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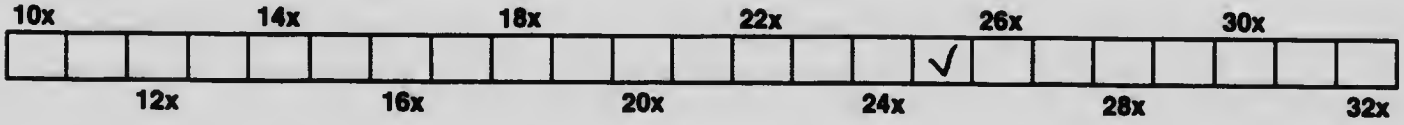

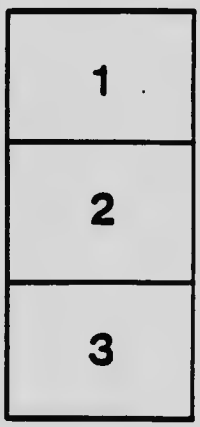

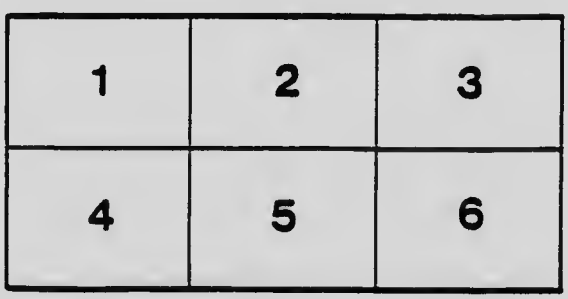

DEPARTMENT OF THE INTERIOR, CANADA

FORESTRY BRANCH

R. H. CAMPBELL, SUPERINTENDENT

BULLETIN No. 1

TREE PLANTING

ON THE

PRAIRIES OF MANITOBA, SASKATCHEWAN AND ALBERTA

BY

NORMAN M. ROSS, B.S.A., B.F.
Assistant Superintendent of Forestry

OTTAWA
GOVERNMENT PRINTING BUREAU
1907

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FORESTRY BRANCH,

OTTAWA, January 7, 1907.

SIR,—I have the honour to transmit herewith Bulletin No. 1, entitled 'Tree Planting on the Prairies of Manitoba, Saskatchewan and Alberta,' by Norman M. Ross, Assistant Superintendent of Forestry, which has been recently revised, and to recommend its publication.

I have the honour to be, sir,

Your obedient servant,

E. STEWART.

Superintendent.

The Honourable

The Minister of the Interior,

Ottawa.

INTRODUCTION

This bulletin has been written with the idea of affording practical information to the settler on the western prairies as to the best methods of propagating, planting and managing hardy trees for shelter belts, windbreaks and plantations. The Forestry Branch is receiving constant inquiries for information of this kind. As there seems to be no literature dealing with this subject which is applicable to our western conditions, it is hoped that this bulletin may be of some help to any who may be intending to go in for tree planting in Manitoba, Saskatchewan and Alberta. The information given here is drawn from the results of planting and general nursery work which have been found successful, and only such trees are recommended for planting as have been proved absolutely hardy under western conditions. There is an immense field in the Northwest for experimental work in forestry, and it may be found later that many other varieties of trees and other methods of planting and management will be equally as successful as, or even more successful than, those at present recommended.

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CHAPTER I.

Natural conditions on the prairies affecting tree growth—Benefits to be derived from tree planting—Difficulties in raising trees—Economic tree planting on the farm—Points to observe in order to insure success.

Natural Conditions.—The subject of tree planting on the western prairies is fast becoming one of general interest to the settlers in that country. Although certain portions of Manitoba, Saskatchewan and Alberta are nautrolly timbered, the larger part of the settled area is practically treeless. It is impossible to say what the exact causes are which, operating for centuries, have produced this result; but it is generally thought, by those who have given some attention to the subject, that a large part of what now is prairie was not originally so; in fact there is direct evidence to show that at least somo districts which now are treeless, were originally well timbered. Undoubtedly the chief agency which, little by little, has caused the prairies to encroach on the timbered area is the frequently recurring prairie fire. It is well known to those familiar with the country that, if fires are kept out of a district for a number of years, small bluffs of poplars spring up all around the sloughs and low places which, if not disturbed, gradually extend till eventually a formerly treeless district becomes well timbered. This is very noticeable on the east and south sides of the Moose Mountain in Saskatchewan, and may be seen in almost any locality where fires have not run over the prairie for some seasons. From this it would seem that had fires not been so prevalent in the past, the timbered areas would now be much more extensive than they are at present. The fact still remains, however, that there are immense tracts of land absolutely treeless which can only be utilized to their fullest advantage after a certain measure of protection is afforded by the presence of belts or plantations of trees.

Benefits of Plantations.—There are several ways in which plantations of trees benefit the prairie settler, the most important of which are the following:—

1. They afford shelter from the winds to crops, buildings and stock.

In this connection, the following statement made by Dr. Saunders, at the fourth annual meeting of the Canadian Forestry Association, is of some interest:

'I happened to be passing Indian Head some three years ago in the spring after a very violent storm. Mr. McKay, the superintendent, and I went over the ground and we found the protective influence of the forest growth on the plains there was about 50 feet for every foot in height that the shelter belt grew; that is to say, a shelter belt 10 feet high protected about 500 feet wide of field. We had a field of barley that was sown alongside of one of the belts and other fields of grain at other points. The protective influence of the belt was very marked. The storm had been a very violent one, and the trees were about 15 feet high and for 750 feet out the grain was green and well protected and in good condition, while beyond that it began to get thinner and thinner, and for a few feet it was entirely obliterated. There the whole crop was wiped out by the force of the wind blowing the plants out of the ground. We measured this at several points and we found that for each foot of growth there was about 50 feet of protection. I referred to this in our next annual report, but this is a thing that I think should be widely known—the advantage that tree growth is on the northwest plains in affording protection to the ordinary field crop of the country.'

2. They collect and hold the snow during the winter preventing it from banking up around buildings.

3. They preserve and retain the moisture in the soil by breaking the force of the hot winds in summer, thus retarding evaporation. The snow also held by them in the winter, melting in the spring, furnishes a great deal of moisture to the land in the immediate vicinity which otherwise it would not obtain.

4. Plantations will supply fuel, fencing material and wood for repairs. This is a very important point to many settlers who live so far away from any natural supply of timber that it often requires three or even four days to make a round trip for a load of poles. If settlers would only realize that they can grow their own fuel and fencing material, as they undoubtedly can, many more plantations would be set out, as this would mean to them a great saving in time and labour.

5. They are of æsthetic value, beautifying the landscape and making life on the prairies much more pleasant and less monotonous.

6. They greatly add to the money value of the farm. There is not the slightest doubt that a farm which had on it a well managed and productive wood lot of a few acres would, other conditions being considered equal, sell for far more than one without trees.

Difficulties.—Undoubtedly there are more difficulties met with in raising trees on the prairies than are to be found in the eastern provinces. In the first place the rainfall is very limited. Second, the trees have to withstand a great deal of exposure to storms and extremes of temperature. Third, the prairie soil as we now find it, after years of exposure to the elements, is so compact and hard that it needs to be specially prepared before it is fit for tree growth. None of these conditions are, however, of such a nature as to make the raising of trees an impossibility, but by following out certain methods, which are indicated by results already obtained, tree growth on the prairies can be made just as successful and perhaps even more certain than wheat raising.

Economic Tree Planting.—With the exception of setting out a few trees for shelter, practically nothing has been done in the way of tree planting on the prairies of Canada. The question of economic tree culture has not yet received any attention, consequently we have no absolutely reliable data upon which to base any conclusions. There seems to be little doubt, however, that tree planting would pay in many cases. There are on almost any farm certain portions of land which are not utilized for grain-growing, and which if pastured, do not really give the return they should do. Low spots difficult to drain, rough stony places, steep banks of coulees and odd corners cut off from the large fields by water holes or creeks, are left idle, as they are too small to make it profitable to cultivate them. These are instances of conditions where tree planting might be the means of converting land, at present worthless and idle, into valuable and revenue-producing property. As farm lands in the west become more thickly settled, a farmer to be successful must make every acre of his property produce the greatest possible revenue without deteriorating the soil. In the case of spots unfit for grain cropping, there is no doubt that the only way to obtain a revenue from them is to plant them up with trees. There may be an odd case where, owing to the presence of alkali in the soil or from some other cause, trees would not live, but such instances are very exceptional. It is true that for a few years after planting no revenue can be obtained from a plantation, but the initial expense is not so very great, and as an investment would pay good interest in the future; the only other alternative is to allow the ground to remain unproductive for all time.

Important Points.—There are three main points which must be observed if success is to be hoped for. It is safe to say that at least 90 per cent of the failures in tree planting are due to the fact that the importance of either one or all of these features has been overlooked. The three points are these:—

1. The soil must be most thoroughly prepared before planting.

2. Only such varieties of trees should be used as are known to be hardy in the district and suited to grow in the particular kind of soil and in the situation where it is wished to plant them.

3. A certain amount of cultivation of the soil after planting is absolutely necessary. This cultivation must be carried on until the trees are well established and able to grow without further care.

CHAPTER II.

PREPARATION OF THE SOIL.

Soil in the forest—New land—Root land—Summerfallow—Stubble land—Manuring—Spri ploughing.

Soil in the forest.—If we compare the texture of the soil on the open prairie wi that of the forest, we find a vast difference. In the former case the ground is cover by a tough, compact sod, and the soil beneath this is so hard as to be almost impen trable for the roots of plants. In the forest, however, we find on the surface sever inches of loose, decaying vegetable matter and a subsoil rendered comparatively ope and porous, owing to the action of the tree roots. Under such conditions as these the need be no difficulty at all in planting and successfully raising young trees, but unfo tunately these are not the conditions with which we have to deal, as in most place where tree planting is resorted to, as in the prairies, the soil is more or less compac and not suited to the growth of deep rooted plants.

In raising trees as well as other crops, it is always advisable to follow nature' methods as closely as possible. If we do this we may confidently expect a very fai measure of success to attend our labours. We have seen that in nature trees require a fairly loose, porous soil, and it is therefore necessary to bring the land which it i wished to plant up in trees into as nearly a similar condition as possible. It would be absolutely foolish to plant trees on the freshly broken sod of the prairie and expect them to live under ordinary circumstances.

In most cases trees will be found to do best on land that has been under crop for at least a year previous to planting. But as many have no land under cultivation where they wish to plant, they can, by a very thorough cultivation of the soil during one season, in an ordinary year bring it into a fit state for setting out the young trees. In a very dry year one season may not prove long enough to sufficiently rot the sod, and in such cases it will be more satisfactory to defer planting until the land is in a suitable condition, as upon this practically depends the future success of the plantation.

New Land.—To prepare sod land for planting it should be broken about two inches deep as soon as the frost leaves the ground in the spring. When the sod is fairly well rotted, it should be backset two or three inches deeper and thoroughly worked up with the disc harrows. After the second ploughing the soil should receive frequent cultivation. Later in the fall a third ploughing should be given, working up the ground eight or ten inches deep. In the following spring no further ploughing will be necessary except when the trees are being planted, and then a plough should be used to open up a deep furrow in which the young trees are to be set.

New land has one great advantage over old land in that it is much freer from weeds, and the work of cultivation after planting will require less labour. *This does not mean that because no weeds grow cultivation is unnecessary.* In the Northwest the supply of moisture is extremely limited, and what little there is must be preserved in the ground as long as possible. This can only be done by keeping the surface of the soil in a loose, friable condition, as then evaporation of soil moisture is at a minimum. As soon as the surface becomes hard and baked, evaporation is very rapid, and the effect of allowing the soil to remain in this condition will be evident in a very short time.

Root or Garden Land.—Perhaps the very best preparation of the soil for trees is, in the season preceding planting, to grow potatoes or some other hoed crop requiring deep and constant cultivation, and in the fall, after the crop is removed, again plough the land as deeply as possible.

Summerfallow.—Deep summerfallow is an excellent preparation.

Stubble Land.—Planting trees on stubble land is not recommended for two reasons: first, the grain crop takes a considerable amount of moisture out of the soil instead of conserving it; and second, when the stubble is ploughed under it leaves the soil so open that, when the season is hot and windy, it rapidly dries out around the roots of the young trees soon after planting. This does not apply in cases where irrigating can be done.

Manuring in most cases is not at all necessary, and if practised at all should be done at least a year previous to planting. The soil on the prairie is, as a rule, extremely rich. What the trees desire most is a good supply of moisture; thorough cultivation is the only way to bring about this condition. On very heavy gumbo or clay soil, such as is found in the Regina district, manuring may be advantageous to improve the mechanical texture of the soil by making it more porous and increasing its capacity for holding water, but even on these soils it is not advisable to apply the manure at the time of planting.

