....	8,110	\$101,212
Beech.....	1,950	25,258
Maple.....	598	7,456
Oak.....	490	11,145
Ash.....	252	5,254
Poplar.....	192	7,220
Elm.....	30	1,161
Total.....	11,622	\$148,706
Grand Total.....	260,237	\$3,327,034

Total Forest Products of Nova Scotia, 1910*

PRODUCT	QUANTITY	VALUE
Lumber.....	260,237 M ft.	\$3,327,034
Lath.....	47,712 M	111,421
Shingles.....	23,878 M	36,008
Pulpwood.....	29,606 cords	135,965
Mining timber.....	15,653 lineal ft.	168,142
	3,282 M ft. saw timber	45,281
Cooperage stock (1911).....	38,173 M	332,877
Hemlock bark (1909).....	4,600 cords	32,375
Total.....		\$4,189,103

*From Bulletin 25, Forestry Branch, Department of the Interior.

QUANTITY, VALUE AND SOURCE, BY SPECIES, OF THE WOOD USED IN THE FURNITURE AND CAR INDUSTRY
OF NOVA SCOTIA, 1910*

Species	TOTAL QUANTITY USED (Canadian and Imported)			CANADIAN TIMBER			IMPORTED TIMBER				
	Quantity	Cost	Per cent. Distri- bution	Quantity	Cost	Average Cost per M.	Per cent. of Total	Quantity	Cost	Average Cost per M.	Per cent. of Total
	M ft. B. M.	\$		M ft. B. M.	\$	\$ cts.		M ft. B. M.	\$	\$ cts.	
Yellow Pine...	9,892	186,000	57.2	.....	.....	.....	.....	892	186,000	18 80	100
Oak.....	2,358	51,746	13.7	101	2,600	25 84	4.3	2,257	49,146	21 77	95.7
Birch.....	1,253	13,854	7.3	1,253	13,854	11 06	100	.....	.....	.....	.....
Spruce.....	1,118	14,535	6.5	1,118	14,535	12 98	100	.....	.....	.....	.....
Douglas Fir...	904	22,570	5.2	904	22,570	23 80	100	.....	.....	.....	.....
Pine†.....	805	14,682	4.7	805	14,682	18 24	100	.....	.....	.....	.....
Beech.....	300	2,700	1.7	300	2,700	9 00	100	.....	.....	.....	.....
Maple.....	300	2,700	1.7	300	2,700	9 00	100	.....	.....	.....	.....
Basswood.....	175	6,600	1.0	175	6,600	37 71	100	.....	.....	.....	.....
Poplar.....	88	1,350	0.5	88	1,350	15 34	100	.....	.....	.....	.....
Tulip.....	40	2,000	0.2	.....	.....	.....	.....	40	2,000	50 00	100
Elm.....	35	1,300	0.2	35	1,300	37 1	100	.....	.....	.....	.....
Mahogany.....	20	2,500	0.1	.....	.....	.....	.....	20	2,500	125 00	100
Black Cherry...	7	700	†	.....	.....	.....	.....	7	700	100 00	100
Chestnut.....	5	100	†	.....	.....	.....	.....	5	100	20 00	100
Ash.....	2	100	†	.....	.....	.....	.....	2	100	50 00	100
Total.....	17,306	323,497	100	5,083	82,951	15 50	29.3	12,223	240,546	19 68	70.7

*Represents returns from four companies.

†Includes white and red pine.

‡Less than one-tenth of one per cent.

QUANTITY, VALUE AND SOURCE, BY SPECIES, OF THE WOOD USED IN THE AGRICULTURAL IMPLEMENT
AND VEHICLE INDUSTRIES OF NOVA SCOTIA, 1910*

Species	TOTAL QUANTITY USED (Canadian and Imported)			CANADIAN TIMBER			IMPORTED TIMBER				
	Quantity	Cost	Per cent. Distri- bution	Quantity	Cost	Average cost per M.	Per cent. of Total	Quantity	Cost	Average Cost per M.	Per cent. of Total
	M ft. B. M.	\$		M ft. B. M.	\$	\$ cts.		M ft. B. M.	\$	\$ cts.	
Birch.....	110	1,940	28.1	110	1,940	17 64	100	.....	.....	.....	.....
Spruce.....	87	1,660	22.0	87	1,660	19 08	100	.....	.....	.....	.....
Basswood.....	75	3,000	19.1	75	3,000	40 00	100	.....	.....	.....	.....
Maple.....	40	1,200	10.2	40	1,200	30 00	100	.....	.....	.....	.....
Hickory.....	35	1,200	9.0	.....	.....	.....	.....	35	1,200	34 28	100
Oak.....	15	450	3.9	15	450	30 00	100	.....	.....	.....	.....
Ash.....	12	570	3.5	12	570	47 50	100	.....	.....	.....	.....
Elm.....	10	200	2.6	10	200	20 00	100	.....	.....	.....	.....
Tulip.....	4	300	1.0	.....	.....	.....	.....	4	300	75 00	100
Aspen Poplar.....	3	60	0.8	3	60	20 00	100	.....	.....	.....	.....
Pine†.....	3	60	0.8	3	60	20 00	100	.....	.....	.....	.....
Total.....	394	10,640	100	355	9,140	25 75	90.1	39	1,500	38 46	9.0

*Represents returns from three manufacturers. Takes no account of the local industries allied to country blacksmith shops, and omits wheels and bent work which are imported into the Province already manufactured.

†Includes white and red pine.

QUANTITY, VALUE AND SOURCE OF THE WOOD USED IN THE FURNITURE, CAR, IMPLEMENT AND
VEHICLE WORKS OF NOVA SCOTIA, 1910*

INDUSTRY	TOTAL WOOD USED		CANADIAN WOOD			IMPORTED WOOD		
	Quantity M ft. B.M.	Value \$	Quantity M ft. B.M.	Value \$	Per cent. of Total Quantity	Quantity M ft. B.M.	Value \$	Per cent. of Total Quantity
Furniture and Car.....	17,306	323,497	5,083	82,951	29.4	12,223	240,546	70.6
Agricultural Implement and Vehicle.....	394	10,640	355	9,140	90.1	39	1,500	9.9
Total.....	17,700	334,137	5,438	92,091	30.7	12,262	242,046	69.3

TIGHT AND SLACK COOPERAGE†

	M	VALUE
Slack Cooperage.....		\$318,263
Tight Cooperage.....	37,312	14,614

*From Bulletin 24, Forestry Branch, Department of the Interior.

†Owing to the fact that the cooperage returns for Nova Scotia for 1910 were very incomplete, those for 1911, which are comparatively complete, are given instead.

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Estimating Growth

There is nothing so difficult as to determine with any approach to accuracy the amount of product which may be secured from a growing timber crop. The rate of growth on the same acre with the same species varies from period to period and, therefore, the average rate varies with the length of time the timber is allowed to grow. Again, when a large variety of conditions is involved the attempt to arrive at an average figure can be hardly more than a guess. In the virgin, or nearly virgin, forest, growth, so far as quantity per acre is concerned, has practically stopped, although, of course, trees still add to their diameter, and, if rot does not progress too rapidly, their value increment may even be rising. The conservatively culled forest will show in the old stock a greater diameter and value increment, if not too severely culled, than the virgin forest. With the increased severity of culling the growth is transferred from the old stock to the young growth, if any, and the more severe the culling, the better the rate of growth, provided always that young growth, a seedling growth, is established. It may, therefore, be that under certain circumstances, that is, when a satisfactory young growth is on the ground, severe culling may be the much better procedure to secure a satisfactory rate of growth.

Most extravagant ideas exist as to the rate of growth of trees, observations of single trees growing in the open being taken as a basis to be translated into performance by whole acres of trees. The idea prevails that Nova Scotia spruce in the Nova Scotia climate is growing at an extraordinary rate. As a matter of fact, while it can be stated that the climate is most favourable to reproduction, *i. e.*, to the establishment of young growth, the rate of growth of trees in the forest is not very different from the ordinary rate to be found in the New England States under similar conditions.

No time was allowed to make any detail studies; there were, however, incidentally, some 550 trees analyzed

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as to their rate of diameter growth, and a number of sample plats were measured to arrive at a conception of growth conditions. From these measurements it appears that to produce a spruce tree, 12 inches in diameter on the stump, may require from fifty years for the most favoured trees, to one hundred and seventy years for trees which had for a long time to compete for light with their neighbours. The unusually rapid-growth trees are, to be sure, found only occasionally; the much more usual rapid growers require eighty to ninety years to make the 12-inch diameter. In other words, 1 inch of diameter is formed in the best average case in six to seven years; in the poorer conditions, in fourteen years. Older, stouter trees that have averaged twenty years in making one inch of diameter are not infrequent, and twelve years may, as in Sweden, be considered the average performance in the natural woods. That is to say, it took a hundred and forty to a hundred and fifty years, on the average, to grow the trees that are now being lumbered.

A series of measurements were made on second growth trees, which are in more favourable light conditions, and, hence, make better growth. Some 250 trees of this description in various regions were analyzed. Here, as is to be expected, a very much better rate prevails owing to, and in proportion to, the light admitted. Fifty trees on an old pasture south of Springhill in Cumberland county, ranging from thirty-five to fifty-nine years, had averaged one inch in five years, *i. e.*, a tree of 12-inch diameter on the stump was grown in sixty years. The same rate was found in old pastures in other localities. But in the forest, twenty trees in Colchester county, ranging in age from thirty-five to forty-eight years grew at the rate of 1 inch in seven years, making the 12-inch tree in eighty-five years. This may be assumed as a fair average rate for second growth trees.

These statements refer to *red spruce*, which is the species most prominent in Nova Scotia forests. The

Statistical Results of Survey

white spruce, which forms rarely, as much as 10 per cent. and usually not much more than 1 per cent. of the natural forest growth, is the species which occupies readily the abandoned pastures near the coast, and there, in the full enjoyment of light, grows as rapidly, or perhaps more rapidly, but into a poorer tree—a “ladder” tree, as, on account of the branches, a lumberman has called them. A few trees of this species that were measured, showed that they had developed at the rate of 1 inch in four years. Balsam fir, which in some parts is erroneously called white spruce, shows about the same rate of growth. One inch in five to six years seems the rate for young second growth of this species on pastures.

White pine is the fastest grower; yet, a group of 25 trees ranging from 63 to 84 years and averaging 68 years of age, evidently second growth, averaged only 11.4 inches in diameter. They had grown at the rate of 1 inch in six and two-thirds years.

Some 26 trees of hemlock in the forest, and old stand on a first-class site near a stream, ranging from one hundred and seventy to two hundred and sixty-nine years, averaged two hundred and ten years, with an average diameter of 20 inches, made, therefore, 1 inch in ten years—a very good performance for this species.

The following tables will make clear the great variation in rate of growth that is found under varying conditions and, sometimes, under apparently the same conditions. It should be stated for those who desire to ascertain for themselves this relation between time and dimension, that, to the rings counted upon the stump, the time it took to make the height of the stump must be added. This, according to the height of the stump, usually varies from five to ten years.

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RED SPRUCE
IN FOREST

Number of Trees	Average Age	Diameter Average	Years to make 1 Inch	REMARKS
1	171	24	7	Near mill Southampton Cobequid hills
1	173	12.5	13.8	
6	120	12	10	
1	125	15	8.3	Colchester
1	70	14	5	
3	112	8.3	13.5	Butt logs at mill
1	65	17.3	3.7	Victoria co.
4	82	18.2	4.5	Shelburne co.

SECOND GROWTH

50	47	10	4.7	Old pasture, Cumberland
8	56	12.8	4.3	Old pasture, Cumberland
20	42	6	7	Colchester co.
4	52	9.8	5.3	Old pasture, Antigonish
10	47	10	4.7	Old pasture, Halifax co.

BALSAM
IN FOREST

Number of Trees	Average Age	Diameter Average	Years to make 1 Inch	REMARKS
6	86	12.2	7	Cobequid hills
2	107	12.5	8.8	
14	48	3.7	13	Swamp near Halifax
25	100	10.5	10	

SECOND GROWTH

12	42	9.2	4.6	Colchester after '49 fire
5	60	12	5	
14	60	9.4	6.3	Colchester after '49 fire
7	41	7	6	On barren near Halifax
52	50	5.7	8.7	Gentle slope, Sheet harbour
6	45	6.3	7	Victoria co., mill Pasture, North river
12	68	10.6	6	
47	30	5.5	5.4	

Statistical Results of Survey

When it comes to the question of production of volume per acre and year which the Nova Scotia forest area may furnish, there are no data available to make even approximate estimates. Conditions are so variable that no experience figures will apply. All we can do is to discuss possibilities. If we were to assume a hundred and fifty years as the average age of the log trees in the virgin forest—which seems not far from the truth—and divide this age into the stand as we find it, we would have on the best acres cutting 30 M feet, an annual increment of 200 feet, and, if our average of 12 M feet is approximately correct, the rate on the average would be 80 feet, B.M., per acre. This would seem to indicate the possibilities for large areas of virgin forest.

We may also gain some insight by comparison with the experience of countries where thousands of measurements and actual knowledge in scientifically managed forests exists. Of the larger forest administrations of Germany, Prussian State forests furnish the smallest per acre product, and, hence, are best used for comparison with our unregulated conditions. The reason for this lower product is the extent of the area involved, nearly seven million acres, which includes much poor land, and the lack of development of means of transportation in the eastern provinces, which makes close utilization unprofitable; to this may be added the northern climate which makes the rate of growth very similar to that of Nova Scotia. Here, the annual cut of sizeable material, including logs, mine props, posts, poles and the better class of fuelwood, is less than 30 cubic feet per acre. To translate this forest-grown round material into board feet, we may multiply it by 5 at most, that is to say, the annual average growth is at best 150 feet, B.M., per acre. That the best acres may produce as much as four and five times that amount does not change this highest average.

If, then, the whole green forest area of Nova Scotia of, say, six million acres were managed like the Prussian

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government forests, an annual cut of more than twice the present one could be had forever. As conditions are now, we venture to estimate that not one-quarter the growth of useful character takes place, that is to say, we would doubt that the growth over the area of burned, severely culled, and moderately culled area amounts to 40 feet B.M. per acre. If merely fires are kept out and the re-seeding of the valuable species were not prevented by too close culling, such production could be readily attained. Even so, if this amount were produced, at least half the present cut would be secured from new growth. More careful investigations in this direction are called for.