Cases are not at all uncommon where trees die out owing to the fact of the soil being too rich, and a great mistake is usually made in manuring around trees, as they do not require a particularly good soil. At Indian Head on the nursery station there are certain spots where it seems impossible to grow tree seedlings. The ground was originally used as a corral for cattle and horses, and after ploughing the manure turned under has made the ground too rich, and it is not likely that trees can be successfully grown on these spots until the excess gets worked out.

Spring Ploughing.—In cases where there are no irrigation facilities spring ploughing is not recommended as a general rule, for the reason that in a dry spring any deep working of the soil tends to dry it out. Another thing to be taken into account is that spring is the busiest season of the year on a farm, and it is a great advantage if any preparation can be accomplished at some other time when work is not so pressing.

CHAPTER III.

SELECTION OF VARIETIES.

Selection to be governed by the natural habits of the trees—List of trees adapted to vario soils—Slow and rapid growers—Long and short-lived trees—Light-demanding and shad bearing trees—Mixed plantings—Main points to be considered.

After it has been decided where the plantation is to be located it will be necessa to select such trees as from their natural habits of growth are best suited to thrive i that particular spot. There are several varieties of trees suitable for prairie plantin but they are not all adapted to live and grow under similar conditions. Some gro best on heavy land, others on light soil; some require a large amount of moisture an others again would soon die if planted on land which is continually wet and swampy It is impossible to lay down any hard and fast rules as to what varieties are bes suited to the different kinds of soils, as so many other questions have a bearing of thi subject. For instance, the exposure; that is, whether the ground is level or slopes t north or south; the rainfall, which varies in different parts of the west; the differenc in range of temperature, altitude, &c.; all of which must be taken into consideration From this it will be seen that the kind of soil does not alone determine the variety o trees to be planted, so that the following table can serve only as a general guide.

TABLE OF TREES SUITED FOR PLANTING ON CERTAIN SOILS.

Heavy clay.	Moist, sandy loam.	Dry, sandy loam.	Sand or gravel.	Low, wet land.
Man. Maple. *Soft Maple. (Acer dasycarpum). *Scrub Oak. *Basswood. Green Ash. Elm. Cottonwood. Willow. Larch. Scotch Pine.	Man. Maple. *Soft Maple. (A. dasycarpum). Green Ash. *Basswood. Elm. Cottonwood. Willow. Birch. Larch. Scotch Pine. Jack Pine. White Spruce.	Man. Maple. Russian Poplar. Some Willows. Scotch Pine. Jack Pine. White Spruce.	Russian Poplar. White Spruce. Scotch Pine. Jack Pine.	Ash. Elm. Cottonwood. Black Poplar. Larch. Black Spruce. Willow.

Trees marked * are suitable for planting only in portions of southeastern Manitoba.

In planni plantation the natural habits of growth of the varieties to be used must also be idered.

If a mistake is made in selecting the es and in mixing them in the plantation, it will not be realized before at least a ber of years, when it will very probably be impossible to alter the plantation in order to make it as productive as it should be, without a great expenditure of labour and loss of time.

As a general rule, the prairie settler requires first a shelter-belt or wind-break around his buildings. The establishment of a plantation to produce fuel and fencing

material is either of secondary consideration or is not given a moment's thought, the popular idea being that it takes trees too long to grow, and that it is not much use doing work the benefits of which will be reaped by some one else. This, however, is a mistake, as has been clearly shown by actual plantations set out at the experimental farms at Brandon and Indian Head and by private individuals scattered throughout the west, especially in the Mennonite settlement in the southeastern part of Manitoba. In this district, which was settled some twenty years ago, there were absolutely no trees growing at that time. Numerous plantations, principally of cottonwood and Manitoba maple, were set out, and now most of the people in this settlement can secure all the fuel they use without going off their own farms. (In this connection see also the results of elm plantations on page 29).

Many of the varieties which can be used on the prairies are very rapid growers, for example, cottonwood, willow, Russian poplar and Manitoba maple. It is safe to say that wood large enough for fuel can be grown from any of these trees within six years. After that time a plantation will increase in value and productiveness year by year and will prove one of the best investments on the farm.

In setting out a shelter belt, varieties which will produce the most rapid growth are naturally the ones which will be chosen. There is, however, a point which must not be lost sight of in this connection, and that is that the most rapid growers we have, namely, the cottonwood, Russian poplar and willow, are comparatively shortlived trees, so that in setting out a wind-break it would not be altogether wise to confine oneself to these varieties, but a fair proportion should consist of elm, ash or maple, which, though they do not grow quite so fast, have a much longer life and would eventually remain as the wind-break after the faster growing kinds had been cut out.

In setting out a plantation to supply fuel and fence posts, what is looked for is an early return and a continual supply. In order to obtain this, rapid growing trees must be planted with slower growing kinds. In nearly all cases mixed plantations are preferable to those containing only one species. With some varieties of trees it would be very bad policy to set them out in a pure stand, as for instance the green ash, birch or cottonwood. These trees all have a comparatively thin crown, allowing a great deal of light to penetrate to the ground beneath them which encourages the growth of grass and weeds and permits of a great deal of evaporation of moisture from the soil, allowing the surface to become hard and compact. Such are not the conditions under which trees thrive best, as the ground should always be kept well shaded and porous.

Light-demanding and shade-bearing trees.—Trees are divided into two classes by foresters according to the amount of light required by them in order to make healthy growth. These are known as light-demanders and shade-bearers. In early youth all trees are more or less shade enduring, that is, they will grow under the shade of other trees, and in fact many varieties require a certain amount of shade when seedlings, but cannot live under the same conditions after they are a few years older. There can be no hard and fast line drawn between these two classes, as the one merges very gradually into the other. In the group of trees generally classed as shade-bearers, some are more shade enduring than others, and the same is the case with the light-demanders, some requiring more light than others. The white and black spruce are instances of very heavy shade-bearing trees, that is, they will continue to grow under very dense shade. The birch and green ash are samples of light-demanders. The ash-leaved maple and elm will bear a fair degree of shade, but require plenty of light for their best development. As a rule, light-demanding trees should never be set out in pure plantation, for reasons already given, unless it is intended that after a few years the trees should be under-planted with some other variety capable of maintaining a suitable soil cover. Shade enduring varieties may be safely planted without mixture so far as keeping the soil in good condition is concerned. There are other considerations, however, which might make it advisable always to set trees in

mixture in preference to pure plantations. A mixed plantation suffers less fro
sect and fungus attacks because as a rule each particular insect and fungus has
ference for a certain variety of plant or tree, and unless extraordinary condition
ist do not care to attack other varieties. A mixed plantation of rapid and slow gr
or light-demanding and shade-bearing trees will, in most cases, give a larger co
uous return per acre and per annum than one made up of only a single variety.

The main questions then to be considered before planting are these:—

1. What trees are hardy in the district?

2. Of these which are adapted to the particular locality?

3. What varieties are most suitable for the purpose for which they are t
planted, namely, wind break, snow break, fencing or fuel?

4. Will these if planted alone form a suitable ground cover?

After it has been decided which varieties are to be planted, the next thing is to
cure the seedlings. These may be obtained in three ways; from the natural woods,
a commercial nursery, or may be grown by the planter himself.

CHAPTER IV.

OBTAINING PLANT MATERIAL.

Naturally grown seedlings—Seedlings from commercial nurseries—The farm nursery.

Collecting Seedlings from the Woods.—If the area to be planted up is small and a natural supply of seedlings can be found in the immediate vicinity, it may be the most economical method to obtain the young plants in this way. In the sand hills where spruce and jack pine grow, and in tamarack swamps, comparatively large numbers of even sized plants can often be obtained, but with such trees as Manitoba maple, green ash and elm, the seedlings are usually difficult to find in large numbers, and are not as a rule of very uniform size and shape. In taking plants from the woods, those growing only in the most exposed situations should be dug, and most success will be obtained in using small seedlings from one to two feet high rather than larger trees. Seedlings taken from the protection and shade of the parent trees, and at once set out in exposed situations are almost sure to die, as they are not hardy enough to stand the fierce winds or the glare of the hot sun to which they are likely to be subjected in their new position.

Nursery Plants.—When nursery stock can be secured at reasonable rates it may be more economical to buy seedlings than to spend much time hunting them up in the woods. Nursery raised plants will probably prove more satisfactory than those grown naturally, as they are raised under conditions more similar to those they will experience when planted out, they usually have a much better developed and compact root system and large numbers of a uniform size and shape can be secured.

The Farm Nursery.—Where seeds of native trees can be obtained, the cheapest method of getting seedlings is for the planter to grow them himself. Most of the hardy varieties are very easily raised from seed, the labour and expense in this connection on a farm amounting to very little.

Seed should always be procured, if possible, from old trees growing under climatic and other conditions similar to those the seedlings will be expected to endure. The box-elder tree or Manitoba maple has a very wide range, and seed might be procured almost anywhere in North America. It would be found, however, that that picked in the Southern States, or even in eastern Canada, would not produce seedlings hardy in the Northwest. The growing season is much longer in the east than in the west, and it has been found that seedlings from eastern seed do not ripen up or mature early enough to escape the fall frost on the prairies, and are consequently cut back. The greater the difference there is between conditions of growth affecting the parent trees and those experienced by the seedlings the greater the difficulties the latter have to contend with. This shows that many characteristics are required by the seed from the parent trees, so that it would always be wise to get seed from the best individuals and avoid, where possible, taking it from dwarf or stunted trees. Seed from young trees does not generally have so good a germinating percentage as that borne by older ones.

The amount of land a farmer would require for his nursery is very small; in fact, a quarter to one-half an acre would be more than sufficient in the ordinary case. Any land that is in a suitable condition for growing garden crops and is at the same time moderately protected from the high winds, would do for this purpose. The best soil for the nursery is rich, sandy loam. It should be located near the house so that the

work could be done in odd moments. It is not necessary here to go into the de of nursery work, as in the second part of this bulletin the best method of raising lings and cuttings is fully described for each variety.

The only time to plant trees in the west is in the spring. In exceptionally falls trees have been planted and have come through the following winter wit dying, but fall planting cannot be generally relied upon. The seedlings for sp planting can be dug either in the fall or the spring. If a large plantation is to b out, it is advisable to take the trees up in the fall, count them and then heel in on some well drained piece of ground near the site of the proposed plantatio that they will be ready for immediate planting in the spring. Heeling in fo winter merely means digging a shallow trench, throwing all the earth to one sid that there is a gradual slope from the bottom of the trench to the top of the thrown up. The seedlings are then placed close together with their roots in the t and the stems lying on the sloping earth. (See fig. 1.) After the trench is filled

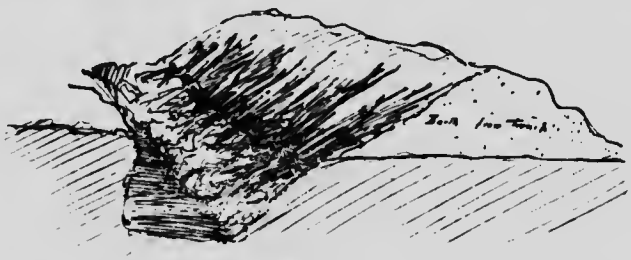


Fig 1

Heeling in seedlings for winter storage (seedlings tied in bundles of about 25).

seedlings, soil is put on them, and is well worked in among the roots, the tops sli covered. After the first layer is covered it should leave a trench similar to the first made. This is filled with seedlings, which are in turn covered with earth, an work continues in this manner till all the plants are heeled in. (See fig. 2.)

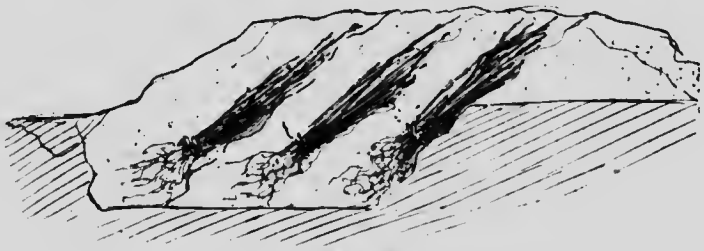


Fig 2

Heeling in seedlings for winter storage.

CHAPTER V.

FORMATION OF THE PLANTATION.

Close planting—Estimating the number of trees for a plantation—Mixing the varieties.

Close planting.—For a wind-break or plantation the trees should always be planted close together. There are several reasons for this. The most important, however, is to get a good soil cover as soon as possible. *In fact, the preservation of a complete soil cover is the one point which must never be lost sight of in the management of any wood lot or plantation.* Unless the seedlings are planted close together, cultivation will have to be carried on for several years until the trees shade the soil themselves, which is an expensive matter. For trees such as Manitoba maple, cottonwood, Russian poplar and willow, four feet apart is about the best distance to plant. Elm, birch, spruce, larch and pine will probably do best planted about three feet apart each way, because they do not grow quite so rapidly as those mentioned before. The number of trees required per acre at four feet apart each way is 2,720; at three feet, 4,840.

Estimating number of trees for a plantation.—To estimate the number of trees which will be required to plant up any given area at any given distance apart: multiply the distance in feet between the rows by the distance in feet the trees are apart in the row, and divide the product into the total number of square feet in the plot.

Example.—Supposing it is wished to plant up a piece of ground measuring three hundred yards by fifty yards, with trees placed in rows five feet apart and three feet apart in the row. The number of trees required would be derived as follows:—

$3 \times 5 = 15 =$ number of sq. feet occupied by each tree.
$300 \times 50 \times 9 = 135{,}000 =$ number of sq. feet in the piece.
$135{,}000 \div 15 = 9{,}000.$

Nine thousand, then, would be the number of trees required in this case, setting the trees three feet by five.

Mixing the varieties.—For an average plantation the largest proportion of trees may be Manitoba maple. It is a good nurse, affords a good soil cover and is one of the hardiest and most easily propagated of western varieties. With it can be planted quicker growing trees as cottonwood or willow, and slower growing but more valuable kinds as elm and ash. One of the best arrangements would be to have every alternate row planted to maple, the remaining rows to be filled in with other varieties so that a row of cottonwood or willow would alternate with one of ash or elm. In a plantation on clay soil, say of maple, ash, elm and cottonwood, the arrangement then could be as follows:—1st row, maple; 2nd, cottonwood; 3rd, maple; 4th, ash or elm; 5th, maple; 6th, cottonwood; 7th, maple; 8th, ash or elm, and so on. Between the rows of the elm and the ash there would then be sixteen feet. In this arrangement, after say five or six years, many of the cottonwoods and perhaps also some of the maples would be large enough for fuel, and could then be cut out, care being taken not to cut so heavily as to expose the soil too much. The elm and ash should be helped as much as possible, as they are more valuable than the others, by cutting out the maple or cottonwood if these varieties interfere with their growth by excluding too much light. The cottonwood and maple, after being cut, would sprout again from the roots so that a good under-

growth of stool shoots could be maintained where not sufficiently shaded by the elm and ash. After the elm and ash reach a suitable size they could also be gradually cut and would grow up naturally again from the stump. In this way a plantation well established and carefully managed would produce a continual supply of wood without any subsequent expense for planting. A good mixture for conifers would be, planting three feet apart, spruce in every alternate row, the remaining rows to be made up of Scotch pine, jack-pine or tamarack. It can be easily seen that a plantation may be made up of many varieties mixed in varying proportions and in many combinations. The rates of growth of the different trees should, however, be taken into account; also their requirements as regards light, the mixture to be arranged accordingly. There are several native varieties of shrubs which will no doubt prove very valuable for under planting or mixing in a plantation to obtain a good soil cover. The native hazel, saskatoon, choke-cherry and dogwood are found to serve this purpose in all our natural timber belts, and will probably be equally as good in artificial plantations. Economic tree planting, however, on the plains, is at present very little understood, and there is a great deal yet to be done in the way of discovering the best mixtures to be set out in order to obtain the largest yield.

CHAPTER VI.

PLANTING.

Seedlings—Cuttings—Cultivation after planting—Planting most necessary on the north and west of buildings—Necessity for a snow trap.

Before planting commences, if the seedlings have arrived from the nursery they should be lightly heeled in, that is, the roots should be covered with moist earth and if possible they should be shaded from the sun by covering the tops with bags or anything to check evaporation. Planting should be done as early in the spring as possible in order to take advantage of the moisture left in the soil after the melting of the snow.

Planting of Seedlings.—The quickest and best way to plant young seedlings in large numbers is to plough out a furrow as deeply as possible, hold the seedling by the top, with the end of the root resting on the bottom of the furrow, and then draw in the soil from each side with the feet, tramping it solidly around the roots.

If the furrow is not deep enough, carry a dibble or sharpened stick to make a hole in the bottom, in which the end of the root should be placed.

Seedlings of cottonwood, ash, elm and maple are almost sure to die if not planted at least as deep as they originally stood in the nursery. It is best to set them about one inch deeper, as the soil will probably settle in the course of a few days after planting.

The furrow should not be ploughed out far ahead of the planters, as the soil dries out very rapidly.

After the trees are all set, the furrow should be filled in at once with the plough, or if the horses cannot be kept from tramping the young seedlings, a shovel or hoe should be used.

The soil should not be hilled up around the stems of the trees.

While planting, the seedlings and cuttings should be carried in pails half filled with muddy water.

Great care should be taken to prevent the roots from drying out. The seedlings should never be left exposed to the sun or wind.

Seedlings with a single tap root may very easily be planted with a dibble.

The best time to plant is on a dull, cloudy day, or in the evening after the sun commences to get low.

Points to be Carefully Observed:—

1. Never allow the roots to become dry.

2. Plant seedlings of broad-leafed trees one or two inches deeper than they originally stood in the nursery.

3. Pack the soil firmly around the roots. If a tree is properly planted it should be difficult to pull it out with the hands.

Planting Cuttings.—Cuttings are small twigs taken from the new growth of the previous season, made into lengths of about ten inches, the average diameter being about half an inch. The trees usually grown from cuttings are cottonwood, Russian poplar and the various kinds of willows.

They should be planted as soon as possible after they are made, as they commence sprouting if they are heeled in for any length of time. These sprouts are very delicate and are sure to be knocked off during planting operations.

Cuttings are best planted with a dibble or sharp spike, which should make a hole in the ground about nine inches deep and three-quarters of an inch in diameter.

The hole should be made in a slanting direction, the cutting inserted into the hole, leaving only about one inch above ground, care being taken to have the buds pointing upwards. The soil should then be well firmed around the cutting, either with the dibble or by tramping.

Caution.—Do not push the cutting into the ground without first making a hole with the dibble, as in doing so the bark is liable to be separated from the wood at the end of the cutting, and it will then most likely fail to root.

Cultivation after Planting.—As before stated, after the trees are all set out constant cultivation is absolutely necessary until the tops of the trees grow together sufficiently to choke out all growth of weeds and grass. The rainfall in the prairie districts is so small that every means must be employed to preserve what little soil moisture there is. Surface cultivation is the best method of accomplishing this, as it keeps a loose covering of soil, which acts as a mulch, retaining the moisture in this way. The single horse scuffler or cultivator is the best implement for this purpose. The hoe is of little use by itself, except to cut off the larger weeds and for working close around the roots of the trees, as it does not stir the soil sufficiently unless a great deal of time is spent on the work.

The number of times it will be necessary to go through a plantation depends a good deal on the season. After a heavy rain, when the ground is dry enough, the cultivator should be always run through in order to prevent the formation of a crust. After the third season cultivation should no longer be necessary. *In any case, cultivation should always cease before the end of August in each year* so that the trees will not be encouraged to grow too late in the fall, as the early frosts would then be liable to cut back a large portion of the new wood.

Mulching with straw or manure is quite often done, but cannot be recommended unless it is absolutely impossible to find time to cultivate. Clean straw is better than manure, as it takes longer to decay, and weed seeds do not so readily germinate in it.

Owing to the strong reflection from bright straw many recommend hay as being the best for mulching.

Planting Round the Buildings.—It has often been suggested that the Forestry Branch should publish a few set plans to represent the best way in which to lay out a wind break around a farm. This, however, does not seem practicable. Although most farms seem at first glance to be situated more or less alike as regards the relative position of the buildings, it is found on closer examination that there are hardly two to which the same plan would apply. There are so many different ways in which the buildings are placed in relation to the road allowances, in relation to creeks, coulees, sloughs, bluffs, &c., which all affect the shape of the windbreak. Of the many plans sent out from the office of the Forestry Branch at Ottawa during the past six years, no two are exactly similar.

On the prairies the most protection is needed from the north and west, as the prevailing winds come chiefly from these directions. The principal belt, then, should be on these exposed sides; four or five rows on the east and south will be found quite sufficient. There seems to be a strong tendency for those planting trees on prairie farms to crowd them too close into the buildings. This is a great mistake, as they will collect large banks of snow in the winter time, which will prove a great nuisance, and perhaps cause extra labour in digging out paths and roadways. There, too, plenty of room should be allowed for, in case it may be wished to extend the buildings at some later date. There is nothing so inconvenient as a cramped barnyard.

In making a shelter belt, if it is to be more than a rod or a rod and a half wide, an extra row of willow, cottonwood or maple should be planted outside this at a distance from the main belt of three or four rods, the space between to be left free from trees. This space is to act as a snow trap in which the snow, drifting through the single row, will be caught. If the snow was not held in this way it would lodge in the centre of the belt, and would be liable to break down the tops of the small trees. (See plate IX.) This is likely to occur year after year, practically destroying the trees which in all probability would never attain any size, but always remain stunted and bushy. The land kept for a snow trap need not be wasted, but would answer splendidly for a garden or root ground.

The Cost of Establishing a Plantation.—The following figures are taken from Mr. Mackay's report for 1897, as to cost of setting out plantations at Indian Head. It must be remembered, however, that a farmer with his own labour, teams and implements, does not have to make any actual cash outlay to carry on the work, and hence the cost of establishing a plantation depends practically upon the value he may set upon the time of his men and teams, plus the cost of seedlings if purchased from a nursery:—

1. Plantation of box-elder, trees set 3 feet apart each way—½ acre:

1st year,	12 hours—cost of planting	$1 80
1st year,	15 hours—cost of scuffling, &c.	2 25
2nd year,	13 hours—cost of scuffling, &c.	1 95
3rd year,	5 hours—cost of scuffling, &c.	0 75
	45 hours.	$6 75

Cost per acre=$13.50.

2. Plantation of box-elder, trees set 4 feet apart each way—½ acre:

1st year,	9 hours—cost of planting	$1 35
1st year,	10 hours—cost of scuffling, &c.	1 50
2nd year,	14 hours—cost of scuffling, &c.	2 10
3rd year,	3 hours—cost of scuffling, &c.	0 45
	36 hours.	$5 40

Cost per acre=$10.80.

The following figures are of interest as comparing the cost of planting seedlings with that of sowing the seed *in situ*. One might naturally suppose that the latter mode of forming a plantation would be the cheaper, but the following figures would rather indicate the advisability of planting seedlings 4 x 4:—

Cost of plantation, ½ acre, box-elder, seed sown in rows 2½ feet apart:

1st year,	12 hours—cost of making drills, sowing and covering seed	$1 80
1st year,	11½ hours—cost of scuffling, &c.	1 72
2nd year,	10 hours—cost of scuffling, &c.	1 50
3rd year,	5 hours—cost of scuffling, &c.	0 75
	38½ hours.	$5 77

Cost per acre=$11.54.

Cost of ½ acre of green ash, sown in drills 2½ feet apart=$6.59, or $13.18 per acre.

From the above figures then $10 to $12 per acre would be a fair estimate of the cost of planting and cultivating for [illegible] years, after which time the trees may be left

to take care of themselves. These figures are based on very small plantings, so that there is not the least doubt that if planting was carried on on a large scale the cost per acre could be very materially reduced. However, there are some items which have not been taken into account which properly must be considered, more particularly the cost of preparing the soil, the cost of seedlings or seed and the cost of fencing. Up to the present no mention has been made as to the necessity for fencing, but in a country where stock is allowed to run at large during certain seasons of the year it would of course be a waste of labour and expense to set out a plantation without doing so.

From several plantations set out on the nursery station at Indian Head the planting has cost on the average about $6.50 per acre. The cost of scuffling and hoeing, however, is much less than given in Mr. McKay's figures, not exceeding $1 per acre in first year and probably about 75 cents in second year; so that after the plantation has become established in say three years, the cost would be in the neighbourhood of $10.50 per acre—practically the same figure as arrived at by Mr. McKay.

The following will give some idea as to cost of and time taken in planting. These figures are for an acre of maple and white birch set in alternate rows, 4 feet between rows and 3 feet between trees:—

Foreman, 6 hours at 20 cents	$1 20
Five men, 6 hours at 16 cents	4 80
Man and team, 6 hours at 20 cents	1 20
Total	$7 20

PART II.

BROAD LEAVED TREES.

MANITOBA MAPLE.

(Acer negundo.)

(See Plates III. to XII.)

General Notes.—The Manitoba maple is a tree of very wide range, being found native from western Ontario, extending as far as Medicine Hat, in Eastern Alberta. It seems hardy throughout the prairie districts of Saskatchewan and Alberta, although in the southwest portion of Alberta it is claimed by some that it cannot be relied upon. Probably the warm Chinook winds occurring in the winter affect it adversely in certain seasons. However, good healthy specimens growing at Calgary, Lethbridge, Macleod, Cardston and elsewhere in this district would indicate that the tree is sufficiently hardy to entitle it to a place in the list of those varieties suitable for planting in that region.