Incidentally, it may be of interest to state that, taking the total forest area of Germany of thirty-five million acres, the annual growth, represented presumably in the annual cut of 1,337,000,000 cubic feet of wood of 3-inch diameter and more, appears to be $1\frac{1}{3}$ per cent. of the growing stock—nothing like the extravagant ideas of growth in the virgin forest that have been almost universally accepted in this country.

Ownership Conditions

We may briefly refer to ownership conditions as being influential in attempts to secure a conservative use of the forest resources.

Unlike other Provinces, the Government of Nova Scotia early adopted the policy of disposing of timber and land at a price per acre, the object being to encourage settlement of the country, no matter whether farm or forest land was taken. Not until 1900, was this policy changed to one of leasing lands for the removal of timber under leases running for twenty years, subject to renewal, at not less than 40 cents an acre for the term. The price, later, was changed to 80 cents, the lessee being entitled to take all timber of not less than 10 inches in diameter. But the Government is also empowered to lease on other terms when land of inferior quality is involved and manufactures are to be established.

Ownership Conditions

The law of 1900 authorizes the re-purchase, at not less than 25 cents an acre, of lands granted in fee simple. Unfortunately the Government did not take advantage of this authority, and the Act was repealed in 1910. Under the policy of sale, all the land but about 1.5 million acres was disposed of, largely in small parcels, with a few grants of larger extent. A large number of grants were issued to soldiers, the majority of which probably were never occupied by them. After the best timber had been thus disposed of extensive grants were made to railway and mining companies—notably the Nova Scotia Railway Company—which often were no better in character than the lands still held by the Crown.

Some large operators and corporations have acquired and combined numbers of smaller grants and, at present, probably little less than half the timbered area is owned in large holdings of 10,000 to 250,000 acres in extent, the other, and larger, half being owned in holdings which rarely exceed 1,000 acres.

Small portable and water mills are a quite frequent feature.

It appears that, contrary to the usual experience, the small ownership is the more conservative one. The large operators, being forced to cut large quantities, do not have the same chance of lumbering conservatively, which the small owner has who personally superintends his cut. At any rate, it is worth noting that many of the small owners treat their woodlots with care, cutting to a diameter limit in selection, and even "downing" the brush.

The character of the Crown lands, as stated before, places them largely in the class of barrens and semi-barrens. Yet, there is enough of present and prospective value in them to call for closer investigation and conservative management, and the Government undoubtedly is under prime obligation to consider such management.

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Recommendations

Finding that 80 per cent. of the Province—when not barren—is forest country and practically destined to remain so, it would appear rational for government and people to put forth every effort to keep the same in productive condition. Here is a natural resource capable, under proper management, of forever producing, by annual increment, as interest, at least twice as much as is now being cut from capital stock ; a resource which, basing its value on reasonable rates of growth, both of wood and of wood values, may reasonably be stated as representing a potential capital of at least \$300,000,000. It is now largely in poor condition, and is being annually, further deteriorated by abuse and injudicious use, because those owning it are mostly not concerned in its future, or do not realize its potentialities. To arrest further deterioration and to begin restoration is the present duty of those who have the continued prosperity of the Province at heart.

The first, most needful step towards a change from past neglect has already been taken in the enactment of legislation to protect the forest properties against fire, and in inaugurating the beginning of a suitable organization for carrying out its provisions in co-operation between the Government and the timberland owners. This organization should be extended and perfected until the fire danger to forest property has become as remote as to city property. This is practically possible in Nova Scotia, where the populational conditions are most favourable, inasmuch as the country is almost everywhere settled and accessible, and owners of woodlots or small timber tracts are distributed throughout the country. Fire watchers and fire fighters are, therefore, nearly everywhere available on short notice. There is no reason why in a few years of earnest and determined effort, by an educational campaign and by efficient protective service, the destruction of forest by fire should not be reduced to a rare accident. Only when

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this is accomplished, will it be reasonable to resort to methods of recuperation.

To further reduce the chance of destructive fires, the propriety of lopping tops in logging operations, if not burning the same, as a reasonable protective measure, should be seriously considered.

As to details of practicable measures in this direction and otherwise, I may refer to a report by the Committee on Forest Fire Legislation of the Canadian Forestry Association, lately issued.

I would recommend its study especially with regard to the provisions for making land along railways safe and the railways liable for the fires they set out, and also as regards suggestions with respect to the erection of watch towers, the issue of permits for setting fires in the woods, the lopping of tops, the burning of brush, and the proper organization of a fire fighting force.

Next to protection against fires, improvement in logging methods with proper regard to young growth should be secured. The aim of the logger, at least, should be not to prevent the efforts of Nature to restore the cut-over lands to useful production. This is a matter of complex nature, for which no general prescription can be given, each case requiring special diagnosis locally, and special expert advice ; and it is also a matter of education to secure the application of the advice. As an expression of its educational function, the Government should establish a technically educated Provincial Forester, whose business it should be to study the situation in the various localities and act as public adviser or instructor—a wandering teacher.

In this respect the recent institution of Conservation Boards in Sweden is most suggestive. In that country, for every province or county, a local Board of three members is established to promote forest conservation. The Board consists of one member appointed by the Government, one elected by the County Council, and one elected by the County Agricultural Society ; and additional members

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may be elected directly by the people. This Board chooses a technical adviser from the State Forest Service whose salary is paid by the Government, which also raises the funds for the use of the Board by the imposition of a small duty on wood exports.

It is left entirely to the discretion of the Board how these funds are to be applied in executing the law for furthering the forestry interests, with the mere injunction that a conservative treatment of the woods must be enforced, and that regeneration or reforestation must be attended to. The Board, working under the County Council, has the power, however, to enforce its rulings in the courts by injunctions, money fines, confiscation of logs, etc.

Naturally, at first, different Boards construed the law differently, and applied the funds in different ways, which was undoubtedly intended by the law, in order to give scope according to varying conditions. There are, however, three directions in which eventually all have come to work, namely, education, assistance, and police regulations.

In one of the provinces, the forestry expert gives three separate technical courses of instruction to woodland owners, each lasting about two weeks, namely two in the autumn on silviculture and on mensuration, and one in the spring on draining—the utilization of the many peat bogs being an important problem; and this problem is also an important one in Nova Scotia. Two lectures a day and six to eight hours demonstration in the field is the time given to these courses in which some four or five forest rangers assist at the demonstrations. The Board pays the living expenses of those attending. The number admitted annually, out of the 80 to 90 applications is 50; in five years, some 200 or more men attended these courses. In addition, literature of a popularly written but technical character is distributed. Sometimes this instruction is given in combination with high schools or county schools.

To those who ask for special advice in the management of their properties it is given by sending an expert on

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the ground. To those who desire to plant waste lands or old clearings, seed is furnished up to 50 lbs., at one-tenth of its cost, and other plant material may, under certain circumstances, be supplied free of charge.

The owner has a right to cut as he pleases, but, if natural regeneration fails to appear he is obliged to plant, the Board determining when the necessity for such planting has arrived. If the owner objects to the decision of the Board, a special inspection is ordered, the expense of which he must pay, and at the same time he loses all claim to assistance. Although the power of the Board is great, the policy is to secure co-operation rather than to use force. By this time, owners have learned the advantages of these arrangements, and only speculators make trouble. I have described this institution at length, because it is thoroughly democratic and is, with minor changes, immediately applicable to Nova Scotia.

For Nova Scotia, the appointment of at least one expert to attend to this educational campaign in co-operation with existing or specially constituted local authorities would be a step in the right direction. The appointment of a Provincial Forester—as has been proved in the several States of the Union, where they have such officials—would immediately result in an awakened interest in the possibilities of improved methods of forest use, and from what we have seen and heard during the progress of this survey,

land owners will be found ready to follow his advice.

With such a Provincial Forester, the government would also be enabled to find out what is the best policy to pursue with regard to the remaining Crown lands. Their extent, exact location and condition should, of course, first be ascertained, and in their management, considerations of their future, rather than their present, value should dictate the policy. If the Government cannot manage its property conservatively, who will?

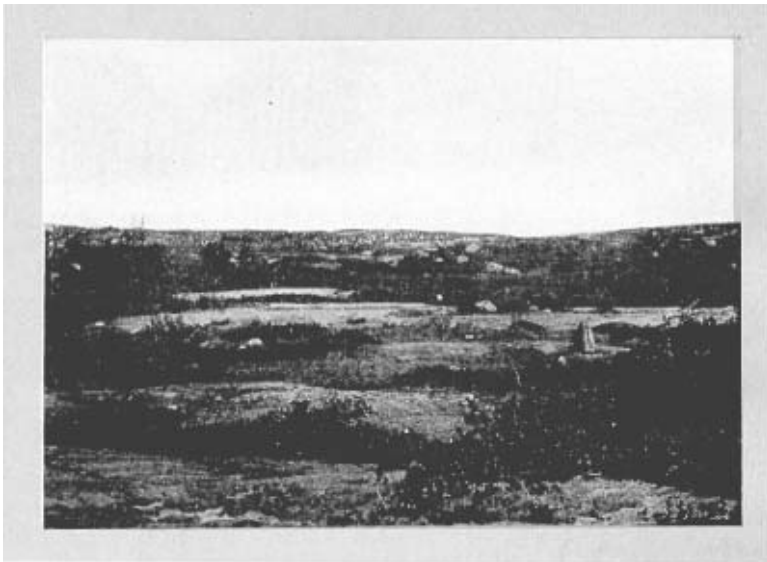
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Lastly, perhaps in conjunction with the Agricultural College and Experiment Station at Truro, the Provincial Forester should conduct an investigation into the question of the use and restoration of the barrens, and should make experiments in improving natural meadows and savannas, and in forest planting on areas fit for such planting.

We hope to have shown by this survey that the forest resources of Nova Scotia are an important factor of the industrial economy of the Province, that they are liable to exhaustion in the not distant future, that they are capable of being perpetuated by more conservative use, and that it is high time to provide for such perpetuation.

In conclusion, I may be allowed to say that in no portion of this Continent, and of the Dominion in particular, are the chances for the immediate inauguration of a definite practical forest policy so favourable as in Nova Scotia, and this is so because of the presence of an intelligent, well-distributed population.





A GRANITE ROCK BARREN, THE PREVAILING CONDITION ON THE MAIN MOUNTAIN AXIS IN GUYSBOROUGH COUNTY, N. S. THIS AREA WAS NEVER BURNED



BLACK SPRUCE BOG, A VERY COMMON TYPE IN THE ATLANTIC TIER OF COUNTIES OF NOVA SCOTIA ; THE SMALL TREES AT THE RIGHT ARE AS OLD AS THE TALL TREES AT THE LEFT

Distribution and Reproduction of the Forest in Relation to Underlying Rocks and Soils

BY C. D. HOWE, PH.D.

THE Province of Nova Scotia, exclusive of Cape Breton Island, has an area of 17,450 square miles. It is in the form of an irregular peninsula, joined to the mainland by a narrow neck of land lying between Chignecto bay and Northumberland strait. The western portion is formed into a secondary peninsula by the bay of Fundy and its eastern arm, Minas basin. The drainage of the Province is divided nearly equally so far as area is concerned, into two regions, the Atlantic drainage basin, including the lower portion of the bay of Fundy ; and the drainage basin of the Northumberland strait and Minas basin. The forest distribution, in its relation to rocks and soils on each of these great divisions of the mainland, will be described separately.

I

The Atlantic Slope

(1) *Distribution and Topography of the Granite Areas :**

In that portion of Nova Scotia lying between the bay of Fundy, Minas basin and the Atlantic ocean, the principal topographic features are a series of rounded granite ridges and elevated plateaus interspersed with frequent lakes. This granite outcrop extends in the form of a low-arched crescent, in an unbroken mass from the western side of Halifax harbour; at first in a northwest direction, through portions of Halifax, Hants and Lunenburg counties ; thence

*The distribution of the various rock outcrops was taken from the geological maps of the Province, published by the Geological Survey of Canada.

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west through Kings and Annapolis counties to the western border of the latter. Here, it turns southward through the western portion of Digby county, and ends in two spurs, one of which extends southwest into northern Yarmouth, and the other south into northern Shelburne county.

Farther south two isolated areas of granite of the Devonian age, extend to the Atlantic coast and have intruded through the gold-bearing quartzites and slates which are probably Pre-Cambrian.

This series of granite ridges averages twenty miles in width. Along its crest it is 125 miles long. It thus comprises about three-eighths of the area of the western peninsula. This granite crescent constitutes the backbone of the south-western portion of the Province and its main axis forms the water-parting between the streams flowing to the Atlantic and those flowing to the bay of Fundy. As a result, the former are much longer than the latter. The highest points along the divide are seldom more than 600 feet and do not exceed 800 feet. The streams from the northern slopes flow, for the most part, into the bay of Fundy, and those from the southern slopes into the Atlantic ocean.

East of Halifax harbour, the granite occurs in detached ridges and isolated rounded hills, intruded through and surrounded by the quartzites and slates of the gold-bearing series whose distribution will be given later. The largest continuous granite area is in Halifax county. Beginning at a line connecting Soldier lake and lake Major, it extends north-eastward to a line drawn between Mushaboom harbour and Little West River Grand lake, a distance of 50 miles. The outcrop is three miles wide in its narrowest and eight miles wide in its broadest portion. This area has the appearance of a plateau, elevated about 200 feet above the sea, from which rounded ridges and hills rise 100 to 200 feet above the general level. Unlike the granite areas in the western counties, this granite outcrop is crossed from north to south by the main rivers which have



THE CREST OF THE GRANITIC AXIS MAY BE SEEN IN THE DISTANCE. NEARLY ALL THE SLOW-FLOWING RIVERS HAVE EXTENSIVE NATURAL MEADOWS



ONE OF THE INNUMERABLE LAKES ON THE GLACIATED GRANITIC AREAS

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their sources further north in the quartzites and slates. The Musquodoboit river, for example, has cut a narrow gorge through the granite in its widest part. Porter lake and Ship Harbour lake also cross the granite belt. One small isolated area occurs between the eastern portion of this granite mass and another larger one further north in the region where Halifax, Colchester, Guysborough and Pictou counties meet. This granite area and a portion of the quartzites and slates immediately adjoining constitute the axis of maximum elevation between Halifax and Canso.