From the results of the plantations set out from 1901 to 1906 it would seem that after all the maple, although successful in certain cases, does not on the whole seem as suitable for general planting west of Swift Current as other varieties, such as the ash, elm and Russian poplar.

In its native state it is generally found growing in river or creek bottoms, or on rich moist soil. In Manitoba it attains a height of from forty to fifty feet, and reaches a diameter of from sixteen to twenty inches. It is naturally of a very branchy, irregular habit of growth, the main trunk dividing into two or more stems either at or a few feet above ground.

Uses.—The present value this tree has in the west is for windbreaks, as it grows rapidly and branches profusely. It is exceptionally easy to propagate and transplant, and will adapt itself to a great variety of conditions. It will stand considerable drought on the high prairies, but on very wet or very dry soil growth is much slower, and consequently this tree should never be planted in such places, except perhaps to fill up a plantation composed of more suitable varieties.

Owing to its extreme hardiness and wide range, the maple will prove one of the most valuable trees in forest plantations throughout the west in the capacity of a nurse to other more tender and desirable kinds. It is a moderate shade bearer, and would help to form a good soil cover, planted in mixture with such trees as ash, cottonwood and other light demanding varieties. From the fact that it is easy to propagate and obtain young seedlings of this maple it has been very widely used throughout the west for avenue and street planting. It is not, however, especially adapted for this purpose, as it requires a great amount of pruning and care to bring it into a proper form and keep the top from becoming straggly and heavy. As an avenue tree it suffers considerably from heavy winds and early snowfalls, and the trunk is frequently damaged by sun scald, which causes the bark to crack on the south or southwest side, making an unsightly scar and laying the inner wood open to the attacks of fungi, which sooner or later will cause the decay of the stem.

It leafs out very early in the spring, which is one point in its favour, but with the exception of the ash, it is the first tree to lose its foliage in the fall.

The wood of the Manitoba maple is hard and close-grained. It makes excellent fuel, and if properly peeled and seasoned should last well as a fence post.

Propagation.—The Manitoba maple is propagated only by seed. Large crops of good seed are borne after the tree reaches the age of about eight years, and are produced almost every year. Seed is borne only on the pistillate or female tree; the staminate or male tree does not bear seed. The seed ripens, according to the season, from the end of September to the middle of November, and should be picked after the first heavy fall frost, which causes many of the leaves to drop off, thus making the collection of the seeds the more easy. After picking, the seed should be thoroughly dried by spreading it over a floor or outside in the sun, after which it should be bagged and stored in a dry building. Maple seed properly cured and kept in a dry place will retain its vitality for a number of years. When fresh the germinating percentage averages from 60 to 70 per cent. This percentage of course decreases according to the age of the seed.

The seed should be sown in the spring, about May 15, so that the young seedlings may germinate when there is the least danger from late frosts and high winds. Many planters claim that it is advisable to soak the seed for several hours before sowing. This, no doubt, shortens the germinating period, but it is doubtful whether any material advantage is gained by this unless in exceptional seasons, as those who sow the seed dry seem to be equally successful in obtaining a good stand of young plants. When the seeds are wet they are inclined to stick together, and it is not so easy to get an even stand. Besides, in raw, cold weather the operation of handling wet seeds is anything but a pleasant one.

It has been the practice at the nursery station to sow part of the maple in the fall (late in October). The seedlings from these sowings are always much larger than those from spring sowings, though in some cases the crop has suffered from late frost and very high winds in early spring. It is not, however, advisable to depend altogether on fall sowing for maple.

In an exceptionally dry season the seed sometimes fails to germinate, but lies dormant in the soil throughout the summer and following winter, but the seedlings make their appearance early in the succeeding spring. Before sowing, the seed should be thoroughly rubbed between the hands or well flailed in the bag in order to separate the bunches and break off some of the wings. This will secure a much more even stand of seedlings, and, the wings being broken off, sowing can be done on a windy day, which would not be posaible were they left attached to the seed.

The best method of planting the seed is to place it in drills from one and a half to two inches deep, and far enough apart to admit of thorough cultivation between the rows. If horse labour is to be used, thirty inches is about the right distance. The seed should be sown rather thickly, at the rate of about twenty grains per running foot.

The soil for the nursery should be deeply and finely worked up, well drained and fairly moist, never wet. A rich, sandy loam is the best, as it is possible to work it very early in the spring, and it does not bake or cake after heavy rains as is the case with clay soil.

Care of Seedlings.—During the growing season the seedlings should be constantly cultivated, never allowing the surface soil to become baked. Cultivation should not be carried on later than the beginning of August in order that the plants may be induced to stop growing and give them time to harden up before the severe fall frosts. If growth is continued on too late in the season the young plants are sure to be cut back, and perhaps so badly damaged as to be no use for transplanting in the following spring.

Maple seedlings, if properly grown, should be transplanted at one year old into the permanent plantation. Sometimes they may be left in the nursery for two years,

but after this age the strong roots which they form make the transplanting of large numbers an expensive operation.

Seedlings one year old average from 12 to 16 inches.

Seedlings two years old average from 24 to 36 inches.

The rate of growth depends almost altogether upon the amount of cultivation given.

Flowers appear about May 8 to 12.

Seed ripens towards the end of September.

Seed should be sown about May 15.

Number of seeds per pound is about 13,000.

Weight of seed when dry, with stems and wings, about 11 pounds per bushel.

Sowing seed in drills 30 inches apart, about 80 pounds are required per acre.

Average stand of seedlings per acre sown in this way, about 85,000.

GREEN ASH.

(Fraxinus viridis.)

(See Plates XIII. and XIV.)

The green ash is found in the west in the valleys of the Qu'Appelle, Assiniboine and Red Rivers, also scattered in the Pembina and Moose mountains and in the eastern part of the Dirt Hills south of Moose Jaw. On good soils this tree attains a fairly large size. Specimens eighteen inches in diameter and correspondingly high used not to be uncommon. It is a fairly rapid grower, though not quite so much so as the Manitoba maple. A single specimen seen at Nelson in Southern Manitoba measured twenty years ago two and a-half inches in diameter. This tree is now over one foot in diameter and at four and a-half feet from the ground, and carries this width up to twenty feet when branching commences.

Naturally the green ash thrives on heavy, moist soils. It does not stand planting in light, dry localities. It usually grows with a single fairly straight stem. The crown is open and therefore permits a large quantity of sunlight to pass through and reach the ground, thus inducing the growth of grass and weeds. This is very undesirable in a plantation, as it retards the growth of the trees. Ash then should never be planted alone, but should always be mixed with some variety of tree which will help to form a complete soil cover.

Uses.—From small plantings that have already been done it would seem that the ash is hardy all over the west, in fact more so than the Manitoba maple. One reason for this, perhaps, is that it does not start growing so early in the spring, and thus escapes damage from late frosts, although the foliage in the spring is very tender and should frosts occur early in June, the young leaves are sure to be blackened. It also matures up much earlier in the fall and consequently is seldom cut back by early fall frosts. The wood makes excellent fuel and also lasts well when used as fence posts. As it is tough, light and elastic, it is of great value on the farm for small repairs. It is a tree that may be used successfully for pioneer planting in windbreaks or shelter belts, mixed with maple, elm or other suitable kinds. As an avenue tree it is very satisfactory, having a naturally upright growth and requiring but little pruning. It leafs out rather late in the spring, and loses its foliage again rather early in the fall, which is somewhat against the tree from an ornamental standpoint.

From the experience of the past six years the ash proves to be the most generally suitable tree for planting in any part of the west. In mixture with other varieties its growth is rapid and strong, and in Alberta when cottonwoods and maples in the

same plantation have been winter killed to the roots the ash has come through without injury.

Propagation.—The ash is propagated entirely from seed. This ripens towards the end of September. Many trees do not produce seed at all, as they only bear the staminate or male flowers. The pistillate or female trees bear seed about every second or third season. The seed is easily gathered as it grows in bunches which permits of picking it in handfuls. The seed should be cured and stored in the same manner as that described for treating maple seed; seed kept dry has produced excellent crops of seedlings after three and four years. The best time to sow ash seed is probably in the fall, just before the freeze up. Seed sown at this time in the nurseries at Indian Head commenced to show above ground about May 24, in the following spring. Seed sown on May 6 in a very wet spring did not come up till June 13. This shortens the growing season by nearly one month and makes a great difference in the size of the seedlings in fall. Ash seed very often does not come up at all in the first season, but lies over till the following spring. For this reason and also owing to the long period necessary for germination, fall sowing is recommended. Otherwise it should be sown as early in the spring as the ground can be worked. The seed should be planted in drills eighteen inches to two feet apart, thick enough to ensure a stand of about ten seedlings to the running foot. Compared to the maple the growth of the seedling is slow, an average for the first year being about six inches. It is well to allow the seedlings to remain in the nursery for two years, when they will reach a height of about two feet, and form very strong plants. The formation of a strong taproot makes it inadvisable to leave them longer without transplanting.

One-year-old seedlings average 4 in. to 6 in. high.
Two-year-old seedlings average 18 in. to 30 in. high.
Flowers appear end of May.
Seed ripens end of September.
Seed should be sown end of October or very early in the following spring.
Weight of seed with stems and wings, dry, about 12 lbs. per bushel.
Amount required for 1 acre—drills 2 feet apart—about 60 lbs.
Average stand of seedlings per acre—about 100,000.

AMERICAN ELM.

(Ulmus Americana.)

(See Plates XV., XVI., XVII. and XVIII.)

General Notes.—The American elm is undoubtedly one of the best broad-leaf trees for general prairie planting. It is hardy throughout the west, the natural range extending roughly north to about the 54th degree of latitude and west to about the 3rd principal meridian. On heavy, moist soils the tree attains a large size, trees two feet and upwards in diameter and 60 to 70 feet high being common in the river valleys. The elm has a naturally upright habit of growth, generally forming a good straight trunk, which divides into two or three main stems at a considerable height from the ground. The height growth is rather more rapid than in the case of the Manitoba maple, although it would probably not produce so great a quantity of wood in the same time, as it only grows one stem, whereas the maple usually has two or three.

Uses.—The elm should be largely grown in western plantations, as it is easily propagated and transplanted, is a rapid grower and a long lived tree. The wood is

very tough, making excellent posts, and is of value for many small repairs for which hard wood is always needed on the farm. The wood when dried makes very good fuel, and after the tree is cut reproduction is very vigorous from the stump by means of stool shoots. As an avenue tree the elm cannot be surpassed, having an upright growth and not being subject to sun scald. (See Plate XV.) When young the branches are liable to split in the forks if heavily laden with snow. Small seedlings sometimes suffer from being eaten back by rabbits in the winter.

Propagation.—The elm for all practical purposes is grown almost entirely from seed. Large seed years occur in the west about every second or third season. A small amount can, however, generally be obtained every spring. Good seed, though only in small quantities, has been collected from trees fifteen years old. The seed is small and not very conspicuous. It ripens from the end of May to about the second week in June. It should be picked as soon as the kernel is well filled. Any delay in picking is risky, the seed being so light that very little wind is needed to blow it all off the trees.

After picking it may be allowed to dry for a week or so, when the wings can be easily rubbed off, which greatly facilitates sowing, especially in windy weather. When cleaned the grains very much resemble flax seed, being about the same colour and size. Sowing should be done shortly after picking. The seed bed must be very finely prepared and the seed sown in drills one foot to 18 inches apart, and covered as lightly as possible, never deeper than half an inch. If the season is dry it will be necessary to water the rows in order to get the seed to sprout. The young seedlings usually show above ground two or three weeks after sowing. After the seedlings appear, surface cultivation should be given, and if the stand is too thick the plants may be thinned out to about one inch apart. Cultivation should cease early in August. By October the seedlings should average from seven to ten inches in height. The nursery rows should not be disturbed until the following fall, when the seedlings will be of suitable size for transplanting into the plantation. At the end of the second season the plants should average about twenty inches in height.

The elm thrives best on rich, moist soils, and should never be planted on very dry land. As it is rather a light demanding variety, it should be set out in mixture with maple, choke-cherry or other shade bearers in order to obtain a good soil cover. If set out in a pure plantation it may be necessary to underplant after 15 or 20 years, with some shade enduring species in order to maintain good growing conditions.

Flowers appear early in May before the leaves.

Seed ripens early in June.

Should be picked at once.

Should be sown at once.

Average stand per acre grown in drills 18 inches apart, 200,000.

The following figures represent the results of two plantations of American elm, one grown at Brandon, Manitoba, and the other at Indian Head, Saskatchewan. The measurements in both cases indicate that such plantations would be a profitable investment to the owners, and that it would be possible to obtain from them a small revenue as early as the twelfth or thirteenth year after planting. This return would increase according to the age of the plantation until the final cutting took place.