While frequent small outcrops are found elsewhere, most of the granite of Guysborough lies in the southeastern portion of the county. East of St. Mary river to cape Canso there are three groups of granite outcrops. The first group, going eastward, extends from the head of the estuary of St. Mary river to Ogden in the Salmon River valley, a distance of 22 miles. It consists of one large and six smaller masses. The second group lies between Cole Harbour river and New Harbour river, and contains three large masses. The third group extends from Whitehaven to cape Canso, and, on the mainland, it, also, consists of three distinct masses surrounded by altered quartzites and schists. These three groups cover approximately 200 square miles. Adding to this, the areas of the other masses in Guysborough and Halifax counties, we find the entire area of granite in the two eastern counties is not over 580 square miles, compared with the nearly 3,320 square miles of granite outcrops in the western counties. Only about one-seventh of the Atlantic slope east of Halifax harbour is granite.

(2) Forests and Soils of the Granite Areas :

While granites decompose very slowly, they give rise to soils capable of supporting good forest growth, although often too stony for agricultural purposes. The original soils, resulting from the decomposition of the granite in Nova Scotia have been much altered in character and distribution by ice action. It may be that practically none of the soils now covering the granite have been formed in

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place by the decomposition of the underlying rock ; but for the purposes of the present discussion, they will be called granite soils, unless the results of ice action are very pronounced. In such cases they will be considered in a subsequent sub-section under the title, *Forests, and Soils of the Glacial Deposits*.* It may be said, in general, that all the granite soils examined were by weight from one-quarter to a third part small stones and gravel. The fine earth was chiefly sand of various grades and the clay content was always low, usually not over five per cent. Since the soil samples were all taken to determine conditions of reforestation, the results of their analyses will be discussed in a succeeding section on *Forest Reproduction*.†

As regards distribution of species and forest types on the granite areas in general, it may be said that the soils of the higher ridges, which are very thin, are occupied mostly by balsam fir, with occasional white pine ; while the slopes of these ridges are covered with mixed forests of beech, maple, birch, spruce and hemlock with scattered white pine. The ridges of medium height, however, are usually capped by a hardwood forest with considerable admixture of red spruce which becomes most abundant at the base of the slopes. The best spruce lands are found where the slopes of the medium high ridges are broad and gentle, or where they form benches and flats. The second best situation for spruce is found on the narrow flats or depressions between the low ridges. Hemlock occurs most abundantly on the flats about the smaller lakes and on the benches in the narrow stream valleys.

To one travelling from the western portions to the eastern portions of the Province, the following detail of soil and forest distribution on the granite areas will be noticeable :

Yarmouth county Granite covers about one-eighth of Yarmouth county, and this area is practically all barren of commercial trees. This barrenness is undoubtedly due to fire as well as to natural causes, the mineral soil is naturally thin and is covered with a raw

*See page 75.

†See page 77.

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humus, forming a thick peaty layer of half decayed vegetable matter. In addition, the soil is, for the most part, poorly drained, and is, consequently, sour, thus giving rise to conditions very favourable for the development of peat moss and various heath plants, but very unfavourable to the growth of commercial trees. The dry portions now support second growth wire birch, red maple and scattering oaks, which are mixed with spruce and fir in the more moist situations.

Digby county In Digby county the granite occupies an area approximately 25 miles long and 18 miles wide. Its aspect is that of a rolling plateau traversed by low ridges, most of which are not over 50 feet above the general level. In the depressions between them lie peat bogs, black spruce and fir swamps, or red maple and fir swamps. Approximately two-thirds of the area is barren. The western third, however, is covered by a forest in which red spruce and hemlock prevail, with frequent ridges covered by mixed forest and occasional hills with pure hardwoods.

Annapolis county Fully two-thirds of the 1,330 square miles of Annapolis county is underlain by granite. It extends from the Annapolis valley southward nearly to the southern limit of the county and the northern portion of this area constitutes a well-defined range called South mountain. The slopes, facing the Annapolis valley, are abrupt with relatively short streams flowing from them, while the southerly facing slopes are gentle, and their streams flow into the Atlantic ocean, 60 miles away. This portion of the county is an elevated plateau into which the streams have worn rather wide valleys separated by low rounded ridges. In the portion draining northward the forests are of the mixed type with red spruce and hemlock predominating over the hardwoods, but there are frequently hills of pure over-mature and decrepit hardwoods, half composed of beech, 40 per cent. hard maple and the rest, yellow birch. In going southward, especially between the

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Lahave and Port Medway rivers, hemlock is of more common occurrence than the red spruce, in some places reaching as high as eighty per cent. of the stand. Frequent barren and semi-barren areas are scattered through the county, doubtless, in most cases, the result of repeated fires. One type, however, approaches the character of a natural barren, that is, a low rocky ridge, usually ten to fifty feet above its surroundings, covered chiefly with scrubby red oak and red maple. The largest areas of these latter barrens are found east and northeast of the Milford lakes and south of the Molly Upsum and McGill lakes. The very numerous lakes and ponds usually have at their upper ends, extensive peat bogs and black spruce and fir swamps.

Kings county Approximately three-eighths of Kings county is granite—the eastern extension is South mountain. The topography is similar to that already described for the granite of Annapolis county. Ponds and bogs and light soils are noticeably less frequent. The cut of the mills in the western portion of the county consists of approximately 50 per cent. hemlock, 40 per cent. red spruce and 10 per cent. white pine, and these species form from 75 per cent. to 80 per cent. of the forest. In the eastern portion of the county, the ridges are broader and higher; the hardwoods become more prevalent, and finally dominate.

Hants county The granite of Hants county occupies the southwestern portion in a strip thirty miles long and ten miles wide, thus comprising one-fourth of the county. The county is well forested except for fire barrens southwest of Five-mile lake, and east of Six-mile lake. Along the basin of the St. Croix lakes the larger percentage of the stands is hemlock. Eastward to the headwaters of Ingram river, red spruce prevails over the hemlock. These areas are near the centre of the granite mass. Both eastward and westward to the limits of the granite in the county, the forest is mixed hardwoods and softwoods, with spruce mostly predominating.

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Lunenburg county Four hundred and fifty of the 1,200 square miles of Lunenburg county are composed of granite. This granite area is situated in the eastern portion, eastward of Nine-mile, East Chester and Whale lakes. Beginning at the sea and travelling northward, one finds the first five or six miles of the granite covered with spruce and fir of pulpwood size. The soil for the most part is wet and sour. The dry portions have been burned and now support wire birch and red maple, with spruce and fir in various degrees of intermixture. For ten miles north of this region also, the forest is chiefly second growth red maple, red oak and poplar, with frequent black spruce and fir swamps, apparently the result of a severe burn which occurred between twenty and thirty years ago. The largest block of commercial forest on the granite was found along the eastern border north of the Windsor road, where red spruce prevails over the hardwoods. Another area may be found east of Nine-mile lake where the stand is approximately 74 per cent. spruce, 20 per cent. hemlock, and six per cent. hardwoods. On the remaining portion of the granite between the head of Nine-mile lake and the head of Gold river, the forest is composed of culled and second growth farm woodlots, with hardwoods and softwoods about equally divided. Frequent patches within this area have been made semi-barren by fire.

Halifax county Practically all of Halifax county west of Halifax harbour is granite, and this region represents the eastern extremity of the continuous granite outcrop which we have been traversing from Yarmouth county. Southwest of Ingram river and east of Island lake the forest is second growth, paper birch and red spruce being the most common species, with fir and yellow birch next in abundance. Northwest of this region to the Hants County line, hardwood hills compose about one-fifth of the stand, between which red spruce and hemlock prevail, with the spruce in the lead. The peninsula

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between St. Margaret bay and Halifax harbour is three-fourths a fire barren. A large block of fir, from 80 to 100 years old, lies north of the head of Prospect harbour.

The crests of the granite hills east of Halifax harbour have been deeply eroded by glacial action and have naturally very thin soils; and frequent fires have so exposed the rocks, that from a distance most of the rounded domes appear white. When not burned, they are sparsely covered by a black forest, that is, coniferous, in striking contrast to the lighter green of the hardwoods prevailing on the lower slopes. The higher slopes, especially when facing southward are covered with spruce overtopped by scattering white and red pine. The hardwoods go nearly to the top on the northerly-facing slopes. The low ridges usually support pure hardwoods. Red spruce prevails in the broader flats between the ridges, while hemlock predominates in the ravines and gullies, and at the base of steep slopes along the rivers and smaller lakes. The mixed slopes along the Musquodoboit river are approximately 42 per cent. beech, 29 per cent. hemlock, 21 per cent. yellow birch, and eight per cent. hard maple. On the more gentle slopes, the hardwoods may not form more than 25 per cent. of the stand, the rest being red spruce and hemlock.

In going eastward over the granite outcrop, one finds mostly natural barrens and fire barrens until the Gibraltar and Pace Lakes region is reached, where there are culled mixed forests. On the east side of the Musquodoboit river to Ship Harbour lake, second growth prevails in alternating patches of pure coniferous, mixed, and pure hardwood stands. From Ship Harbour lake to the eastern edge of the outcrop at Little West River Grand lake, the country is about half barren, natural barren, burns and bogs. The most common type of forest is the black spruce-fir swamp. The best forest is south of Tangier Grand lake where spruce predominates.

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Guysborough county

The granite area in the north-western corner of Guysborough county is about one-fourth burned and barren. The soil on the rest is deep, and hardwoods prevail, with frequent patches of pure red spruce and fir. The exposure of granite northeast of Country harbour, extending to Salmon river, is chiefly covered with second growth hardwoods in which yellow birch and paper birch about 80 years old prevail. The northern edge of the granite is a well defined ridge about 400 feet above the conglomerate rock adjoining it, and it has hardwoods on top, a mixed stand on the slopes with red spruce and fir becoming more pronounced on the lower slopes until, at the base they are the chief species. As a whole, the ridge is to the extent of five-eighths of its area covered by a coniferous type.

Granite forms a little more than one-half of the peninsula formed by the ocean on the south and Chedabucto bay on the north, and is mostly a natural barren, containing nearly 200 square miles. The bare rock is largely exposed and is strewn with boulders. The soil cover in the drier portions is not over two inches deep and is composed of raw humus. The deeper soils are of the same nature and both are covered with small heath herbs and shrubs. The crevices of the rock and the depressions are filled with alder and stunted black spruce and fir.

(3) Distribution and Topography of the Quartzite and Slate Areas :

In the western counties the southern and western sides of the main granite area, and the smaller areas along the Atlantic coast are enclosed by quartzites and slates, probably of Pre-Cambrian age. Beginning on the shores of the Annapolis basin, they follow the irregular margin of the granite around to Mahone bay and underlie, approximately, one-half of Digby, seven-eighths of Yarmouth, three-fourths of Shelburne and Lunenburg and nearly all of Queens counties.

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As in the granite regions, the general trend of the major ridges is northeast-southwest. *It may be well here to explain that this main physiographic feature is attributed to the geological structure and distribution of the quartzites and slates and to their different degree of resistance to erosion. The gold-bearing rocks are composed of sedimentary rocks, the lower portion of which consists of hard quartzites and slates three miles thick, and the upper part is entirely made up of soft slates two miles thick. This enormous thickness of rocks has by a powerful pressure from the south been folded into a series of huge, sharp undulations, the axes of which describe a curve roughly parallel with the Atlantic coast. They run northeast-and-southwest in the western counties and nearly east-and-west to the east of Halifax. Extensive erosion has then worn away the upper portions of the folds and gradually planed the face down to its present attitude, exposing alternately at the surface, belts of hard quartzites along the apices of the folds and bands of soft slates along the troughs, which give to the region its main physiographic structure. The crescent-shape of the main granite ridges, already referred to, was, especially in the western counties, probably also caused by this same Appalachian upheaval. The streams generally follow the lines of glaciation, crossing the main ridges nearly at right angles, the watersheds have formed low ridges running perpendicularly to the direction of the more pronounced ridges. The result is a country of low but diversified topography. In Queens county, where the quartzite-slate area is widest, beginning at the coast and going north, one may trace three parallel belts of disconnected quartzite ridges, between which lie valleys or flats of slate. The remarkable chain of lakes beginning with Fiddler lake in Shelburne county, including Rossignol and Malaga lakes in Queens and extending to the lakes near New Germany

*E. R. Faribault, Summary Report Geological Survey for 1910, pp. 249-251.

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in Lunenburg county, lie in a slate trough bordered on each side by broken ridges of quartzite. These lakes, however, are not all drained by the same river. Many of the lakes in the other counties are similarly situated. The slates and quartzites extend back from the ocean from 40 to 60 miles and the gradient of the slope is approximately thirteen feet to the mile.

The quartzite and slate areas of the eastern counties, east of Halifax harbour, are separated from those of the western counties by the eastern arm of the granite crescent which reaches the sea between Mahone bay and Halifax harbour. From the eastern border of the granite outcrop in Halifax and Hants counties, the quartzites and slates extend in a belt, interrupted by frequent granite outcrops, to cape Canso. In the beginning, the belt is about 30 miles wide, from whence it gradually narrows until, when it meets the sea at the eastern extremity of Guysborough county, it is not more than a mile wide. From the western end of the belt in Hants county to the southwestern corner of Pictou county, the northern ridges of these rocks constitute in general, the height-of-land between the Atlantic ocean and the bay of Fundy. The transition to the soft lower carboniferous rocks lying to the northward, is along a very irregular line, not always well defined. From the corner of Pictou county eastward, however, the transition is very abrupt, and is marked by a high escarpment extending with only one interruption to Chedabucto bay.

While in the western counties the slate and quartzite areas are approximately equal in extent, in the eastern counties of the Atlantic slope, the areas of quartzite far exceed those of the slate. Along the coast, the east-and-west trend of the ridges is very pronounced, but in the interior, they conform more to the courses of the streams which flow from the northwest to the southeast, partly along the glaciation and partly, along the structure of the rocks. In travelling from Sheet harbour to West

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St. Mary river, a distance of 25 miles, in a direction at right angles to the streams, one crosses twelve ridges, the last one—the escarpment already mentioned on the northern boundary of the slates and quartzites—attaining a height of 600 feet.

(4) Forests and Soils of the Quartzite and Slate Areas :

The quartzites are aggregations of sand grains which are usually cemented together with a fused sand or silicon and are consequently very resistant to decomposition. Sometimes they are cemented with a material less resistant and then they readily decompose. In either case, they give rise to sandy or gravelly soils. East of Halifax harbour, the quartzites are finer in texture and much more firmly cemented than those of the western counties. In addition, mica is a more abundant ingredient. Rock composed entirely of quartz and mica, when decomposed, yields about as much plant-food material as glass. Moreover, the quartzite soils, unless increased by ice- or water-deposited materials, are naturally thin, often not over two inches deep. They support an abundant growth of heath plants, like the blueberries and laurel, whose leaves in decomposing make a sour soil. The fact that usually these quartzite soils are ill-drained adds to the acidity of the soil. In a sour condition, the vegetable matter does not decay normally but accumulates in a peaty mass called raw humus. A sour soil is no more favourable to the growth of trees than to the ordinary farm crops. While the quartzite areas have been extensively burned and are now semi-barren or barren, it is probable that this is not far removed from their original condition. At all events it may be reasonably inferred that they never supported forest trees larger than those of pole-wood size, excepting always, the areas covered by glacial drift.

Slates are hardened clays variously mixed with sand grains, mica and other substances. In decomposition they revert to the clay and so produce fertile soils. All the upland farms of normal fertility in the western counties are on

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slate outcrops. The transition from slates to quartzite in most cases may be readily determined by the character of the farms alone. Sometimes, however, the slates are very hard, and then they are unfit for farming and remain as forested ridges.

Yarmouth county

In Yarmouth the exposures of quartzite and slate are about equally divided in extent, and together occupy about seven-eighths of the county. Unless covered by glacial drift, the quartzite exposures are usually barren of commercial trees. The two larger areas of this kind are along the eastern, and in a strip extending north and south, in the central portion of the county. The former is nearly thirty miles long and from four to six miles wide, and, except for local exposures of slates, is covered with wire birch, red maple and blueberry heaths, with scattering red oak and white pine, or not infrequently with bogs and black spruce-fir swamps. The central strip has the same length, but is somewhat wider, averaging about eight miles, and the northern third of this is more gravelly and barren than the eastern strip. Red maple-fir and red maple-black ash swamps are the principal types in the depressions, while the dry ridges are covered with second growth hardwoods. The southern portion, however, is well covered with soil and supports a mixed forest in which spruce predominates. The slate areas along the coast are covered with inferior spruce, while further inland, being occupied chiefly by farmlands, the forests are confined to farm woodlots which are mostly second growth of the mixed type.

Digby county

The quartzites and slates in Digby county extend from the granite in the eastern portion to the sea in a strip 20 miles wide on the southern border and eight miles wide at the head of St. Mary bay. At the headwaters of the various tributaries of the Tusket river, the softwoods are less abundant than on the granite areas to the eastward, although there are frequent blocks of pure conifers, and

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the hemlock is relatively more abundant in the mixed stands than the spruce. Westward toward the coast, spruce predominates and the whole coastal region has a "black" forest. It is of commercial size on the soils derived from the slates, but on the thin, stony, quartzite soils it is inferior and in many places is reduced to scrub form. In the northeastern portion of the county, the quartzite becomes relatively more abundant, and the soil, for the most part, is coarse with sandy and gravelly ridges covered with wire birch and scattering white pine. In other places it is poorly drained, giving rise to frequent swamps and bogs. On the more favourably drained situations between the ridges and bogs, there is considerable second growth of spruce and maple. The transition from the quartzite to the slate outcrops, with their good farms and beech-maple-yellow birch woodlots is abrupt and impressive.

Queens county

With the exception of about 20 square miles of granite, the underlying rock of Queens county is quartzite and slate. Nearly all the county is drained by the Liverpool and Port Medway rivers, which take their rise in the granite areas to the northward in Annapolis county. The former, in Queens county has worn practically the whole of its valley through slate, but the latter in its lower course has cut through two quartzite ridges. Practically, all the coastal region is quartzite, and the forest is spruce, fir and second growth wire birch and red maple. Spruce and fir grow in about equal proportions on the flats, while the hardwoods predominate on the higher ridges. In following up the Port Medway river the country is of the same character until Greenfield is reached, when slate outcrops are more frequent northward to the county line. The forest in this region has been severely culled and burned, and it is now mostly young stock of good quality. North of Cameron lake and south-west of Tupper lake, there are remarkably good stands of young white pine and fir. Further eastward the hard-



A CHARACTERISTIC BARREN OF THE SANDY OR GRAVELLY SOILS, BURNED IN 1878. NO REPRODUCTION OF COMMERCIAL SPECIES



REPRESENTS THE PREVAILING CONDITION ON THE BOULDER-STREWN GRANITIC AREAS. THE REPRODUCTION OF COMMERCIAL SPECIES IS CONFINED TO THE MOIST DEPRESSIONS

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woods predominate in the second growth. The commercial timber is in scattered lots, the largest groups of which are just north of Tupper lake and west of McGowan and Dean lakes.

In going up the Liverpool river one finds a region made semi-barren by fire, with escaped patches of commercial forest in the depressions and at the bases of the hardwood hills, until the Rossignol group of lakes is reached. South of Second Ponhook lake and Schreecher bay are hardwood hills between which are good stands of red spruce and hemlock with first one and then the other in control. From Schreecher bay northward along the shore of lake Rossignol and thence onward into Annapolis county the forest has been destroyed by fire. There is also an extensive burn on the east side of the lake. In both of these areas no reproduction of softwoods is evident except around the margins of the swamps. The southwestern corner of the county north of Port Joli and Port Hebert was devastated by fire in 1903. Patches of good coniferous timber remain, however, along the upper waters of the streams.

Lunenburg county The western two-thirds of Lunenburg county is underlain by quartzite and slates in alternating bands. As in Queens county, the shoreward region supports mostly a black spruce and fir forest type, although some of the slate outcrops support heavy stands of red spruce and hardwoods. In the interior, when not covered with glacial drift, the quartzite is almost invariably barren or semi-barren of commercial trees. The heaviest forest was found on a slate outcrop, about six miles wide, lying west of the northern half of Nine-mile lake. Red spruce and hemlock form the greater portion of the stand and patches occur in which the hemlock comprises three-fourths of the cover.

Halifax county That portion of Halifax county east of Halifax harbour and south of the granite outcrops to the ocean, is occupied by quartzites and slates. With the exception of the Gay and

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Musquodoboit valleys, similar formations occupy the regions north of the granite outcrops as far as the county line. The numerous peninsulas formed by the long re-entrant bays and harbours are covered with an inferior black spruce-fir forest, and exhibit abundant bogs. The softer places in the rock have been worn into little hollows and pockets, sometimes only a few feet and usually not many rods apart. These fill with water which cannot drain away freely because of the massive quartzite beneath. The loss by evaporation is replaced by frequent rains, but it is also very much retarded by the natural humidity of the air. The result is a sour soil composed of raw humus, and hence the stunted forest. The trees are about ten to fifteen feet high, and, frequently, not more than three or four feet high in the more boggy situations. A section of one of these trees, three-eighths of an inch in diameter, when placed under a compound microscope revealed 47 annual rings. On the drier portions where a little real soil is present, one finds sapling thickets and dense polewood stands of fir. Along the streams of normal rapidity the stand is mostly second growth yellow birch and red maple. Further inland the type is the second growth mixed stand in which three-fourths of the trees are conifers. In the western portion, spruce predominates in such stands, but, in going eastward, balsam fir becomes more pronounced, frequently composing 90 per cent. of the forest.

North of the granite, the quartzite is approximately one-half barren of commercial forest, made so by nature and by man. In the western portion, the country has the appearance of a plateau, in which the low narrow ridges have nearly vertical strata, bare of soil and bare of trees except in the crevices of the rock. The depressions between the ridges are filled with patches of sand, on which are pine stands alternating with swamps in which balsam fir and black spruce predominate. The broader and higher ridges are capped with hardwoods and mixed stands are found on the lower slopes. Most of these are now in a severely

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culled or second growth condition. The slow moving streams are bordered by broad swampy areas in which fir and red maple form two-thirds of the stand, the other third being made up of black spruce, yellow birch and black ash in about equal proportions. The eastern half of the quartzite north of the granite is of the same general nature as the western half, except that the ridges are longer and more continuous, following the longer streams. The ridges are farther apart and have more extensive sand deposits and bogs between them.

Guysborough county The coastal vegetation on the quartzites and slates in Guysborough is of the same types as those already described for Halifax county, except that they become more pronouncedly differentiated and cover larger areas. Alder and tamarack, also make up a larger portion of the swampy barrens. In some places trees are so scarce that the fishermen go twelve or fifteen miles inland to get wood for fuel, and this is spruce and fir of only polewood size. The best timber limits are on the headwaters of Liscomb and Moser rivers and along their remarkable chains of lakes. Most of the spruce is on the immediate slopes of the streams, the upland interior being a succession of extensive peat bogs and gravelly barrens. One is impressed by the predominance of yellow birch and paper birch on the hills around the lakes. In some places the former makes up four-fifths of the stand and pure stands of the latter are frequent. The quartzite formations end abruptly to the northward in a distinct range along the south side of West St. Mary river. The crest of this range is covered with pure hardwood, and the slopes with mixed types, the hardwoods predominating, except along the northern base where three-fourths of the stand is second growth fir. The eastern portion of the range, that is, from the point where the St. Mary river turns southward to the head of Country harbour, is covered with second growth hardwoods, some of it even-aged and very

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thrifty, but most of it is inferior and scrubby. The low places and the base of the ravine slopes support fir forests.

(5) Forests and Soils of the Glacial Deposits :

Ice scouring has modified the character of the soils of the Atlantic slope in various ways. It has removed the original covering and exposed the bare rock. In such cases it takes a very long time for the soil to build itself up again to a sufficient depth to support a normal forest. At present, this point has not been reached on many of the granite hills, in both the western and eastern portions of the Province.

The ice has left its scourings in great masses of unsorted materials, varying in size from clay to boulders. If the clay and the finer materials predominate over the coarser, such deposits make good farm lands, and practically all of the fertile upland farms of the Atlantic slope are on soils thus derived. The deposits in which the coarser materials predominate are usually covered with forests. When cleared, they make an indifferent or poor quality of farm soils, such as may be seen on the old military road leading eastward from Annapolis.

Much of the ice-deposited material has been worked over and sorted by water, and is now exposed by the complete drainage of former lakes or by the withdrawal of existing lakes to lower levels. The clays, being much lighter, were carried down the streams and deposited along their lower courses or in the sea, while the heavier sands and gravel were left behind. All conditions of such deposits from deep sands to coarse materials covered only with a thin layer of sand, may be found spread out in billowy masses. Such sands are very common in portions of Shelburne, Queens and Lunenburg counties, giving rise to extensive areas of white pine forests ; while the coarse materials are frequent along the southern border of the granite, from the scouring of which they were derived. Being heavy and coarse they never got far from their original source. The most extensive deposits of such soils are

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found in northern Shelburne and Yarmouth counties. They are barren or semi-barren because of too thorough drainage and natural poverty of plant food materials.

The glacial drift material may occur as long, continuous ridges, which probably represent beds of streams that originally flowed beneath, or in the crevices of the ice sheet, and deposited material. A ridge of this kind in northern Yarmouth county from ten to forty feet high and from 20 to 100 feet wide, may be traced for nearly 20 miles. Deposits of a similar nature may be found in the other counties. They are connected with other low ridges of gravel and sand, and they are not well forested.

One meets on the southern edges and adjacent areas of the granite great masses of boulders distributed by ice action. These influence the character of the vegetation markedly, for, being originally deposited close together on bare rock, trees cannot get much of a foothold until the boulders are covered with decaying vegetable matter. Since the deposits of boulders often averages four feet in depth, this process will take a long time. It follows, therefore, that such deposits are natural barrens. The largest barrens of this kind are found in the neighbourhood of the meeting point of Digby, Yarmouth, Shelburne and Queens counties, and also in eastern Guysborough county.

The damming of drainage courses by glacial debris has created innumerable lakes, ponds and peat bogs. They are in all stages of possession by vegetation, from a fringe about the upper edge to complete replacement resulting in black spruce-fir swamps. Swamps of this kind also occupy poorly drained depressions which are between ridges, and probably never had free standing water. They also occur on water-seeping slopes, especially when under the influence of the humidity of the sea, and along the margins of slow-moving streams. The unforested peat bogs are probably due to the fact that the water is so high in the germinating time that the seedlings cannot get a foothold, or those that do germinate are drowned by the

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high water in the following spring. One frequently finds drained lake beds in the possession of coarse grasses and sedges.

Shelburne county

While glacially deposited sands, gravels and formations like those described above are frequent in all of the counties, they are most extensive in Shelburne, and those of this county will be described here as types of similar conditions wherever found.

The lower and middle courses of the rivers crossing the county from the Clyde to the Sable are characterized by low undulating deposits of sand interspersed by rocky or gravelly ridges, bogs and swamps. The two latter are most extensive in the valleys of the Clyde and Sable where they occupy from one-third to one-half of the area. They contain spruce and fir pulpwood in about equal proportions, usually, however, the spruce predominates. One finds in these regions, blocks of several thousand acres, not over five per cent. of which are forested, the rest being barren, open bogs and brushland. Thickets of wire birch, red maple and red oak cover the gravelly and rocky ridges. Along the bases of the ridges the young hardwoods are mixed with spruce and fir. The largest continuous deposits of sand are along the Jordan and Roseway rivers, where there is a block of approximately twenty square miles covered with white pine, with black spruce and fir in the depressions. In the western portion in particular, seventy-five per cent. of the stand is white pine. This fine stand of white pine is said to be the result of a severe burn which occurred about 90 years ago, and it will be described more fully under reproduction after burning in another section of the report.* In the regions mentioned above, there are patches of heavier soils, especially in the eastern portion, with mixed forests in which red spruce prevails. These become con-

* See page 77.

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tinuous above Great East Jordan lake and extend to the county line. In going northward through these, hemlock becomes increasingly common until it predominates.