Elm Plantation at Brandon Experimental Farm.

(See Plate XVII.)

Size of plantation, one-third acre.

Plantation set out in spring of 1891.

Seedlings were then two years old.

Original planting distance, 3 feet · 3 feet.
Soil, good, rich clay loam.
Number of trees originally set out, 1,613.
Average height now, 25 feet.
Number of trees now standing, 840.
Of this number 350 are too small to make a post each.
Of this number 490 are large enough to make one post each.
Of this number 85 are large enough to make two posts each.
Total number of posts, 660.
(These posts are considered as seven feet long, with a minimum diameter of tw inches at the small end.)
Number of posts per acre, 1,980.
Cedar posts are now retailing for about 18 cents, so that these elm posts might b considered as worth at least 10 cents. The value then, of this plantation, 12 yea old, is $198 per acre. Cost of planting and establishing plantation would probabl amount to about $16 at the outside, giving a profit in 12 years of $172, or an averag annual profit of $14.33 per acre.

Elm Plantation at Indian Head Experimental Farm.

(See Plate XVIII.)

Size of plantation, one-third acre.
Plantation set out in 1893.
Seedlings then two years old.
Original planting distance, 6 feet x 3 feet.
Number of trees originally planted, 806.
Number now standing, 596.
Of these, 181 are less than 2 inches in diameter, at 4 feet 6 inches from ground.
Of these, 351 are from 2 to 3 inches in diameter, at 4 feet 6 inches from ground.
Of these, 59 are from 3 to 4 inches in diameter, at 4 feet 6 inches from ground.
Of these, 5 are over 4 inches in diameter, at 4 feet 6 inches from ground.
Four hundred and seventy-three posts, 6 to 7 feet long, with a minimum diamete of 2 inches at small end, could be cut out of these.
Number of posts per acre, 1,419.
Valued at 10 cents each, $141.90.
If we put the estimated cost per acre of plantation at $16, this shows a profit o $125.90 in ten years, or an average annual profit of $12.59 per acre.
These measurements are given merely to show the growth and value such a plan tation has. It would not be considered the best policy to cut these trees at once, a in a few years the value would be greatly increased. Many trees which are now jus too small for posts would then be large enough, and some which would now cut on post each would in a year or two make two posts. Outside of its value for fencin material, such a plantation would supply considerable fuel as well as being a source o shelter and protection.

COTTONWOOD.

(Populus monilifera or deltoides.)

(See Plates XIX, XX, XXI.)

General Notes.—The cottonwood is a native of the western prairies from the Rock Mountains to Manitoba. It is found growing in the valleys of the Red, Pembina

South Saskatchewan and other rivers; the writer has seen it as far north as Saskatoon on the South Saskatchewan, and it no doubt extends still further north along this river. It is hardy and a very rapid growing tree, and under favourable conditions attains a height of seventy-five to a hundred feet, and several feet in diameter. Professor Macoun in his catalogue of Canadian plants says that in 1880 'there was a grove of these trees of very large size' at Big Stick lake, north of Maple creek. 'These had escaped the annual prairie fires, being surrounded and partly covered up by sand, and stood as a proof of the existence of forests in the past where now there is not even a bush. The trees were over fifty feet high and some of them at least two feet in diameter.' This tree has a very upright habit of growth, keeping one well defined stem throughout. The leaves are large, deep green and glossy, so that when in full foliage the tree presents a very handsome appearance.

Uses.—The cottonwood will no doubt be largely used in prairie planting as a pioneer tree, for wind-breaks and shelter-belts, or wherever it is desired to obtain very rapid tree growth for the sake of ornament. Owing to its fast growth it may be set out in plantations with slower growing kinds and cut out after four or five years, when wood of large enough size for fuel will have been produced. The fuel is only of fair quality, ranking between that of Balm of Gilead and the native white poplar, but owing to its great rapidity of growth it will no doubt come into favour where other wood fuel is not easily obtainable. In the Western States the wood of the cottonwood is used in the manufacture of cheap boxes, pulp, &c. A variety known as the yellow cottonwood produces very valuable wood used for turnery and other purposes, but as there is no outward distinction between this and the common variety, the sole difference seeming to be in the texture and quality of the wood, it is not possible to raise this variety at will.

In connection with the nursery at Indian Head some cottonwoods were planted in 1903 in rows for shelter. The trees were about 30 inches apart and the total length of the rows would be about 700 yards. In the fall of 1906 these rows had to be cut out, and after four years' growth afforded over 3½ cords of small fuel, the poles averaging about 13 feet long and 4 inches in diameter at base.

Propagation.—Either by seed or cuttings, or in some cases from root-suckers.

The growing of cottonwoods from seed is not generally undertaken in nurseries, as the seedlings can be obtained very cheaply in such large numbers from the sand-bars along many of the rivers. Most of the cottonwoods planted in western Canada are imported from the western States, where certain firms make a regular business of pulling the seedlings from the sand-bars and distributing them wholesale among the nurserymen, who afterwards retail them to their customers. The seedlings obtained are usually from two to three years old and average two feet in height. They should be planted at once in the permanent plantation, as growth is so rapid after transplanting that it would not pay to put them in nursery rows. Two feet of growth is not uncommon in the first season if well cultivated, and in after years varies from two to five feet according to the season. During the first and second winters the young shoots are frequently cut back by frost, especially if the fall is a wet one, thereby inducing late growth. This, however, does not seem to impair the vigour of the young plants which, after the third winter, seldom show the effects of frost.

Cuttings.—Raising cottonwoods from cuttings is rather an expensive method, considering the cheapness with which the seedlings can be bought, but when only a few specimens are required, or it is wished to propagate some special variety, it is often done in this way. Cuttings are made from well-ripened wood, generally of the previous season's growth. They can be made almost any time when the tree is in a dormant condition, but preferably in the late fall or very early spring. If made in the fall they should at once be buried in moist soil and left until spring. The best cuttings are made about ten inches long and from a quarter to three-quarters of an inch in

diameter. They should be planted out as early as possible in spring, on well prepared soil. Holes should be made with a dibble of suitable size; the cutting is placed in the hole, buds pointing upwards and about one inch of the top left above ground; the soil then being firmly trampled round it. The cuttings may be spaced about three inches apart in rows far enough apart to admit of cultivation. If sixty to seventy per cent of the cutting strike root may be considered very successful. After rooting, the new shoots make a fair growth, often as much as three feet in the first season. They should be transplanted from the nursery in the following spring.

In plantations the cottonwood should always be mixed with such species as maple, elm, &c., as it is, like the ash, a light-demanding tree, and consequently does not sufficiently shade the ground by itself. If set out in pure plantation, it will no doubt be necessary to under plant with some shade-bearing variety after some years. When cut for fuel close to the stem it reproduces abundantly from root suckers and stool shoots, so that a crop cut one year will probably be reproduced in a few seasons without the necessity of again planting. It should never be planted in very dry situations. It thrives best on heavy clay soils and wherever it can obtain a fair supply of moisture. On dry, gravelly or sandy soils it becomes affected by a leaf rust which destroys it after a few years. This rust is most destructive in wet seasons.

RUSSIAN POPLARS.

(See Plates XXII., XXIII., XXIV.)

General Notes.—Three varieties of Russian poplar have been introduced into the Northwest and have proved to be more or less hardy and desirable under certain conditions. The names of these three are given as *Populus petrovski, Populus certinensis,* and *Populus wobstiriga.* Nurserymen and others find these varieties difficult to distinguish, as there seems to be great uncertainty as to the exact characteristic differences. However, as their habit of growth and general requirements are very similar, they may for all practical purposes be here considered under the one head of Russian poplar.

When young the growth of this tree is extremely rapid. Specimens planted as cuttings in various places show an average growth of 20 to 25 feet in from eight to ten years. The trees are exceptionally hardy. It is very seldom, even with young plants, that the new shoots are frozen back, as is often found to be the case with the cottonwoods after the first hard fall frosts.

Uses.—Although the Russian poplar is hardy and a very rapid grower, it cannot be recommended as a suitable tree for planting in all kinds of soils and in all parts of the west, and in no case would it be advisable to plant it at all extensively where it is possible to successfully grow other kinds of trees. Owing to its rapid growth and extreme hardiness this tree was widely boomed in the prairie districts of Minnesota and other western states. It has since been found to be very subject to the attacks of certain borers which seriously injure the trees, to such an extent that authorities on tree planting in these states are now discouraging the extensive use of this poplar. In Manitoba and the Northwest Territories it would seem that the Russian poplar will thrive on all kinds of soils, but after about nine or ten years on heavy clay land, the heart of the tree commences to decay and cankers form on the trunk, making a very unsightly appearance, and would undoubtedly cause the death of the tree before many years. On sandy, gravelly or sandy loam soils the growth is slower, and consequently the wood is not so soft. Trees seen growing on such soils do not appear to suffer from this early decay. The only cases in which Russian poplar can be thoroughly recommended is on very dry soils where it is difficult to get other trees

to grow. On moist and heavier soils the cottonwood is just as rapid a grower and furnishes a better wood for fuel and other purposes. The uses for the Russian poplar in the west are practically limited to the formation of shelter belts and wind-breaks on the drier and lighter soils, and for ornament where a quick tree effect is desired. A particularly objectionable feature of this tree is its habit of suckering from the roots in cultivated land. If a belt of these poplars is planted round a garden roots are sent out on either side which run along just beneath the surface of the soil. When cultivating the land, if these roots are cut or injured by the plough or cultivator they immediately send up suckers which grow exceedingly rapidly, often three or four feet in the first year. Suckers have been found growing at a distance of fully 30 feet from a ten-year-old tree. In a garden or on a dirt road this suckering is most objectionable, and the more the ground is cultivated and the oftener the suckers are cut back the more numerous they become. After it is once fairly established it would be almost impossible to get the roots all out of the ground, should it be desired to get rid of the tree, without an immense amount of labour. For this reason it would be well not to plant these trees near land used for a garden or frequently cultivated for ordinary crops.

Propagation.—The Russian poplar is very easily raised from cuttings, as described under cottonwood; also by digging up and transplanting the small root suckers before mentioned. The cuttings may either be dibbled in in their permanent position or else planted in nursery rows, and allowed to remain for one season before transplanting. The cuttings will make an average growth of from two to two and a half feet in the first season. The percentage of those that strike root is generally larger than that of cottonwood under similar conditions.

WILLOWS.

(See Plates XXV. and XXVI.)

There are many varieties of willows hardy in the Northwest which can be used to advantage in most places where rapid growth is desired. The varieties of most importance are: The white willow *(Salix alba); Salix fragilis; Salix voronesh;* the Russian laurel leaf willow *(Salix laurifolia);* the Russian golden willow *(Salix aurea);* and acute leaf willow *(Salix acutifolia).*

The white willow is perhaps the most important of these, and is most highly recommended by Samuel B. Green, of the Minnesota State Agricultural College, for prairie planting. This variety attains a very large size, sometimes reaching a height of 75 or 80 feet, with a correspondingly large trunk. It grows well on fairly dry, light soil, but thrives best on heavy, moist land.

Two or three rows of cuttings planted three to four feet apart would form a splendid shelter or windbreak in a very few years.

Propagation.—The method of dealing with willow cuttings is much the same as in the case of Russian poplar and cottonwood. However, it is not necessary to be very particular about the time of planting, as cuttings made any time from early spring to well on in June and set immediately seem to strike root equally well provided there is sufficient moisture in the soil. It is hardly necessary to keep the plants in nursery rows during the first year, as the percentage of cuttings which do not strike root is very small. The growth, too, during the first season is very rapid, and the plants in the second spring are too big to be handled conveniently and cheaply. The best time to plant is early in spring, as then, of course, the plants can take advantage of

the whole growing season. Cuttings of almost any diameter and size will root, but preferably ones about ten inches long and from half to three-quarters of an inch in diameter should be used. These can be planted out in well-prepared land to remain as permanent plantation. If it is desired to set out a grove consisting purely of willows the cuttings should be set fairly close together, three feet apart each way, or in rows four feet apart and two feet apart in the row. Willows can be used to advantage with other broad leaf varieties, and if found to grow too rapidly, thus interfering with what may be more valuable trees, they can be cut back as much as desired without sustaining any injury.

Uses.—As a fuel producer the willow is excellent, not so much on account of the quality of the fuel, which is only medium, but especially owing to its rapid growth and its habit of sprouting profusely from the stump after being cut down to the ground. Samuel B. Green in his small work, 'Forestry in Minnesota,' states that one acre of white willow on good soil will yield as much as five and a half cords of wood per year. Although this is somewhat indefinite, as it is not stated at what age the cutting can commence, still a farmer owning a wood lot capable of producing annually five cords per acre would find such an addition to his farm of considerable value. Mr. Green further states that poles of white willow if cut in summer, peeled and thoroughly dried, will last a number of years exposed to the weather, and as fence posts they will last about six years.

Of the other varieties of willow previously mentioned nothing definite can be given, with the exception that they have proved hardy and grow rapidly at the Experimental Farms both at Brandon and Indian Head. The golden willow seems to be less hardy than the others named.

BIRCH.

(Betula papyrifera.)

(See Plate XXVII.)

This tree, known as the canoe or white birch, has the widest range of any northern tree. In western Canada it is found scattered all over the Territories and Manitoba, extending as far north as the limit of deciduous tree growth. In habit it is an upright growing tree, reaching often 60 or 70 feet in height and a trunk diameter of over two feet. It is found growing amongst other hard wood and coniferous trees, especially on the moister and richer soils, although it adapts itself to much drier conditions. When transplanted it seems to be a rapid grower in mixed plantations. As it has a very open crown and is very light demanding, it should never be planted alone in large numbers.

Uses.—The white birch will probably prove of value in mixed plantations and as a nurse for other broad-leaved trees or conifers. It is an exceptionally pretty tree and largely used for ornamental planting. The wood when green makes excellent fuel, but if left lying in the open very quickly decays.

Propagation.—The birch is grown from seed. The catkins ripen about the middle of August, but will often hang on the trees for some months if not exposed to violent winds. The seed is exceptionally small and light, there being over 800,000 grains to the pound. From our experience in raising birch it would seem that the best time to sow the seed is in the fall of the year. The seed should be sown in beds as described for conifers, as the young plants require shading during the first season. In the first

summer they will probably grow about three to four inches. In the fall they may be taken up and heeled in ready for transplanting next spring, or they may be left in the beds over winter. In the spring they should be planted out in nursery rows about two to three inches apart in the row, the distance apart of the rows depending upon the method of cultivation to be used. After one year in the nursery the seedlings will be ready to transplant into the permanent plantation as they make a growth of from eighteen inches to two feet in the second year.

SCRUB OAK.

(Quercus macrocarpa.)

(See Plate XXVIII.)

The mossy cup or scrub oak is a native of southeastern Manitoba. Its natural range extends west about as far as range 2, west of the 2nd principal meridian, and north to about township 21. On good soils and under favourable conditions this tree reaches a large size. (See Plate XIII.) In southern Manitoba, in the Pembina and Turtle mountains, trees of two feet in diameter are not at all uncommon, and stumps left in the woods show that before cutting commenced there were originally trees of a much larger size than this. The name scrub oak is somewhat misleading, as one would naturally infer that the growth was stunted and scrubby. It is true that dwarfed trees are very common in some parts, but these are found only on very poor soils and on the limits of the natural range of this tree. On heavy soils and where plenty of moisture can be obtained, as stated, it will attain large proportions. It is one of the long-lived trees. From rings counted on the stumps of trees grown in thick bush it would seem that about two hundred years were required to produce an individual measuring two feet in diameter.

Uses.—The wood of the scrub oak is hard and heavy, and though coarser in the grain than white oak, affords valuable lumber in large sections. It makes excellent posts, as it does not rot readily in contact with the soil. Where it can be obtained in Manitoba the wood is used largely for fuel in preference to any other kind. For forestry purposes this tree will prove valuable in southern Manitoba, although it cannot be recommended for general planting even within the limits of its natural range. It should be set out only on the best soils, preferably in mixture with other broad leaf trees. After the tree is cut close to the ground reproduction is very vigorous from the stump. In Manitoba the scrub oak seems to be a moderate shade-bearer.

Propagation.—Seedlings are raised from the acorns which fall from the trees about the beginning of September. They should be collected as soon as they fall and should be sown at once in drills, the acorns being dibbled in about two inches apart in the rows and about one and a half inches deep. The seedlings will probably require to be kept in the nursery for two years before transplanting. The oaks develop a very strong, straight tap root when young. Consequently they should not be left in the nursery too long. As far as the writer knows, this oak has not been much used for planting in Manitoba, and the above directions are not based on actual experience. It may prove later on that it would be more advisable to plant the acorns immediately in the permanent plantation, as it is often stated that oaks are particularly hard to transplant. However, in the dry climate of the Northwest it will be best if transplanting can be done successfully to give the young plants a couple of seasons in the nursery.

S. B. Green, in 'Forestry for Minnesota,' states that scrub oak seedlings on good prairie soil attain a height of about four feet in five years.

BASSWOOD.

(Tilia Americana.)

In the west the basswood is native only in southern Manitoba, its western limit ending about range 30, west of the 1st principal meridian. It reaches a fair size in the Pembina mountains and along the Assiniboine valley. At Portage la Prairie there are still some good-sized trees, and evidences in the shape of stumps show that large specimens have been cut in that district.

Uses.—The wood of this tree is light and very easily worked. It is largely used in furniture and carriage manufacture and for other purposes. As a fuel it would probably be about equal to the wood of the cottonwood. For forestry purposes it should be very valuable for planting on good soil in certain districts of southern Manitoba. It is a rapid grower and reproduces vigorously from the stomp after being cut down. For street planting, the basswood forms a very handsome shade tree, and is largely used for this purpose in eastern towns. In spring the flowers are very numerous, and emit a very pleasant odour. Honey obtained from these flowers is said to be of excellent quality. In a plantation the basswood is a moderate shade-bearer.

Propagation.—The basswood is usually raised from seed which ripens about September 1. The seed grain is about the size of a pea and is very hard. It should be sown soon after picking in drills about one and a half inches deep. Quite frequently the seed remains dormant in the ground for a whole season, germinating only in the second spring. Consequently the ground should not be ploughed up if the seedlings do not appear at once, but should be left undisturbed for another year. The seedlings will probably require two years in the nursery.

CONIFERS

There are four or five varieties of conifers which are native in parts of Manitoba Saskatchewan and Alberta: the white spruce, black spruce, jack pine, scrub pine, American larch and Douglas fir. Besides these the Scotch pine and European larch give evidence of being hardy, and will no doubt prove of value in prairie plantations. As the methods of raising and caring for the seedlings of the conifers are practically the same for all the above varieties, the following suggestions in regard to rearing the young plants in the nursery will apply in all cases unless stated to the contrary.

Seedlings of the cone-bearing trees are much more difficult to raise and require considerably more time and labour before they are large enough to plant out permanently. In moist climates two year old plants are frequently used for planting, but in the west the seedlings should be at least four or perhaps five years old before they are put out in the permanent plantations. Unless a person can afford to give the young seedlings plenty of care and attention during the first season, it would not be advisable for him to try raising this class of stock, and he would find it much better to purchase young plants from a commercial nursery.

Seed Bed.—The best soil for raising conifers in is a good sandy loam. If such soil cannot be found in the nursery, it should be made by mixing about equal quantities of sand and rich loam together. The ground should then be made up into beds, preferably about three and a half to four feet wide, so that a person can easily reach to the middle to weed and cultivate, and any desired length. The sides of these beds

should be protected by rough inch boards set on edge and held in place by pegs driven in on the outside at suitable distances. The soil on the bed should be an inch or two higher than that outside the boards (which should stand up three or four inches), in order that the surface can be easily drained. This is a very important point in dealing with this class of seedlings.

Sowing.—After the surface of the soil is made perfectly smooth and level the seed should be scattered broadcast over the whole bed or it may be sown in rows 2 or 3 inches apart. The former method takes much less time. The latter probably results in a more even stand and permits of more thorough cultivation after the seedlings are up. If sown broadcast the seed should be pressed lightly into the ground by going over the surface of the bed with the flat side of a broad board. A very light covering, about an eighth of an inch, of fine sandy loam may then be put on. This is best done by sifting it through a fine wire screen. If the seed is sown in rows it should also be covered to about the same depth. In the dry climate of the Northwest it is not advisable to rely upon rain to start the seeds, but the beds should be watered constantly. The evaporation of moisture from the beds is very rapid and may be stopped to a considerable extent by placing screens above them. The most satisfactory screens, and ones easily put together, are made by nailing common lath to strips of 2-in. x 2-in. or 2-in. x 1-in., spacing the lath about an inch apart. These screens should be made as wide as the beds and about six to eight feet long for convenience in handling. Anything, however, which will exclude a portion of the sun's rays would answer the purpose, as for instance brushwood laid across poles or on top of coarse wire netting. Whatever is adopted, however, should be light and easily moved, as the screens must frequently be taken off in order to water and cultivate the beds. (See Plate XXIX.)

Until the seedlings show above ground the screens may be allowed to rest on the side boards, or two or three inches above the surface of the bed. As soon as the plants are well up they should be raised one and a half to two feet.

Mice and birds often do considerable damage in the nursery by eating the seeds of conifers, especially the larger ones of the pines. This can be prevented to some extent by coating the seed with red lead. This is done by slightly moistening the seed and then sprinkling the powder over it and mixing it well up till every grain is coated. Traps set in the beds will also keep down the number of mice.

Damping off.—During the first two or three weeks after germinating, the beds must be very carefully watched, as at this stage the young plants are very tender and are often killed off in great numbers by a certain fungus known to gardeners and nurserymen as 'damping off fungus.' It is noted more particularly in wet, cloudy weather, especially if the air is warm. Patches of seedlings are found lying flat on the ground where they quickly wilt. If one of these small plants is examined it will be seen that, just at the point where the root and stalk join, the stem is brown and withered for about an eighth of an inch, the rest being apparently healthy. When damping off commences immediate steps must be taken to stop, if possible, the spread of the fungus. Otherwise the whole stand of seedlings may be destroyed in a few days. If possible all dead and dying seedlings should be picked off, the surface of the bed thoroughly stirred and lightly scattered with dry sand or road dust if either can be procured. The screens should be removed for a short time if the sun is shining, and if raining they should be slightly tilted up and covered with matting or lumber in order to keep the beds as dry as possible. If the beds are kept well drained and the surface occasionally cultivated, danger from damping off need not be feared in ordinary weather. As soon as the stems of the young plants become hardened, no more anxiety need be felt. During the growing season the beds may need an occasional watering, and of course must be kept free from weeds. Cultivation should be stopped after the beginning of August. Just before the ground freezes the beds may be covered with a light mulch of straw or leaves to protect the seedlings during the winter, though no protection is given them at the nursery station other than that

afforded by the screens. During the past four years no damage has been done in the seed beds by winter killing

The following spring this mulch is removed, preferably on a cloudy day, and it may be well to use the screens for a few weeks during the early part of the season, after which they may be dispensed with, at first removing them for an hour or so each day, extending the time until the plants are perfectly accustomed to the strong sunlight.

Transplanting.—When one or two years old the seedlings should be transplanted from the seed-bed to others prepared in much the same way, except that side-boards are not used. When the young plants are raised great care must be taken not to injure the roots nor to allow them to dry out for a single instant. The seedlings should then be placed in rows running across the bed about six to seven inches apart and placed 4 in. to 5 in. apart in the row. When planting the roots should be kept in muddy water. Suitable holes can be made with a small dibble or the seedlings may be planted in shallow trenches, and the soil pulled in by hand. Care should be taken not to plant too deeply and to *thoroughly firm the soil around the roots.*

The seedlings should be allowed to remain in the transplanting beds either one, two or three years, according to the variety, when they may be set out in the permanent plantation. If the young trees have not got to be transported over any great distance, it is advisable in lifting them to take up with the roots a small ball of soil which should not be disturbed in planting. *On no account should the roots of this class of trees be exposed for an instant to sun and wind, as once the small rootlets dry out the tree is practically killed.* The great number of failures experienced in transplanting evergreens is without doubt due to carelessness in this respect.

Fig. 3.—Hollow spade for transplanting coniferous seedlings.

In transplanting small coniferous seedlings, where the nursery is near the plantation, a hollow spade (see fig. 3) can be used with great success. This spade should be about 2½ to 3 inches in diameter and about 4 to 5 inches deep, the bottom being slightly smaller than the top. In digging up a seedling with this spade, a cylinder of earth the same size as the spade is taken up with the roots and may be placed at once into a hole previously made with the same or a similar instrument, so that the roots are practically not disturbed at all.

WHITE SPRUCE.

(Picea alba.)

(See plates XXX., XXXI., XXXII., XXXIII.)

The white spruce is native throughout the Northwest, its principal distribution being in eastern Manitoba, southern Saskatchewan, northern Alberta and along the foothills of the Rockies in southern Alberta. It is also found in a completely isolated district on the Sandhills of Manitoba, which extend over townships 8, 9 and 10, in ranges 11 to 16, part of which has been set aside as a forest reserve, and also scattered in the Cypress Hills in the neighbourhood of Fort Walsh. The spruce grows to a large size. In Brandon, Prince Albert and other points, large quantities of this timber are sawn into lumber, and logs two feet in diameter are not at all uncommon. The spruce

has proved hardy wherever it has been tried in the Northwest. Most of the young trees which have been transplanted have been secured from the sandhills or natural spruce woods and are not nursery raised specimens. Owing to carelessness in digging and transplanting these trees, and also very often because the trees taken were far too big, there have been many failures in planting spruce on the prairies. In consequence of these failures there is a general impression in certain districts that the spruce cannot be transplanted, but there is no doubt that with proper handling there is no reason why there shou'd be less success with this than with any other hardy tree. In taking plants from the woods there are certain points which should be observed.