Shelburne is the most scantily forested county in the Province, 67 per cent. of its area being classed as either natural or fire barrens. The natural barrens, as shown above, are due to ice action and the slow recovery after fires is due in part to the lightness of the glacially deposited soils.

II

The Northumberland and Minas Drainage Basins

THE region to the northward of the crest of the Atlantic slope comprises approximately one-half of Nova Scotia proper. Its rivers for the most part drain into Northumberland strait and Minas basin. While the northern half contains higher points of land, and a greater variety of rock, the topography as a whole, is not so diversified as that of the southern half of the Province; low undulating plains and gentle slopes are more extensive; the river valleys are wider and, with the exception of portions of Guysborough county, lakes and bogs are of much less frequent occurrence. The most striking topographic feature of this portion of the Province is the central axis and watershed which extends with some interruptions from cape Chignecto in Cumberland county to cape George in Antigonish county. The largest continuous portion begins with the Cobequid hills in Cumberland county and extends to Mt. Ephraim in the east central portion of Pictou county, a distance of seventy-five miles with an average width of eight miles.

From Mt. Ephraim eastward, the continuity of the watershed is broken by the valleys of West, Middle and East rivers of Pictou for a distance of about twenty miles. When taken up again it soon bifurcates; the principal spur runs in well-developed ridges northeast and terminates in cape George in Antigonish county. The minor spur

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extends in a series of relatively low ridges, to a little north of east of the strait of Canso. Most of the southern slopes of this spur are drained into Chedabucto bay. The waters of the other portion, however, flow into the Atlantic through the St. Mary and Country Harbour rivers. The waters of the main spur and of the northern slopes of the minor spur drain into Northumberland strait.

The region between the central axis described above and the height of land to the southward extending through the Atlantic tier of counties, has the appearance of an elevated valley dissected into numerous low ridges by its streams. The more westerly streams flow into Cobequid bay and Minas basin, while those farther east flow, for the most part, into Chedabucto bay. The character of the rock indicates that this valley was once occupied by the sea which separated the Province into two long parallel islands. Nearly one-half of the valley is still occupied by Minas basin and Cobequid bay.

A low undulating plain occupies the territory north of the central axis to the Northumberland strait. It is 20 miles wide in Cumberland county and it becomes narrower in going eastward until excluded by the high promontory terminating in cape George in Antigonish county.

The rocks of the region, and therefore the soil and vegetation are much more diversified than in the country draining into the Atlantic ocean. Instead of three prevailing kinds of rock, as on the Atlantic slope, one finds here at least ten different kinds which extend over large areas. Even this statement does not adequately express the difference, for each kind of rock varies greatly in its composition and hardness.

(1) Distribution and Topography of the Igneous and Metamorphic Rocks :

The rocks of the central axis just described vary widely in character since they are made up of felsites, syenites, diorites, schists and granite. In the western half of Cumberland county, the ascent to the height-of-land from the



A PURE STAND OF WHITE PINE SUPPOSED TO HAVE STARTED AFTER A FIRE IN 1830. SECOND GROWTH WHITE PINE IS OF THE MOST COMMON OCCURRENCE IN QUEENS AND SHELBUERNE COUNTIES, N. S.

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north is gradual over a series of low ranges, but farther eastward, the northern slopes are more precipitous, and in eastern Cumberland and through Colchester county to Mt. Ephraim they rise abruptly from the northern plain. The highest point in the range is about 1,000 feet. The southern slopes of the central axis are more gentle than the northern.

In the eastern portion of the central axis the largest mass of igneous rocks lies north of the East St. Mary river, an area approximately square with sides ten miles long. From this region they extend, in isolated hills or crests of hills made up of other rock, northeastward to cape George in Antigonish county, and eastward through southwestern Antigonish and central Guysborough counties to Chedabucto bay, where they meet the granite described above as part of the Atlantic slope.

(2) Forests and Soils of the Igneous and Metamorphic Rocks :

The felsites and syenites are rocks similar to granites except that they usually lack quartz, at least such as can be discerned by the naked eye. The felsites vary in hardness, and the softer forms give rise to very vigorous soils which rank with alluvial soils in fertility, while the harder forms result in a soil similar in fertility to that of the more compact sandstones. They are, therefore, feeble soils. The syenites rank with the more easily disintegrating granites in soil quality, that is, they produce a vigorous soil. The diorites give rise to very vigorous soils. The schists are the poorest soil-formers in the group. As a whole, however, this group of rocks yields light, fertile soils as the character of the forest they support attests. The soil, however, is usually very stony, and, where it is not, its topography is such as to make farming impossible.

Beginning at the western extremity of the outcrops of this group, one finds on the granite north of Advocate bay a luxuriant forest which contains 75 per cent. red spruce. The same type is found on the granite mass north of

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Greville bay. From there, the outcrops of this group of rocks occur only in small patches, until the Cobequid hills are reached, where they are found in largest mass. The northern slopes of the Cobequid hills in the neighborhood of Wentworth, for example, support at the base a mixed forest of hardwoods and red spruce, fir and hemlock, in which softwoods originally predominated. As one ascends the slopes the forest becomes prevailingly of the hardwood type. In some places it is two-thirds yellow birch ; in other places it is about equally divided between yellow birch, hard maple and beech. Near the top of the slopes one often finds narrow ridges which are covered to the extent of ninety per cent. with beech of inferior quality. In the higher levels frequently immense hopper-like basins are found nearly enclosed by ridges. In these, the forest is composed in nearly equal proportions of balsam, fir, red spruce and the hardwoods. In the narrow valleys of the streams on the other hand, hemlock, spruce and fir prevail in the order named, so that looking at the northern slopes of the Cobequid from a distance, one sees the green of the prevailing hardwoods interspersed with black bands of coniferous softwood foliage.

The forests of the southern slopes of the Cobequids are similar to those of the northern. There are, however, generally more outlying ridges, and the valleys between these are wider, resulting in situations more favourable for red spruce and hemlock. This is particularly true for the western portion of the southern slopes. The rounded crests of the lower ridges are covered with hardwoods, while those of the higher ridges support the mixed forest type.

The percentage which the various species contributes to the stand was determined from the base to the top or a southeasterly facing slope near the McCallum settlement in Colchester county. Sample plots were made 20 rods apart, from a stream to the top of the slope with the following results : For the first 20 rods of a *gentle* slope the forest was equally divided between beech, hard maple and yellow

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birch. On *steep* slopes, at the same distance from the stream the stand was 52 per cent. fir, 35 per cent. red spruce, and 13 per cent. yellow birch. At forty rods from the stream : 47 per cent. hard maple, 40 per cent. beech, 11 per cent. yellow birch. At sixty rods from the base, the composition was 52 per cent. beech, 32 per cent. hard maple, and 16 per cent. yellow birch. At 80 rods : 55 per cent. beech, 42 per cent. hard maple and eight per cent. yellow birch. The last three plots were on moderately steep slopes. From this point, a crescent-shaped basin extended for a half-mile to the crest of the slope, and the forest was composed of the hardwoods to the extent of two-thirds of the stand. The top of the slope was moist and the stand was 52 per cent. fir, 35 per cent. red spruce and 13 per cent. yellow birch. The soil of the slope was a fine sand and a sandy loam filled with small angular pieces of rock.

The large mass of felsites and syenites north of the East St. Mary river supports a mixed, thoroughly culled forest. The eastern slopes along the Upper Ohio river are quite abrupt and are covered with a mixed coniferous and hardwood forest in which the hardwoods predominate. On some of the slopes they are in pure stands. The broad tableland between the headwaters of the Ohio river and Black brook is made up of low ridges and depressions, the former being covered chiefly by yellow birch and the latter by rather inferior red spruce. The soil is thin, and large areas are covered with rock fragments. The flats about the lakes, however, support nearly pure stands of good spruce. The tableland also contains frequent black spruce-fir swamps. The western third of the area is three-quarters hardwood, over half of which is yellow birch, and the remaining portion is about equally divided between red spruce and fir.

Another large area of felsites and syenites lies just west of the one described above, and is drained principally by the headwaters of the East river of Pictou and Sutherland river. The forests are mixed, with hardwoods forming about 60 per cent. The farms on both of these outcrops are few and

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poor except where they happen to be upon glacial drift soil.

(3) Distribution and Topography of the Sandstones and Slates :

Three distinct regions of sandstones and slates are found in the northern tier of counties. The central belt is the largest, extending, as it does, from the strait of Canso and Chedabucto bay to the head of Cobequid bay, and then with some interruptions, along both of its shores, as well as along those of Minas basin. Along the shores of the latter it extends to the head of Annapolis basin on the south and to Advocate bay on the north. This belt is twenty miles wide in eastern Guysborough and Antigonish counties. As it extends westward it narrows rapidly to little more than two miles wide in the southwestern corner of Antigonish county near Lochaber lake. From this point the belt gradually widens until the southern corner of Pictou county is reached, where it expands suddenly to twenty miles wide, a width which it keeps nearly to the head of Cobequid bay.

The second region lies north of the central axis, extending from Chignecto bay to Merigomish harbour, a distance of one hundred and thirty miles. Its average width is twelve miles. This northern belt connects with the central belt described above in the valley of the West river of Pictou. The third and smallest region, composed of rocks of this kind, is formed by the eastern and northeastern spurs of the central axis. The northeastern spur abuts upon the north and west sides of the felsite-syenite outcrop in Antigonish and Pictou counties, described in the preceding section. It is twenty-five miles wide at the points of contact with the other kinds of rock and it gradually narrows to the northeastward until at cape George it is only three miles in width. The region has the aspect of an elevated plateau which has been cut into deep narrow valleys and high steep ridges by the streams flowing from it. The eastern spur leaves the main axis in the southeastern corner of

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Pictou county and runs northeast for fifteen miles approximately along the line between Guysborough and Pictou counties, then it trends a little north of east, reaching the strait of Canso near Mulgrave.

(4) Forests and Soils of the Sandstones and Slates :

The sandstones and slates are grouped together because they occur that way in nature. Some of the sandstones are made up of small particles and give rise to fine-grained sandy soils, while others are coarse grained, resulting in coarse porous soils. The same differences may be noted in the slates. Most of them, however, are rather coarse in texture, giving rise to sandy loams. Frequent small outcrops of quartzite are associated with these rocks and they give rise to thin and coarse soils.

The forests of the sandstones and slates will be described in the order given above, namely, those of the central belt, the northern belt and the northeastern spur belt ; furthermore, for convenience of description, the central belt will be divided into the western area, the central area and the eastern area.

The western area of the central belt is divided into two sections by Cobequid bay and Minas basin. The section on the northern shore of these waters extends, with a few interruptions, in a narrow band from Advocate bay to the head of Cobequid bay. The area is somewhat more than one-half under cultivation, and the forest is nearly all second growth farm woodlots, whose composition is more than two-thirds spruce and fir, the rest being white birch and red maple with scattered larch.

The sandstones and slates south of Cobequid bay divide just west of the Shubenacadie river. One section extends westward in a narrow strip not more than three miles wide, along the southern shores of the bay to the Avon river. The other extends in a southwesterly direction to the neighborhood of Upper Rawdon in Hants county. Along the coast, the ridges are capped with hardwoods and the depressions support a mixed forest in which either red

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spruce or hemlock prevails ; and frequently, the conifers occur in pure stands. There are also sandy pine ridges as well as semi-barren outcrops of quartzite. The broad belt of sandstone and slate extending southwest is covered with second growth and mature mixed forest ; conifers prevailing in both. The mixed forest is very luxuriant on the broad gentle slopes where the composition is from one-half to three-fourths red spruce and usually about 15 per cent. is yellow birch and five per cent. beech. The soil is deep and consists mostly of silt and fine sand. When the top of the ridges are narrow they are crowned with hardwoods, otherwise the mixed type extends over them.

West of the Avon river, the sandstones and slates extend between the North and South mountains to the head of Annapolis basin. The upland soils are for the most part sandy loams. The character of the soils, together with the protected nature of the valleys, makes the area famous for its fruit orchards. The southern slopes of North mountain are approximately one-half under cultivation. The old forest stands contain hardwood in the greater proportion. There is, however, so much second growth white spruce, fir and red spruce, that in the region, as a whole, the conifers somewhat surpass the hardwoods in forest composition. The forests of the northern slopes of South mountain have already been described under the granite areas.*

The central area of sandstones and slates is approximately 30 miles long and 20 miles wide. On their southern margin they border on the limestone of the Shubenacadie and Stewiacke valleys, and to the north they form the foothills of the central axis of metamorphic rock. They extend from the head of Cobequid bay to the height of land which diverts the drainage on the one hand to the Stewiacke, the Middle and West Branch of the Pictou, and on the other to the East St. Mary river. The portion of this area which lies in Pictou county north of the Intercolonial

*See page 47.

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railway and south of a line drawn from Green Hill to Mt. Ephraim is largely under cultivation, with mixed second growth woodlots. South of the railway to the height-of-land mentioned above, the country is made up of low rounded ridges and depressions. The higher points are covered with hardwoods, while the bases of the slopes and the forested depressions support mixed stands in which the conifers are in the majority. As a whole, one-half of the forested areas is composed of red spruce, fir and hemlock. In Colchester county, from the eastern boundary of the county westward to the Truro Township line, the softwoods slightly exceed the hardwoods in number. They prevail especially along the broad uplands which act as watersheds in this region.

From the eastern boundary of Truro township to the head of Cobequid bay and thence to the Shubenacadie river, the forest is approximately equally divided between red spruce, hemlock and fir on the one hand and the hardwoods on the other, and it occupies 60 per cent of the area.