1. Never select plants which are growing in very sheltered spots, but take them from the most exposed situations, so that the change from the woods to the plantation may not be too great.

2. The greatest care should be taken when lifting the trees not to injure the roots, and during transportation never to allow them to become at all dry from exposure to wind and sun.

3. Always secure small seedlings in preference to larger ones. Those about ten inches or one foot in height will prove far more satisfactory than those three or four feet high, aside from the fact that they are much more easily and cheaply handled.

4. Do not waste time on poorly rooted plants.

Uses.—The white spruce is one of our most useful trees from an economic standpoint. It is a most valuable lumber tree and is extensively used in the manufacture of pulp. For forestry purposes the spruce will undoubtedly prove one of the most useful trees for western planting. As it is an evergreen, it is sure to become a favourite on the prairie where everything is welcome that tends to relieve the monotony of the landscape in winter. The tree grows with a single main stem, from which the branches spread out on all sides at right angles almost from the ground, so that it forms, when planted closely in rows, an ideal windbreak. The spruce will endure heavy shade and may be planted either pure or in mixture with some light demanding variety. After the fourth or fifth year the rate of growth is fairly rapid, the annual growth at Indian Head averaging about 18 inches a year.

The seed of the spruce ripens about the middle of August. If the season is dry and hot the cones seem to ripen up earlier, open and shed their seed. In the autumn of 1901 a quantity of seed was collected by the Forestry Branch in the sand hills east of Brandon. On August 22 it was found that many of the cones had already opened and a large proportion of the seed had fallen out. The seed inside the cones is ripe when the cones themselves are still quite green. When the cones are cut open the seed can be examined, and if the hull is found to be black and the kernel white and fairly stiff the cones may be considered ready to pick. The cones grow only on the tops of the trees, except in the case of isolated specimens when a few are sometimes found on the lower branches. The best way to pick them is to climb into the tops, putting them into a bag carried slung over the shoulders. As the cones are covered with soft resin and the needles are very sharp, it is more pleasant to use gloves than to pick with bare hands. The resin can, however, be easily removed from the hands by the application of a little coal oil. After the cones are collected they should be spread out in the sun. If they can be dried under glass the scales will very quickly open and the seed can ten be readily shaken out by stirring the cones over a fairly coarse wire sieve. The seed may either be sown in the fall or else very early in the spring. If kept dry the seed can be stored for a long time, as the kernel is very oily and retains its germinating power very well.

Seed ripens in August or early in September.
Cones should be picked as soon as seed is ripe.
Should be sown late in fall or early spring.

JACK PINE.

(See Plates XXXIV., XXXV.)

There are two varieties of scrub or jack pine native to the North-west. These are *Pinus Banksiana* or *divaricata* and *Pinus Murrayana*. The former is the one found most commonly, and grows to a large size. Pinus Murrayana is found west of the Athabaska along the gravelly slopes of the foothills of the Rockies at about 4,000 feet elevation, also at the western end of the Cypress Hills, but not lower than 500 feet from the summit. (Macoun, Catalogue of Canadian Plants, part III., p. 467.) It is the principal tree at Banff, on the mountain slopes. In regard to the distribution of these two pines, Professor Macoun states in an article published in Vol. XII. of the Proceedings of the Royal Society of Canada, 1894, Section 4, p. 16, that '*P. Banksiana*, *P. Murrayana* and *P. contorta* form a natural group of scrub pines that under one form or another pass, without intermixing, from the Atlantic coast of Nova Scotia to the Athabasca river at Fort Assiniboine. Here at its western limit as far east as Prince Albert on the Saskatchewan it is a fine tree. Scarcely a day's journey west of Fort Assiniboine the writer found the second species in great profusion, but never more than three inches in diameter. * * * * * Throughout the Rocky Mountains *P. Murrayana* is the principal tree, between 4,000 and 5,000 feet, and in British Columbia on the plateau between lat. 51° and 55°, at an altitude of from 2,000 to 4,000 feet.' In the Cypress Hills the *Pinus Murrayana* reaches a very fair size, 18 inches being the maximum diameter. In one part of the west end there is a small saw-mill operating which cuts lumber for the local market.

The common scrub pine or *Pinus Banksiana* is, however, probably the most important from the standpoint of the western planter. This tree grows naturally on dry, sandy situations, and is a fairly rapid grower. It is very hardy and the seedlings are easily raised, as they do not require shading as do those of most other varieties of conifers. S. B. Green says of this tree in his 'Forestry in Minnesota': 'The jack pine is not a pretty tree, and is seldom used in ornamental planting. It is, however, the hardiest native evergreen we have, and is especially adapted to dry, loose soil, where it has a wondrous power of withstanding drought. It is of rapid growth when young, which, together with its great hardiness, has led to its being planted on some of the sandiest, dry lands of the west.'

Uses.—In certain districts the wood is largely used for railroad ties, also for fencing material and fuel. For planting it will no doubt prove especially valuable in dry situations, but should also grow well and produce good timber on the better soils. It is a fairly light-demanding tree, and will probably thrive best in mixture, although it grows naturally in pure forest.

Propagation.—The cones should be collected about the latter part of August or the beginning of September. The cones, however, either of *Murrayana* or *Banksiana*, may be picked at almost any season, as they remain on the branches for many years, the seed still maintaining its vitality. The cone of this pine is particularly hard and it is often very difficult to extract the seed. In order to open the cones enough to allow the seed to be shaken out, artificial heat must be used. A steady temperature of 150° Fahrenheit must be maintained in order to do rapid work. (Forestry and Irrigation, January, 1903, p. 31.) Care should be taken not to exceed this temperature, as the germinating power of the seed would probably be injured. When subjected to this heat the cones should fully open in between 3 and 4 hours. The seed should be sown in early spring, and subsequent management the same as that before given for conifers in general, except that shading is not necessary, although it would probably be of benefit in checking evaporation of soil moisture.

Cones ripen—end of August.

Should be picked—any time.

Seed sown—late fall or early spring.

SCOTCH PINE.

(Pinus sylvestris.)

(See plates XXXVI., XXXVII., XXXVIII., XXXIX.)

This is an European variety of pine which has proved itself hardy almost everywhere it has been introduced. In the Northwest it has only been tried in such a few cases that it would not do to make any definite statements as regards its suitability for prairie planting. However, where it has been tried at Indian Head, Moose Jaw, Brandon and Nelson (Southern Manitoba), it has made healthy and rapid growth, and seems to be equally as hardy as the white spruce. It is such a valuable tree, both for its timber and in the capacity of a wind-break, that it will undoubtedly come very quickly into favour if, after more extended trials, it proves to be suited to western conditions. In Europe the Scotch pine is one of the principal timber trees and reaches a large size on comparatively poor soils. It seems to adapt itself to a great variety of conditions, growing almost as well on light, dry soils, though of course slower, as it does on heavy, richer ones.

It is very easily raised from seed, if care is taken to prevent 'damping off fungus' in the early stages. The seed generally used in this country is obtained from Europe; consequently it is rather high priced. The seed, however, is small and a large number of trees can be grown from one pound, which according to G. B. Sudworth (Bul. 29, U.S. Dept. of Agr., Div. of Forestry) contains 38,880 grains; according to Bulletin on Tree Planting (published in 1899 by the Forest Department of Cape Colony) one ounce of cleaned seed contains 4,340 grains, or 69,440 seeds per pound.

Until more extended trials have been made it is not possible to say much about this tree for planting in the Canadian Northwest, although in the opinion of the writer the Scotch pine will, in the future, prove to be one of the most valuable trees for the prairie.

The variety known as *Pinus Sylvestris Rigaënsis*, or Riga pine, of northern Europe, is supposed to be the most hardy.

THE LARCH.

(Larix Americana.)

(See Plates XL., XLI., XLII.)

The larch, or tamarack, is found ranging from the Maritime Provinces as far west as the eastern foothills of the Rockies. It grows naturally in the low spots and swamps, seems to easily adapt itself to new conditions, and strikes root readily and thrives well on ordinary clay soils.

The larch is one of the few coniferous trees which lose their leaves in the fall. Like the spruce it grows a single, straight, gradually tapering stem. The foliage, however, is not dense, the tree being one of the light-demanding varieties. From specimens planted at Brandon and Indian Head it seems to be a fairly rapid grower on ordinary prairie soils, but the trials have not been extended enough to furnish accurate information as to its behaviour when set out in close plantations.

The wood is one of the best for fuel and is largely used for fencing and railway ties, as it lasts well in contact with the soil. Planted in mixture with spruce or with some shade-bearing broad-leaf tree, it should give good results on the better and moister soils. It may also prove of use in planting up low, wet places which are of no value for ordinary agricultural operations.

Propagation.—The larch is grown from seed. The cones ripen early in August, and the seed very soon drops out so that collecting should be commenced as soon as it is noticed that the seed is well filled. The seed should be sown either in late fall or in the spring in beds similar to those before described. The young plants require shading during the first season.

From trials at Indian Head extending over the past five years it would seem that this tree is the most promising variety for general prairie planting on any but the very poorest and driest soils. Several thousands of seedlings have been obtained from the natural swamps in Manitoba and transplanted at Indian Head with remarkable success. After becoming established the annual growth averages at least 30 inches. The tree seems to stand unlimited exposure and the plantings at Indian Head show far fewer losses than any other variety.

The following evergreens are more or less hardy and worthy of trial.—

Balsam fir—*Abies balsamea.*

Colorado spruce—*Picea pungens.*

Norway spruce—*Picea excelsa.*

Bull pine—*Pinus ponderosa,* from seed grown in North Dakota or Northwestern States east of the Rockies.

Pinus Montana, or mountain pine, a low growing shrub, attaining a height of about 7 feet, very hardy.

Pinus cembra, or Swiss stone pine, is very hardy, but extremely slow growing.

The European larch, which has been grown from seed for the past five years at the Indian Head nursery station, shows good results, though seedlings suffer badly from rabbits.

The Siberian larch should prove quite hardy.

An average Prairie Homestead just after Settlement.
Photo taken 1901. (Near Pense, Assa.)

Plate II.

Photo taken in 1905. Same Place as Plate I.
The trees in foreground are maple, cottonwood and some willows, planted spring 1901.

Plantation of Manitoba Maple about 13 Years old, Unpruned and Planted close enough together to Maintain a good Soil Cover, preventing Growth of Weeds and Formation of Sod.
(Brandon, Manitoba, Experimental Farm.)

PLATE IV.

PLANTATION OF MANITOBA MAPLE, ABOUT 15 YEARS OLD, PRUNED AND THINNED OUT TO SUCH AN EXTENT THAT A THICK SOD OF GRASS HAS FORMED BENEATH TREES—AN UNFAVOURABLE CONDITION FOR HEALTHY TREE GROWTH.
(Near Brandon, Manitoba.)

PLATE V.

MIXED PLANTATION OF MANITOBA MAPLE AND DAKOTA COTTONWOOD ON FARM OF SAMUEL PURSE, PENSE, SASK.
Planted spring 1901. Photo. taken fall 1903.

PLATE VI.

CULTIVATION OF SEEDLINGS IN NURSERY.
(Indian Head, Sask.)

PLATE VII.

CULTIVATION OF SEEDLINGS IN NURSERY.
(Indian Head, Sask.)

PLATE VIII.

PLANTATION OF MANITOBA MAPLE AT INDIAN HEAD EXPERIMENTAL FARM, SHOWING BRANCHY SHRUBBY CHARACTER OF GROWTH WHEN TREES ARE PLANTED FAR APART.
(Compare this with Plate III.)

PLATE IX.

PLANTATION OF MANITOBA MAPLE, 10 YEARS OLD, SHOWING DAMAGE DONE BY DRIFTING SNOW BREAKING THE TOPS OF THE YOUNG TREES.
(Indian Head, Experimental Farm, Sask.)

PLATE X.

NURSERY ROWS OF MANITOBA MAPLE, FROM SEED SOWN IN DRILLS, 30 INCHES APART.
Seedlings about 3½ months old. (Indian Head.)

PLATE XI.

MANITOBA MAPLE AS AN AVENUE TREE.
Indian Head Experimeneal Farm.

PLATE XII.

MANITOBA MAPLE PLANTED FOR SHELTER AND WIND BREAKS.
(Indian Head Experimental Farm.)

Green Ash, Growth attained in Natural Woods near Nelson, Manitoba.
Tree on left of picture is green ash, one on right scrub oak.

PLATE XIV.