The eastern area of the central belt of sandstones and slates begins at the headwaters of the East St. Mary river and extends in a band averaging eight miles wide and 35 miles long to Lochaber lake where it widens suddenly to 25 miles and extends to the strait of Canso and Chedabucto bay. The forestal nature of the first portion may be characterized very briefly : barrens and semi-barrens interspersed with bogs and low hardwood ridges. The forest on the broad belt east of lake Lochaber is of the mixed type with hardwoods, chiefly yellow birch, forming one-half of the stand, the rest being red spruce and fir in about equal proportions. The crests of the hills and ridges are pure hardwood, 90 per cent. of which is often yellow birch, the remaining being beech, hard maple and paper birch. East of the Cross Lake region to the Guysborough river, practically pure hardwoods prevail. As one approaches the coast from the interior, fir and spruce form a large pro-

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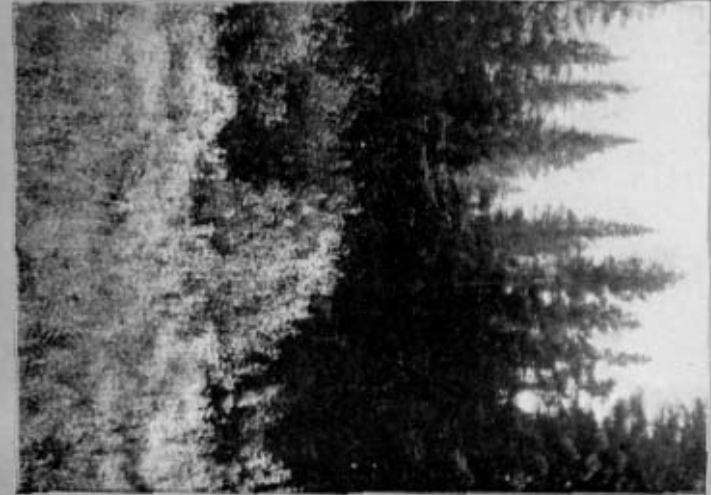
portion of the forest, until on the steep Canso slopes, these species make up about 80 per cent. of the stand with the fir predominating.

From Pirate harbour, southwest to the county line there is an interrupted belt of coarse flinty quartzite which is mostly barren of trees of commercial size. In some cases, the barrens are covered with stunted white birch and maple ; in others, with dwarf spruce and fir, while in still others, the ground is strewn with blocks of rock and is bare of trees except in the depressions which are occupied by black spruce and fir. Except for the region east of Guysborough harbour, the upland soils are not successfully cultivated because of the presence of flagstones near the surface.

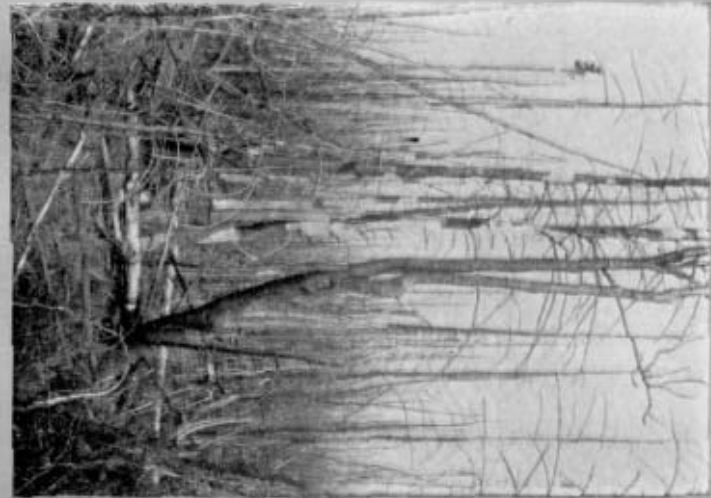
As already stated in discussing the sandstones and slates, the second largest region of such rocks lies north of the central axis and extends from Chignecto bay to Merigomish harbour. That portion draining into Chignecto bay contains extensive unbroken forests in which the softwoods exceed the hardwoods in number. The area draining into Northumberland strait, east to river Philip, contains frequent forest areas of like nature, but from that point eastward to Merigomish, the forest on sandstone and slate is second growth white birch, red maple, spruce and fir, a condition due both to fires and severe culling of the farm woodlots. About three-fourths of the area is under cultivation.

The third and smallest area of sandstones and slates has its western boundary just east of East river of Pictou and extends in a northeast direction to cape George in Antigonish county. These rocks form a mountain range the northeast spur of the central axis. They have been considerably altered by geological agencies, and partake of the nature of schists. On the eastern side of Cape George promontory they are very coarse and hard, almost conglomerates. In the western portion, the hardwoods prevail over the conifers, although occasional patches of pure spruce and fir occur. The tops of many of the broad

A FIRE-WHITE SPRUCE STAND. BURNED OVER IN 1819



A RECENT BURN IN A FIRE-WHITE SPRUCE STAND



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ridges are covered with large over-mature hardwoods. North of the Intercolonial railway, the forest is largely second growth, the result of extreme culling. The largest area of mature stands is found along the line between Antigonish and Pictou counties, and the hardwoods are here in the majority. In the interior of Cape George promontory, second growth spruce dominates, and along the coast it is found in a pure stand of polewood size.

(5) Distribution and Topography of the Conglomerate Rocks :

The conglomerate rocks are large masses of gravel and pebbles which have been subjected to great pressure, cemented together and made into rock. They are deposits of a sea-shore, and, interestingly enough, one finds them in bands along the base of both the northern and southern slopes of the Cobequid hills and their eastern extensions. This indicates,—in addition to the presence of sandstones and slates on all sides of it,—that the central axis was at one time entirely surrounded by the sea.

The belt of conglomerate rock on the northern slopes of the Cobequid hills is five miles wide at the mouth of Apple river in Cumberland county. From there it can be traced with some interruptions to a point a few miles east of Wentworth village in Colchester county, a distance of sixty miles. A narrower belt extends along the southern base of the Cobequid hills from the East river of Five Islands to near the McKenzie settlement in Colchester county. Near the meeting point of Colchester, Guysborough, Halifax and Pictou counties, a belt of conglomerate, averaging four miles wide, extends eastward to the vicinity of Salmon River lake in Guysborough county, a distance of nearly sixty miles. A smaller outcrop of the same kind of rock is found along the southeastern slope of the watershed extending into Cape George promontory in Antigonish county.

(6) Forests and Soils of the Conglomerate Rocks :

When the cementing material of the conglomerate is decomposed, the gravel and pebbles are freed, and appear

as an integral part of the soil. Thus the nature of the soil arising from rock of this kind can be readily understood. The conglomerate regions are natural barrens except where the soil has been re-enforced by glacial drift. Probably three-fourths of the Guysborough County conglomerate is without commercial timber. The character of the forest on the conglomerate north of the Cobequids can be seen from the railway line between Westchester and Oxford Junction. Many of the low ridges are covered with jack pine; other ridges are covered with wire birch; still others are barren of tree growth. The depressions contain black spruce-fir swamps and bogs. To the westward the conglomerate belt has been severely burnt. From the effects of burning the conglomerate recovers nearly as slowly as does the quartzite. On the conglomerate at the headwaters of Apple river, there is a fairly good forest in which spruce prevails, although interrupted by frequent barrens and bogs. The conglomerate rock in Antigonish county is mostly covered by glacial drift and supports a hardwood forest. As would be inferred from the nature of the soil, the conglomerate regions can have good farms only in stream bottoms.

(7) Distribution and Topography of the Limestones :

While limestone occurs in scattered patches throughout the tier of counties bordering upon Northumberland strait, only three regions of larger extent are found. The largest of these extends up the valley of the Shubenacadie to Shubenacadie lake, a distance of approximately thirty miles. The main area sends off two branches, one extending up the Stewiacke and its main northern tributary, Little river. This arm averages eight miles wide and is thirty miles long. The other extension runs up Gay river, crosses over into the upper Musquodoboit valley and extends up that valley for twenty-five miles. The second limestone region is in Hants county, and extends up the valleys of the Kennetcook and Cogmagun rivers. It is about ten miles wide and thirty miles long. Approximately one-half of Antigon-

ish county is occupied by the third limestone region. The outcrop is ten miles wide where it abuts upon the igneous rock of Keppoch mountain from whence it narrows, going eastward to a strip a mile wide where it meets the strait of Canso.

(8) Forests and Soils of the Limestones :

While the river valleys contain excellent farms, the upland portion of the first region is chiefly uncultivated. The limestone is very hard and massive and does not readily form soil. The forests contain both softwoods and hardwoods, with the latter in the majority. One frequently meets in this region extensive sand plains and sandy ridges on which are remnants of one-time white pine forests. A large portion of the forest along the upper Stewiacke river is second growth spruce, fir, paper birch and red maple as the result of an extensive fire sixty years ago.

The good farms of the second limestone region are near the mouths of the Avon, Cogmagun, Kennetcook and St. Croix rivers. The greater part of the area does not even support a high grade forest. The limestone is very hard and the soil thin. The area is poorly drained owing to the hardness of the underlying rock and the lay of the land. The result is extensive black spruce-fir swamps and bogs. Semi-barren gravelly ridges are frequent. The forests of the watersheds are of the mixed type with spruce and fir predominating.

The eastern half of the Antigonish Limestone region supports excellent farms with chiefly mixed stands of second growth on the farm woodlots. The uplands of the western half are mostly under forest cover composed of spruce, hemlock, fir and the hardwoods.

(9) Forests and Soils of the Glacial Deposits :

Evidences of ice action are most pronounced on the Atlantic slope. The largest deposits of glacial gravels and sands are in Cumberland and Colchester counties. Bogs, swamps and lakes arising from the damming of water-courses by glacial débris are the most frequent in that por-

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tion of Guysborough included in the northern tier of counties. The vegetation of these areas is similar to that already described for the corresponding situations on the Atlantic slope.

Summary Climate, soil and topography all contribute to make the portion of the Province lying between Northumberland strait and Minas basin, better farming country than the Atlantic slope. For this reason, the proportion of cleared areas there is twice as large. The larger farming population has led to a more severe culling of the adjacent forests, hence there is a larger percentage of second growth. The largest area of this kind is in Antigonish county where nearly three-fourths of the forest area is young stock, while in Colchester approximately one-fifth of the forest is second growth.

Comparing the forests of the northern tier of counties with those of the Atlantic slope, one is impressed by the greater abundance of pure hardwood stands in the former, where the proportion of the hardwood areas to the total forest area is nearly seven times greater than in the latter. The soil-forming rocks here, for the most part, decompose more readily than the prevailing granite and quartzite of the Atlantic slope. There has been much less disturbance of the soils by glacial action so that the general result is deeper soils in which the hardwoods thrive. This expresses itself also in the more luxuriant growth and larger volume of the hardwood in the northern counties. It is only fair to say that many of the now pure stands of hardwood may be the result of the removing of the valuable softwoods, but in making up relative proportions of the two types such areas are doubtless offset by the pure conifer stands resulting from the severe culling of farm wood-lots, and from the growing up of abandoned pastures.

Forest Reproduction on Burned Areas

III

Forest Reproduction and Soil Conditions on Burned Areas

IN making the forest maps in the field, three classes of burned areas were differentiated, namely, recent burns, fire barrens, and second growth after fire. As recent burns, were classed those not over ten years old ; as fire barrens, the older burns in which there was practically no reproduction of commercial species ; as second growth after fire, the old burns in which there was at least a fair reproduction of merchantable species. Beginning with the youngest and proceeding to the oldest, the present condition of these three classes of burns will be described in the following pages :

(1) Recent Burns :

The recent burns are most extensive in Annapolis, Cumberland and Shelburne counties ; they took place in 1903. The largest burn in Annapolis county is in the east-central portion and consists of about 80 square miles. The same fire burned nearly as much in Kings county. The swampy depressions and many of the hardwood hills escaped so that only about one-half of the area was actually burned. As yet, there is no reproduction of commercial species on the area, it being covered by thickets of red maple, pin cherry and wire birch, with alder and viburnum in the swampy pockets. Many of the low, boulder-scattered ridges are without young trees of any kind, being in the possession of bracken fern, sweet fern, raspberry and blueberry bushes.

The most extensive burn in Cumberland county is between the Maccan and Black rivers, mostly south of the Intercolonial railway. It extends in a southwesterly direction for 25 miles and its average width is four miles. As a whole, the unburned patches of forest occupy one-third of the area. In some places, the rock is near the surface, in others it is deeply buried by gravel and sand. The region is now covered with scattered wire birch and a dense growth

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of blueberry, sweet fern and bracken fern, with frequent patches bare of vegetation except for lichens and mosses.

Near Springhill Junction, the sandy plain is covered with small sandy knolls from one to two feet above the little depressions which are from a yard to five yards in diameter. The bed rock is a hard, fine-grained sandstone which, in general, is apparently not more than two feet below the surface. The vegetation is composed of wire birch and scattering jack pine, which escaped the fire, with an undergrowth of blueberry, sheep laurel and hair cap moss. The damp pockets contain purple laurel, Labrador tea and sometimes spruce seedlings. Jack pine seedlings are frequent on the knolls. A soil sample taken here to the depth of six inches was found to be composed of the various soil grades in the following proportions :

SOIL SAMPLE NO. 3

Fine gravel.....	1.37	per cent.
Coarse sand.....	13.67	" "
Medium sand.....	10.66	" "
Fine sand.....	24.35	" "
Very fine sand.....	6.77	" "
Silt.....	17.90	" "
Clay.....	25.03	" "
Loss by burning.....	1.72	" "

The soil for this sample was put through a sieve, the meshes of which were one-twelfth of an inch in diameter. Ninety-seven per cent., by weight, of the soil sample was of this nature and the remaining three per cent. was coarse gravel. The amount lost by burning represents chiefly the vegetable matter in the soil. The analysis shows a large percentage of clay for a forest soil, but because of its shallowness and the acidity of its humus layer, it will support only a sparse growth.

Southwest of the Maccan river, the soil of the burned area is much deeper, since the country is made up of a series of gravelly and sandy ridges. The spruce, in depressions, is not burned and frequently the white pine on their slopes also escaped. These remnants are slowly re-establishing the commercial forest ; in case of the spruce at the rate of

Forest Reproduction on Burned Areas

twelve seedlings, and in case of the pine at the rate of two seedlings to the square rod. A soil sample taken from one of these situations beneath a wire birch-poplar thicket was composed of fine earth 53 per cent., gravel and pebbles 47 per cent. The fine earth contained the following grades :

SOIL SAMPLE NO. 1.

Fine gravel.....	20.69	per cent.
Coarse sand.....	16.37	" "
Medium sand.....	3.83	" "
Fine sand.....	4.87	" "
Very fine sand.....	9.41	" "
Silt.....	23.27	" "
Clay.....	19.10	" "
Loss by burning.....	2.14	" "

A good stand of white pine was removed from the area before it was burned ; the above represents, therefore, the average white pine soil. The replacement of white pine, however, will be exceedingly slow for the seed trees are very infrequent and widely scattered.

The northern and eastern portions of Shelburne county were run over by fire in the dry season of 1903. The same fire extended into the adjacent portions of Digby and Yarmouth counties on the western and into Queens on the eastern border. The escaped patches of swamp and heavy timber make up from one-third to one-half of the area. About one-half of the actually burned area is now in the possession of bracken fern, sheep laurel, huckleberry, blueberry, sweet fern and raspberry, named in order of their abundance, and the other half is covered by thickets of wire birch, red maple, poplar and red oak with the plants enumerated above as undergrowth. A sample plot in one of the birch thickets on a granite ridge disclosed forty-three wire birch, ten viburnum and one pin cherry saplings to the square rod. The soil was covered with one inch of duff and was mixed with humus to the depth of one inch. It was 79.6 per cent. fine earth and 20.4 per cent. coarse gravel. The composition of the fine earth is shown below :

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SOIL SAMPLE NO. 24

Fine gravel.....	12.64	per cent.
Coarse sand.....	14.99	" "
Medium sand.....	10.42	" "
Fine sand.....	17.75	" "
Very fine sand.....	16.43	" "
Silt.....	11.94	" "
Clay.....	4.70	" "
Loss by burning.....	10.93	" "

The percentage of vegetable matter is very high, but it was made up largely of raw humus unavailable to the vegetation. This condition is due to the sourness of the soil.

The birch thickets are even more dense on the quartzite as shown by a sample plot which contained 75 wire birch saplings to a square rod. There was only a slight covering of duff with five-eighths of an inch of humus soil. The soil to the depth of six inches was 24.5 per cent. coarse gravel and 75.5 per cent. fine earth, in which the various grades were distributed as follows :

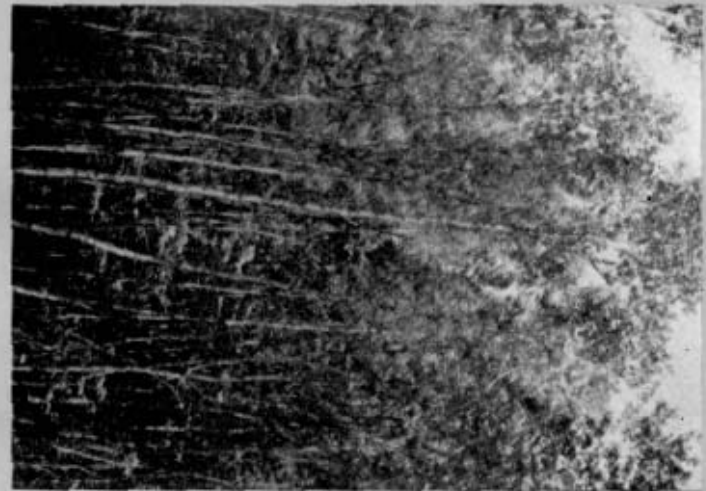
SOIL SAMPLE NO. 25

Fine gravel.....	8.03	per cent.
Coarse sand.....	10.53	" "
Medium sand.....	7.85	" "
Fine sand.....	19.56	" "
Very fine sand.....	20.09	" "
Silt.....	18.15	" "
Clay.....	6.95	" "
Loss by burning.....	9.08	" "

The soil was acid in reaction, and for the first one and one-half inch in depth, was ash gray in colour, due to leaching. The dry knolls of the quartzite are bare of trees of any kind, one-half of the vegetation being huckleberry, and the other half equally divided between the bracken fern and sweet fern. The vegetation beneath the thickets was of a similar nature, usually with the huckleberry predominating.

Although scattered mature white pine and groups of polewood size occur in the burn, the shrubby vegetation beneath is so luxuriant, pre-empting the soil and casting so much shade, that as yet practically no reforestation is taking

WIRE BIRCH (*BETULA POPULIFOLIA*) THICKET, TWENTY YEARS AFTER A FIRE



THE CONDITIONS REPRESENTED BY THESE PLATES EXIST ON 19 MILLION ACRES, OR NEARLY ONE-FOURTH OF THE THICKEST FOREST AREA OF NOVA SCOTIA

WIRE BIRCH (*BETULA POPULIFOLIA*) THICKET, TEN YEARS AFTER A FIRE



Forest Reproduction on Burned Areas

place, and the same is true along the margins of the spruce swamps. In addition one frequently finds blocks of several square miles without a seed tree of a commercial species.

The smaller recent burns scattered throughout the Province are in a condition similar to that on the three areas described above. There are over a half million acres of recent burns in Nova Scotia proper, on which the re-establishment of timber trees is at a standstill and will be for many years to come, even though future fires are excluded.

(2) Fire Barrens :

The fire barrens are older stages of the conditions described above, in which the greater part of the area is still without any considerable second growth of timber trees. The age of such barrens is from ten to eighty years, the latter age is however only based on tradition. They have doubtless all been burned more than once, although many of them have not been burned for 30 or 40 years.

The largest areas occupied by fire barrens are in Guysborough, Halifax and Shelburne counties. A description of those of Shelburne county would be a repetition of that given above for recent burns, except that the birch thickets are less dense, the birch being supplanted to some extent by oak, mostly of a scrubby nature. About the margins of mature woods and the escaped patches, one finds fairly good reproduction of the coniferous species. This is particularly true of the spruce on the moist slopes bordering the swamps, but the combined areas where such reproduction is taking place is a very small proportion of the whole.

The largest fire barren in Halifax county lies between St. Margaret bay and Halifax harbour, and it continues eastward from the latter point all along the slopes of the granite outcrop. The western portion is chiefly barren of commercial trees, the forest being composed, as usual, of wire birch, red maple, alder and poplar, and frequently it has scattered white pine of polewood size reaching up above them. The soil is sandy and is filled with pebbles and boulders. In many places the bare rock is exposed,

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and the surface strewn with granite boulders. The tops of the sandy knolls where the soil is deep frequently support young red oak. On the more moist, deeper soil of the slopes one finds scattered patches of thrifty hardwoods from twenty to forty years old. In one of these patches the composition of the stand was as follows : fir 24 per cent., black spruce 16 per cent., yellow birch 21 per cent., shad tree seven per cent., red maple 19 per cent., mountain ash two per cent., paper birch one per cent.

Seedlings beneath the stand were present at the rate of 209 fir and 16 black spruce to the square rod. The broad-leaved trees over-topped the conifers so that at a distance the stand appeared to be entirely composed of the former. The soil barely covered the granite boulders, and the interstices were filled with medium-sized, gray sand, which was covered by a humus layer three inches deep, and by duff on the surface to the depth of one inch. Just adjacent to the stand, in a recent cutting of trees, evidently of the same age, the oldest tree was found to be 45 years old, and the average age of the ten stumps was 37.2 years.

Fire barrens are frequent on the granite hills eastward of Halifax harbour and they are of three types. The most common is found on the low boulder-strewn slopes, and at the base of the high steep slopes. The boulders usually occupy the greater part of the surface and between them are groups of red maple, paper birch, willow and alder. The larger pockets between the rocks contain black spruce, white pine in considerable numbers, and occasionally red pine. Narrow, trough-like depressions between the rocks are often filled with glacial débris in which sand prevails, and here one finds the remnants of white pine stands. No reproduction, however, was observed, the ground being covered with a thick mat of huckleberry, sheep laurel and blueberry.

The second type of the fire barren in this section is found on the granite plateaus and in the broad depressions

Forest Reproduction on Burned Areas

between the ridges. The soil as a whole is rather thin and very peaty, the turf often caking in dry weather. The moist depressions are filled with alternating groups of pure stands and mixed stands of fir, black spruce, red maple and paper birch. Interspersed with these, are sandy knolls on which white pine originally grew before being killed out by repeated fires. Such knolls sometimes occupy one-half the area, but usually much less. Thickets of birch and maple as described above, make up the third type.

The fire barren on the quartzite east and northeast of Halifax harbour is covered to the extent of 80 per cent. with wire birch, the rest being red maple with scattering yellow birch and beech. Fir prevails along the margins of the numerous lakes and ponds and it frequently covers the tops of low ridges. Overtopping these are scattered mature white pine and an occasional red pine. In the gullies one finds good stands of young hemlock mixed with red oak. For the most part the surface is strewn with boulders and the soil is sandy, although the greater part of the volume is occupied by pebbles and boulders of various sizes. A cut by the roadside revealed eight inches of sandy and pebbly soil darkened by humus ; below this, 18 inches of gravel and pebbles, then 12 inches of pebbles and small stones. Most of the soil is of a similar nature, but is not as deep as this. It is evident that such soil does not encourage heavy forest growth, even when not pauperized by frequent fires. There are, however, frequent patches of deep sand on which there is good white pine reproduction.

Farther eastward, the fire barrens on the quartzite are similar as to controlling vegetation, but the soil as a whole is less stony and there are more frequent patches of sand between the ridges where the reproduction is good. The average of the sample plots in such situations shows the following composition: fir 35 per cent., white pine 11 per cent., paper birch 35 per cent., red maple 11 per cent., red spruce eight per cent.

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A mechanical analysis of a representative soil sample shows the following composition of the fine earth, 37.7 per cent. of the sample being coarse gravel.

SOIL SAMPLE NO. 12

Fine gravel.....	1.18	per cent.
Coarse sand.....	3.87	" "
Medium sand.....	3.86	" "
Fine sand.....	10.06	" "
Very fine sand.....	23.08	" "
Silt.....	47.73	" "
Clay.....	9.10	" "
Loss by burning.....	1.68	" "

In the extreme northeastern portion of the county, the low ridges of the fire barrens often bear scattered, scrubby white pine, with contorted misshapen crowns. Sixteen trees on an acre was the largest number noted. The soil is loaded with pebbles and stones covered by a thin layer of sand. At least two-thirds of the volume is occupied by the coarse materials. The vegetation beneath the pines is so dense that their seedlings cannot get established. At the base of the ridges there was once good white pine, but the trees which remain have beneath them dense thickets of fir. A number of sample plots taken here show, on the average, 800 fir saplings to one white pine sapling. In the hardwood thickets the paper birch replaces to a large extent the wire birch, and it is usually outnumbered by the red maple.

The fire barrens in the interior of Guysborough county are similar to those described above for Halifax county, but along the coast a new type is found, namely one in which alder and the conifers are dominant. One frequently meets on the hillsides a forest of whitened stubs, with alder thickets so dense beneath that at a distance the dead trees appear to rise from a green pasture. On the more gentle slopes and the rolling plateaus, the soil is peaty, filled with flag-like stones, and is now covered with alder, tamarack, black spruce, fir, maple and birch, mentioned in order of abundance.



A FUTURE FIR FOREST BENEATH PAPER BIRCH. THE BIRCH IS 67 YEARS OLD AND IT EVIDENTLY CAME AFTER A FIRE. THROUGHOUT THE PROVINCE FIR IS THE MOST ABUNDANT SPECIES IN THE SECOND GROWTH, AND IT IS DESTINED TO BE THE DOMINANT TREE OF THE FUTURE

Forest Reproduction on Burned Areas

The vegetation of the fire barrens in central and southwestern Annapolis county is similar to the hardwood type already described for other places, except that red oak and poplar are more common. A soil sample taken from this type near Little Dargie lake was found to consist of 33.4 per cent. coarse gravel and 66.6 per cent. fine earth. The composition of the fine earth is indicated below :

SOIL SAMPLE NO. 13	
Fine gravel.....	12.40 per cent.
Coarse sand.....	13.01 " "
Medium sand.....	5.83 " "
Fine sand.....	11.75 " "
Very fine sand.....	24.71 " "
Silt.....	17.61 " "
Clay.....	9.65 " "
Loss by burning.....	4.89 " "

The humus content is relatively high, but it is in an indigestible condition owing to the sourness of the soil. There are patches of deep sand in this region on which white pine reproduction is excellent.

Owing to the difficulty of determining their history, the natural barrens were included in the survey with the fire barrens, in estimating the acreage. It was found that approximately one-fourth, or 1,986,354 acres (including the relatively small portion of natural barrens) of the present forest area of the Province has been so severely burned that it is now semi-barren of commercial trees.

The future of the recent burns, consisting of 550,098 acres, will probably be the same as that of the fire barrens now under discussion.

(3) Second Growth after Fire :

Under this heading were included stands arising after a fire which are potentially valuable because of the reproduction of commercial trees. The larger areas of this kind probably followed light fires which burned the forest floor sufficiently to expose the mineral soil, but it did not kill the seed trees. Some of the fires doubtless occurred in a year of heavy seeding.

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The earliest re-establishment of the forest is naturally found around the margins of the burned areas. For example, on the sand plains in central Cumberland county, which were run over by a ground fire after cutting ten years ago, one finds scattered seed trees with good reproduction beneath. Where there were two white pine, six red spruce and two fir seed trees left per acre, a square rod yielded a count of 27 fir, 19 white pine and five red spruce seedlings. Adjacent birch-poplar thickets averaged two white pine seedlings to the square rod. Stands, 20 to 30 years old, known to have been the result of fire, are common, and a number were studied in detail. A twenty-year old burn south of Joggins in Cumberland county is now 65 per cent. poplar, the rest being alder, paper birch and red maple. Beneath these are red spruce and fir seedlings at the rate of six each to the square rod. The soil was a heavy clay loam. In the same region a stand, between 25 and 30 years old, was composed of 38 per cent. fir, 31 per cent. red spruce, 23 per cent. yellow birch and eight per cent. striped maple. It was on a soil of deep sandy loam. Still another stand of seemingly pure paper birch had beneath it 14 red spruce saplings to the square rod. The soil, like the others, contained no coarse gravel. An analysis of the fine earth showed it to be of the following composition :

SOIL SAMPLE NO. 14	
Fine gravel.....	0.24 per cent.
Coarse sand.....	0.80 " "
Medium sand.....	1.70 " "
Fine sand.....	6.73 " "
Very fine sand.....	3.58 " "
Silt.....	58.18 " "
Clay.....	21.81 " "
Loss by burning.....	7.01 " "

This would make a good agricultural soil and it is destined to support a luxuriant forest.