NURSERY ROWS OF GREEN ASH SEEDLINGS 1 YEAR OLD.
(Indian Head.)

PLATE XV.

AMERICAN ELM AS AN AVENUE TREE — 12 YEARS OLD.
(Indian Head Experimental Farm.)

PLATE XVI.

AMERICAN ELM SEEDLINGS IN NURSERY ROWS — 1 YEAR OLD.
(Indian Head.)

PLATE XVII.

ELM PLANTATION AT BRANDON.

PLATE XVIII.

ELM PLANTATION AT INDIAN HEAD EXPERIMENTAL FARM.

PLATE XIX.

WIND BREAK OF COTTONWOOD (*Populus deltoides*) 12 YEARS OLD, FROM CUTTINGS.
(Indian Head Experimental Farm.)

COTTONWOODS, 12 YEARS OLD, FROM CUTTINGS.
(Indian Head Experimental Farm.)

COTTONWOOD.
Fuel-wood from Cottonwood Trees 4 years planted (Indian Head).

RUSSIAN POPLAR. FROM CUTTINGS, ABOUT FOUR MONTHS AFTER BEING SET.
(Indian Head).

RUSSIAN POPLAR.
Trunk, showing result of pruning and subsequent injury from sun scald.
(Indian Head.)

RUSSIAN POPLAR.
Tree 10 years old, unpruned and in a healthy condition. (Indian Head Experimental Farm.)

Willow.
A two year growth from cuttings. (Brandon.)

PLATE XXVI.

ACUTE LEAVED WILLOW.
Windbreak, 12 years old. (Indian Head.)

PLATE XXVII.

BIRCH.
(*Betula papyrifera.*)
Seedlings in second year, growing in transplanting bed. (Indian Head.)

SCRUB OAK (*Quercus macrocarpa*) IN SOUTHERN MANITOBA, NEAR NELSON.
Showing size attained on good soil.

PLATE XXIX.

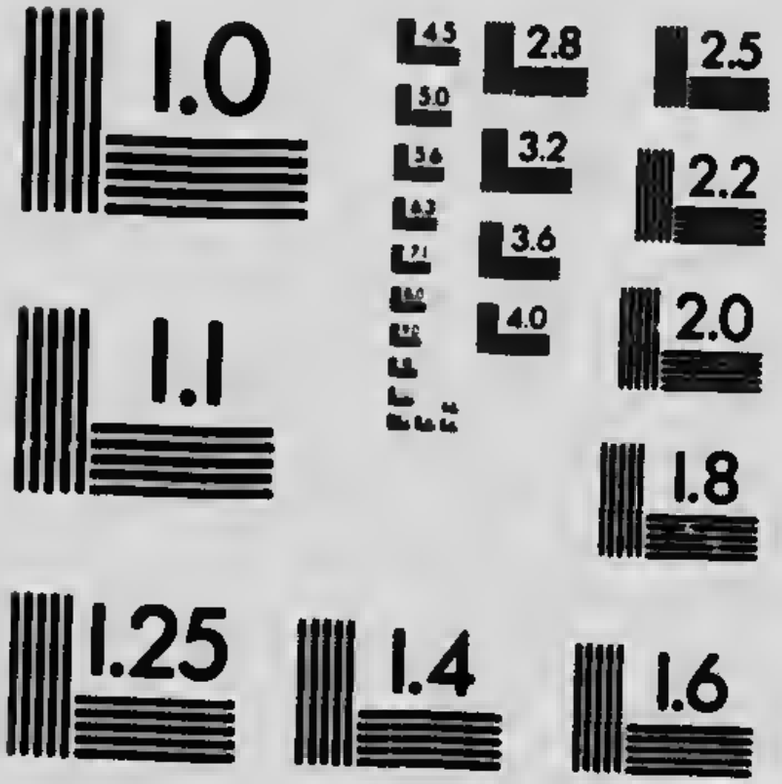
METHOD OF SHADING CONIFER SEED BEDS WITH SCREENS MADE OF COMMON LATH NAILED ON PIECES OF 2 IN. × 2 IN.
(Indian Head Nursery.)

PLATE XXX.

WHITE SPRUCE.
Natural growth near Sewell, Manitoba. The smaller trees have all sprung up from seed dropped from the two larger ones.
(Sprucewoods Forest Reserve.)

MICROCOPY RESOLUTION TEST CHART

(ANSI and ISO TEST CHART No. 2)



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WHITE SPRUCE SEEDLINGS.
Showing comparative size of 1 and 2 year old plants.
(Grown at Indian Head Nursery.)

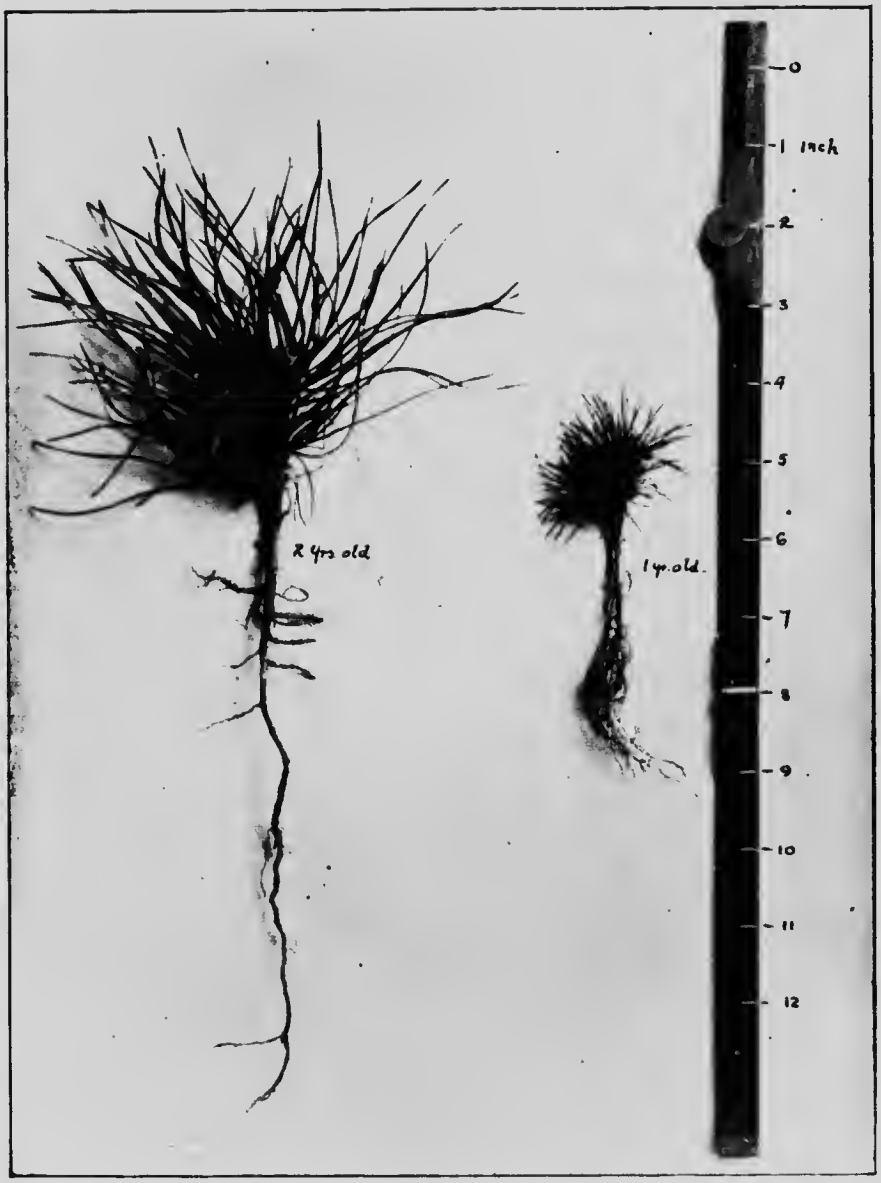
Wind Break of White Spruce at Brandon, Manitoba.

PLANTATION OF WHITE SPRUCE AND SCOTCH PINE AT NURSERY STATION, INDIAN HEAD, PLANTED SPRING 1906.
Photo, November, 1906.

JACK PINE (*Pinus Murrayana*) IN NATURAL FOREST IN WESTERN ALBERTA.

JACK PINE (*Pinus Murrayana*) IN CYPRESS HILLS, SASK.

SCOTCH PINE.
Bed of seedlings about middle of first summer. (Indian Head, Sask.)



SCOTCH PINE.
Showing comparative size of 1 and 2 year old seedlings.
Grown at Indian Head Nursery.

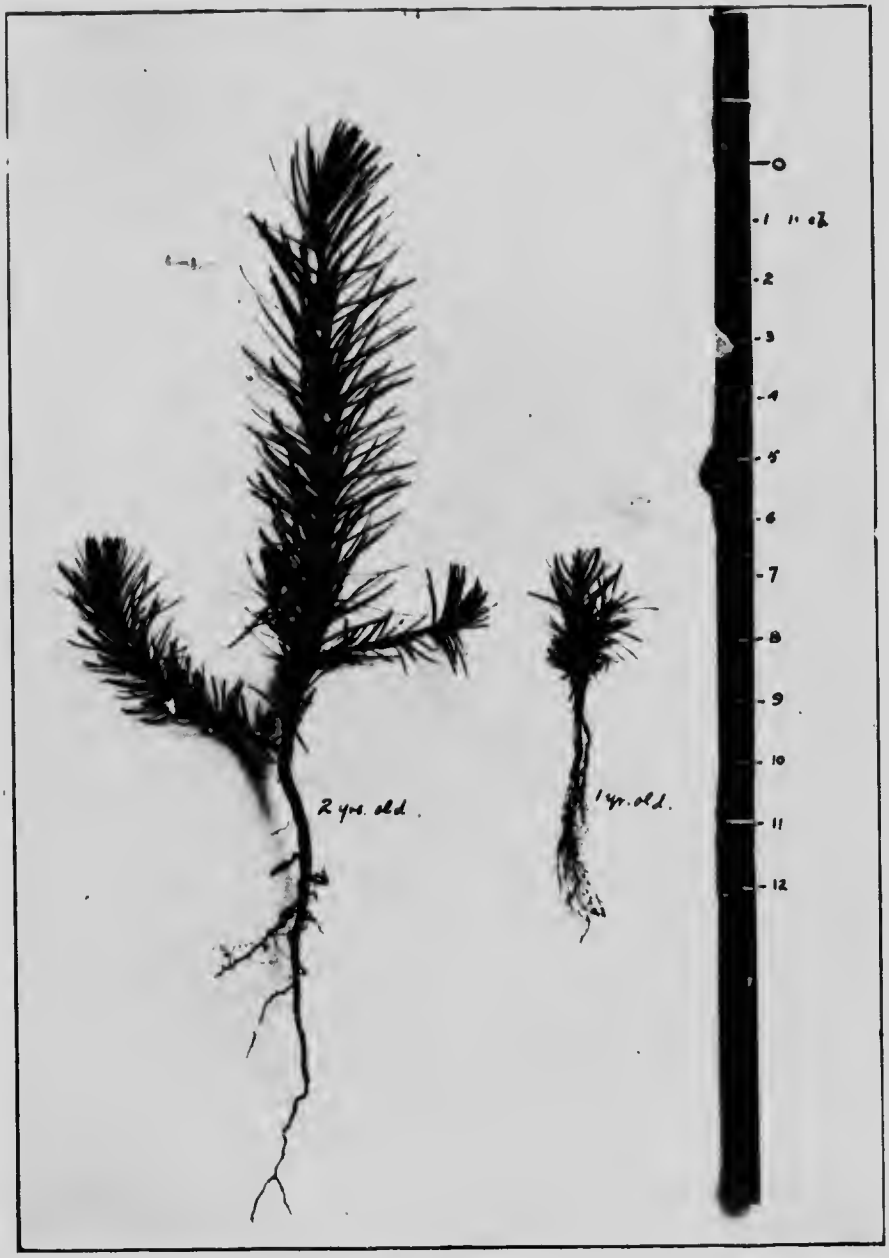
SCOTCH PINE.
Wind break, about 12 years old, at Indian Head Experimental Farm.

SCOTCH PINE PLANTATION, SET OUT SPRING 1906. PHOTO, NOVEMBER, 1906.
Trees 3 feet by 3 feet. Nursery Station, Indian Head.

LARCH.

Natural reproduction of larch in swamp near Sewell, Manitoba, after old trees have been burnt or cut out.
(Sprucewoods Forest Reserve.)

PLANTATION OF AMERICAN LARCH, WHITE SPRUCE AND SCOTCH PINE.
Set 4 feet by 4 feet in Spring, 1905. Photo, November, 1906.
(Nursery Station, Indian Head.



EUROPEAN LARCH.
Showing comparative growth of 1 and 2 year old seedlings.
Grown at Indian Head Nursery.