Several sample plots were examined in a burn, 20 years old, in Colchester county between Greenfield and Smithfield. On the flats between the ridges the young stock was found to contain 59 per cent. fir, 33 per cent. paper birch,

Forest Reproduction on Burned Areas

and eight per cent. pin cherry ; near the base of the slopes : 46 per cent. red maple, 27 per cent. fir, 27 per cent. yellow birch ; around the depressions ; 50 per cent. fir, 17 per cent. red spruce, 17 per cent. viburnum and eight per cent. mountain maple. On the top of the ridges there were frequent thickets in which fir made up 85 per cent. and red spruce 15 per cent. of the stand.

On the Southampton sand plains in Cumberland county, on an area burned between 25 and 30 years ago the stand now is 50 per cent. red spruce, 30 per cent. poplar, 17 per cent. white pine, and three per cent. fir. The pine and spruce range from five to 18 years old. The soil is black with humus two and one-half inches deep ; below this is six inches of medium sized sand, and then a sandy loam to a depth of at least three feet.

In Shelburne county may be found second growth after fire, which contains some fine young red oak, this species contributing, on the average, 33 per cent. of the stand. The rest is made up of white birch, 57 per cent., and red maple ten per cent. Scattering white pine reproduction may be found in some places. The soil is 93.2 per cent. fine earth and 6.8 per cent. coarse gravel. The character of the fine earth is shown below :

SOIL SAMPLE NO. 26	
Fine gravel.....	5.27 per cent.
Coarse sand.....	13.00 " "
Medium sand.....	9.98 " "
Fine sand.....	17.56 " "
Very fine sand.....	22.83 " "
Silt.....	21.16 " "
Clay.....	8.95 " "
Loss by burning.....	1.20 " "

The fine sand extended down at least three feet and probably much deeper, so that the depth as well as the high percentage of the finer grades of sand and silt, insure a commercial forest on the soil.

The sand plains north of the Cobequid hills in the northern portion of Colchester county are covered with a mixed

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second growth, said to be the result of a fire 50 years ago. Three-fourths of the stand is poplar, wire birch and red maple, named in order of abundance, and the remaining fourth is about equally divided between fir and red spruce. The average age of the spruce is 37 years, and that of the fir 44 years. In the Wallace River valley, one frequently finds old burns. In one of these, about 50 years old, the stand is now 53 per cent. red spruce, 18 per cent. fir, 11 per cent. wire birch and six per cent. each of red maple, yellow birch and poplar. The soil was 14.3 per cent. coarse gravel and 85.7 per cent. fine earth. The fine earth was composed of the following grades :

SOIL SAMPLE No. 6

Fine gravel.....	2.86	per cent.
Coarse sand.....	1.99	" "
Medium sand.....	4.35	" "
Fine sand.....	16.19	" "
Very fine sand.....	24.42	" "
Silt.....	37.42	" "
Clay.....	10.80	" "
Loss by burning.....	1.85	" "

On a lighter soil, a stand of the same origin contained 55 per cent. white spruce, 15 per cent. poplar and ten per cent. each of fir, red spruce and red maple. This soil was 37.15 per cent. gravel and 62.85 per cent. fine earth, in which the grades were distributed as follows :

SOIL SAMPLE No. 7

Fine gravel.....	2.49	per cent.
Coarse sand.....	7.02	" "
Medium sand.....	9.34	" "
Fine sand.....	22.36	" "
Very fine sand.....	15.47	" "
Silt.....	35.26	" "
Clay.....	9.05	" "
Loss by burning.....	1.11	" "

The vegetation of both of these plots was rather sparse compared with that of the plots described above, as might be expected from the larger percentage of coarse gravel.

In 1849, a fire swept the region along the headquarters of the Stewiacke river. The best stands which now occupy

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the area are on the deep fine sand of the gentle slopes of the streams where 90 per cent. of the forest is fir and ten per cent. red spruce. The fir averages 56 years old and 14 inches in diameter. In some places 25 per cent. of the stand is spruce, but the fir seems always to predominate. The next best situation is higher on the slopes, and the soil is also fine sand, but pebbles occupy about one-fourth of its volume. The average of the sample plots here shows the composition to be 31 per cent. red maple, 26 per cent. fir, 19 per cent. red spruce, and 14 per cent. paper birch. The seedlings beneath were plentiful, but they are practically all fir. This represents the character of the greater part of the old burn. The average age of the fir is 55 years and the average diameter nine inches. This second site class merges off into two other conditions, the one above to thinner and drier soil where the average composition is : fir 61 per cent., red maple 15 per cent., paper birch 13 per cent., red spruce eight per cent., poplar two per cent., and hemlock one per cent. The other condition is found on the lower slopes where the soil is a clay loam, often with seeping water and pockets of peat moss. Here yellow birch forms 40 per cent. of the stand. The other species are : fir 28 per cent., red maple 22 per cent., paper birch six per cent., hemlock two per cent., and beech two per cent.

Scattered through the burn of 1849, one finds patches of gravelly soils on which the trees are not over four inches in diameter. Wire birch replaces the paper birch and is in control with red maple as a companion, fir usually appearing only in the depressions. This is the third and poorest of the three conditions in respect to soil and vigour of growth found on the old burn. The type merges off in some places into a semi-barren in which the species occur as follows : tamarack 53 per cent., jack pine 23 per cent., white pine 14 per cent., and white spruce ten per cent. The stand is just one-half as dense as the average on the second site class. The soil is 38.5 per cent. gravel and pebbles and 61.5 per

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cent. fine earth. The composition of the fine earth is given below :

SOIL SAMPLE No. 10		
Fine gravel.....	9.35	per cent.
Coarse sand.....	11.12	" "
Medium sand.....	9.15	" "
Fine sand.....	19.78	" "
Very fine sand.....	21.10	" "
Silt.....	16.60	" "
Clay.....	7.10	" "
Loss by burning.....	5.44	" "

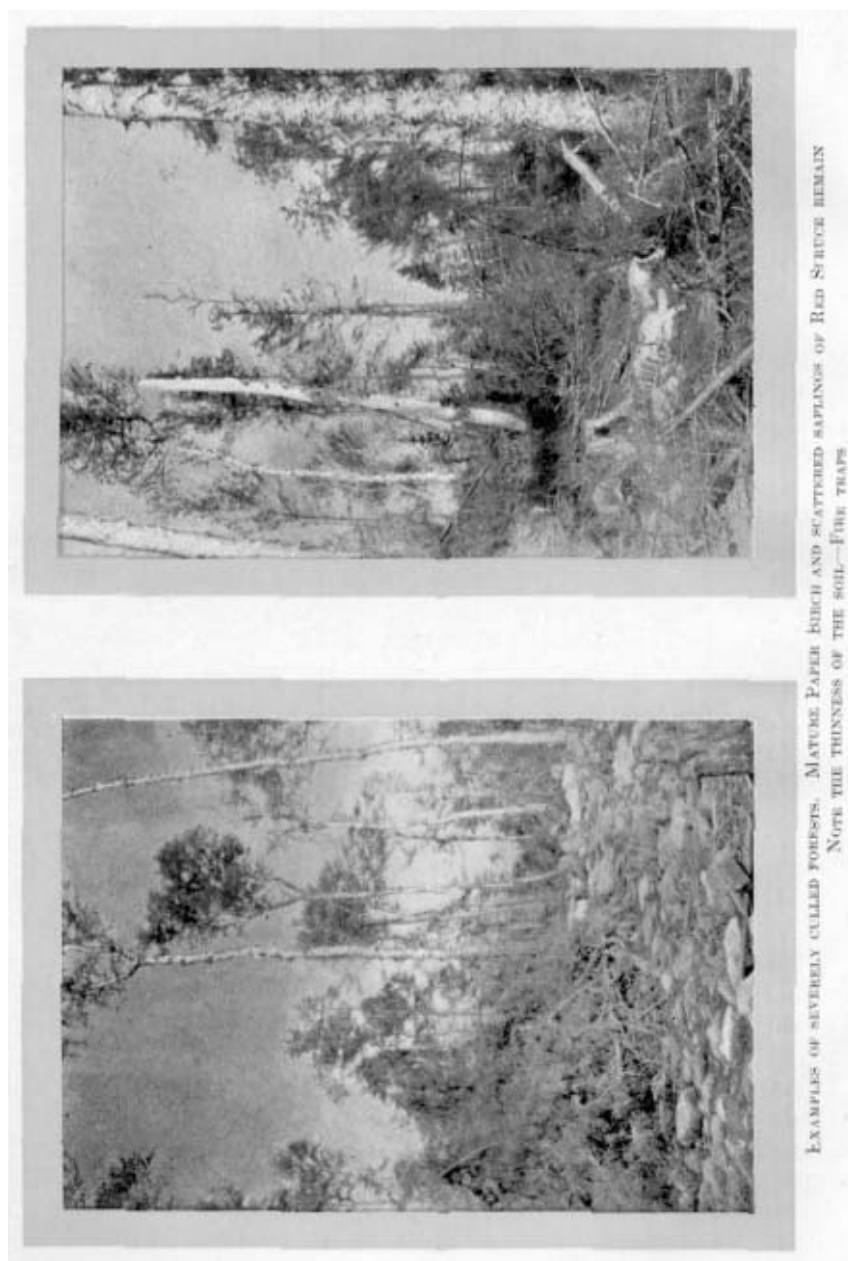
In addition to being coarse it contains sour, raw humus and these two conditions account for the sterility of its vegetation.

The fine stands of white pine between the Jordan and Roseway rivers in Shelburne county occupy an area said to have been burned over, 90 years ago. They are tall with clean stems, and, in the best situations, contain 300 trees to the acre. A representative sample of soil from one of these stands shows 83.5 per cent. fine earth and 15.5 per cent. coarse gravel. The various grades of the fine earth are distributed as follows :

SOIL SAMPLE No. 27		
Fine gravel.....	3.05	per cent.
Coarse sand.....	6.21	" "
Medium sand.....	6.07	" "
Fine sand.....	14.09	" "
Very fine sand.....	30.89	" "
Silt.....	31.15	" "
Clay.....	4.55	" "
Loss by burning.....	3.68	" "

While the soil contains a rather large percentage of gravel, the remaining is over 80 per cent. fine sand and silt and this fine material accounts for the luxuriant growth of the pine which it supports.

In the interior of Guysborough county, even-aged stands, 80 years old, of fir and paper birch, evidently the result of fire, occur frequently. On the flats, two or three feet above the level of the peat bogs, the fir predominates, comprising 75 per cent. of the stand. In the middle of the slopes, the two species are approximately equally



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divided in point of numbers, while at the tops of the low ridges the paper birch appears in pure stand. The reproduction of the fir is plentiful in all three situations, but it is very striking beneath the pure stands of paper birch where it forms dense thickets to the exclusion of other species.

(4) Summary of the Soil Conditions :

In comparing the soils from burned areas lacking good reproduction, with those showing good reproduction of commercial species, one is at once impressed by the better character of the latter. This better character is clearly shown by the average contents of the various grades of soil in the two situations, the difference being mainly in the proportion of coarse particles. For example, the soil with poor reproduction averages 32.62 per cent. coarse gravel and 67.38 per cent. fine earth, while that with good reproduction averages 14.95 per cent. coarse gravel and 85.05 per cent. fine earth ; that is, the soils with poor reproduction have twice as much coarse gravel in their composition as the soils with good reproduction. The averages of the various grades of fine earth, contained in the two classes of soil examined (some 30 samples in all were analyzed) are as follows :

	Fine Gravel Per ct.	Coarse Sand Per ct.	Medium Sand Per ct.	Fine Sand Per ct.	Very Fine Sand Per ct.	Silt Per ct.	Clay Per ct.	Loss by Burning Per ct.
Burned areas without good reproduction.	10.71	11.65	6.82	13.96	19.13	22.55	9.43	5.69
Burned areas with good reproduction.	2.90	6.05	8.64	20.90	17.84	31.31	10.48	2.14

There is nearly four times as much fine gravel and nearly twice as much coarse sand in the soils of poor reproduction as in the soils of good reproduction. While the difference in the finer grades is not so striking, yet with one exception, that of the very fine sand, they run higher in the soils with good reproduction of commercial species. Expressed in percentages the greater proportion on the areas with good reproduction is as follows : Medium sand 26 per cent., fine sand 49 per cent., silt 38 per cent., clay 11

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per cent. There is more than twice as much vegetable matter in the soils of poor reproduction, but most of it is not in a condition to be made use of by the plants, being indigestible because of its acid condition. This comparison does not tell the whole story, for the soils from the fire barrens were taken in the very best situations, that is, where there was some reproduction, while the soils from the second growth stands were taken from average situations. Moreover, the soil of the fire barrens is, as a rule, very shallow, or filled with materials coarser than coarse gravel. In most cases, also, they are sour even when dry, but this condition may be corrected by nature in the course of time.

Comparing the detailed analyses of thirty soil samples from forested areas throughout the Province with the analyses of agricultural soils, it was found that with one exception all were of such composition as to make them unfit for agriculture. The results of several hundred rough field examinations led the writer to the same conclusion, so he feels safe in making the statement that except for isolated areas of a few acres in extent, there are no soils now occupied by forests that could be profitably employed for agriculture. This does not include, however, extensive bog and swamp areas that might be drained, and when properly treated to reduce their acidity, might be transformed into very rich agricultural soils. On the other hand, forests have been extensively cleared in nearly every county from soils so thin, or so coarse in texture as to make farming on them unprofitable. The economic and social conditions on many of these isolated, barren farms are not very satisfactory. It would greatly improve the manhood-asset of the Province if these farmers were brought into the fertile river valleys or into the larger towns, so that the farms might be reforested.

As already stated, *approximately one-fourth of the present forest area of the Province is semi-barren of commercial trees.* This condition has been brought about by repeated fires in situations possessing naturally the coarser soils, as shown

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by the comparison in the table above. If the fires were excluded and if these areas were thoroughly seeded with merchantable species, it would take nature at least one hundred years to produce a marketable forest on these fire barrens. Since, however, seed trees at present exist only in scattered patches and along the margins of the old burns, (the greater part of the area is without seed trees of commercial species) and since the soils are coarser and more sterile than those in other situations, the process of natural reforestation with valuable species will take a very long time indeed. What to do with this great area of fire barrens, now practically valueless, is one of the most important problems facing those who direct the forest policy of the Province.



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