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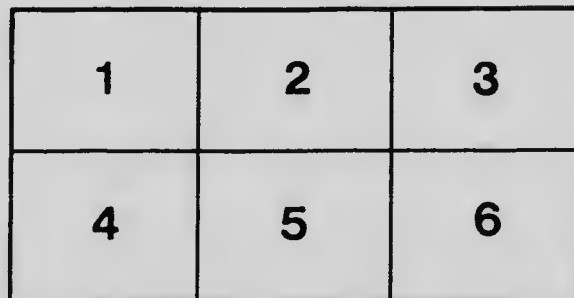
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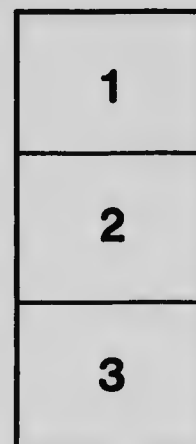
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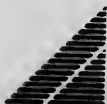
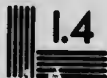
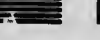
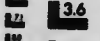
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[BULLETIN 155.]

[FEBRUARY, 1907]

# Ontario Department of Agriculture.

## ONTARIO AGRICULTURAL COLLEGE.

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### FARM FORESTRY.

By E. J. ZAVITZ, B.A., M.S.F., Lecturer in Farm Forestry.

#### INTRODUCTION.

This bulletin has been prepared to assist the farmer and small land-owner of the Province of Ontario to give more rational treatment to the wooded and waste portions of his land.

No space is devoted to arguments showing why the woodlot should be cared for nor why waste lands should be planted. It is assumed that the reader is beyond that stage and desires to make improvements if it can be done practically.

Through such mediums as the agricultural press, the Farmers' Institutes, and Experimental Union, much has been done to advance the cause of farm forestry. Many prominent men in agriculture have seen the need of conserving a portion of our woodlands and re-planting the non-agricultural soil, which should never have been denuded.

Owing to the peculiar nature of a forest crop, in that it takes so long from the planting to the harvest, the individual is very liable to shirk his responsibility. It has been found in the older countries of Europe that Forestry must have the aid and supervision of the State if anything like a rational policy is to exist. It is fitting that the farmer should receive all possible assistance in improving conditions which will in many cases benefit posterity more than the present generation.

An endeavor has been made to make this publication practical for the farmer, and as far as possible technical language has been avoided. Various things have been suggested which might not be practical for the large landowner. However, the farmer is especially fitted to carry out work as outlined in these pages, as he has a knowledge of plant life in relation to the soil; he has the equipment for such work and he can personally superintend and give it future inspection.

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## LIST OF FOREST TREES IN ONTARIO.

Most species of our native trees have synonymous names varying with locality. An example of this is the common maple of Ontario, which is called Sugar Maple, Rock Maple, and Hard Maple. To avoid confusion in this publication it is necessary to agree upon some common name.

Canadian and American species have been given the vernacular and scientific names adopted by Bulletin No. 17, of the Division of Forestry, U. S. Department of Agriculture. The names adopted in Bulletin 17 are in almost every case known in Ontario; so it has been felt advisable to conform to this standard. One exception is the Hornbeam (*Ostrya virginiana*), which in Ontario is commonly called Ironwood.

The adopted names are given in large type with the synonymous names in brackets.

## TREES INDIGENOUS TO ONTARIO.

Scientific name.	Common name.
1. <b>ABIES BALSAMEA</b> .....	<b>BALSAM FIR.</b> (Balsam; Canada Balsam.)
2. <b>ACER NEGUNDO</b> .....	<b>BOX ELDER.</b> (Negundo Aceroides.) (Ash-leaved Maple; Cut-leaved Maple; Negundo Maple; Three-leaved Maple; Manitoba Maple.)
3. <b>ACER NIGRUM</b> .....	<b>BLACK MAPLE.</b>
4. <b>ACER PENNSYLVANICUM</b> .....	<b>STRIPED MAPLE.</b> (Moosewood.)
5. <b>ACER RUBRUM</b> .....	<b>RED MAPLE.</b> (Swamp Maple; Soft Maple; Water Maple; White Maple.)
6. <b>ACER SACCHARINUM</b> .....	<b>SILVER MAPLE.</b> ( <i>Acer dasycarpum</i> .) (Soft Maple; White Maple.)
7. <b>ACER SACCHARUM</b> .....	<b>SUGAR MAPLE.</b> ( <i>Acer saccharinum</i> .) (Hard Maple; Sugar-tree; Rock Maple; Black Maple; Maple.)
8. <b>AMELANCHIER CANADENSIS</b> ....	<b>SERVICEBERRY.</b> (June-berry; Shad bush; Service tree; May cherry; Shad-berry.)
9. <b>ASIMINA TRILOBA</b> .....	<b>PAPAW.</b> (Custard Apple.)
10. <b>BETULA LUTEA</b> .....	<b>YELLOW BIRCH.</b> (Gray Birch; Swamp Birch; Silver Birch.)
11. <b>BETULA PAPYRIFERA</b> .....	<b>PAPER BIRCH.</b> (Canoe Birch; White Birch; Silver Birch; Large White Birch.)
12. <b>BETULA POPULIFOLIA</b> .....	<b>WHITE BIRCH.</b> (Gray Birch.)
13. <b>CARPINUS CAROLINIANA</b> .....	<b>BLUE BEECH.</b> (Water Beech; Hornbeam; Ironwood.)
14. <b>CASTANEA DENTATA</b> .....	<b>CHESTNUT.</b> ( <i>Catanea Vesca</i> .) (Castanea Vulgaris.) (Sweet Chestnut.)

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Fig. 1.

Original pinery now covered with woodlot of hardwoods, as Maple, Beech and Ash.

15. *CELTIS OCCIDENTALIS* ..... HACKBERRY.  
(Sugarberry; Nettle-tree.)
16. *CORNUS FLORIDA* ..... FLOWERING DOGWOOD.  
(Dogwood; Boxwood.)
17. *CORNUS ALTERNIFOLIA* ..... BLUE DOGWOOD.  
(Dogwood; Purple Dogwood.)
18. *FAGUS ATROPUNICEA* ..... BEECH.  
(*Fagus ferruginea*.)  
(Red Beech; White Beech.)
19. *FRAXINUS AMERICANA* ..... WHITE ASH.  
(Ash; American Ash.)
20. *FRAXINUS NIGRA* ..... BLACK ASH.  
(*Fraxinus sambucifolia*.)  
(Hoop Ash; Basket Ash.)
21. *FRAXINUS PENNSYLVANICA* .... RED ASH.  
(*Fraxinus pubescens*.)  
(Brown Ash; Black Ash.)
22. *FRAXINUS LANCEOLATA* ..... GREEN ASH.  
(*Fraxinus viridis*.)  
(Blue Ash; White Ash.)
23. *FRAXINUS QUADRANGULATA* ... BLUE ASH.
24. *GYMNOCLADUS DIOICUS* ..... COFFEE TREE.  
(*Gymnocladus canadensis*.)
25. *HAMAMELIS VIRGINIANA* ..... WITCH HAZEL.  
(Winter Bloom.)
26. *HICORIA OVATA* ..... SHAGBARK. (Hickory.)  
(*Carya alba*.)  
(Shellbark Hickory; Shagbark Hickory; Shellbark.)
27. *HICORIA MINIMA* ..... BITTERNUT. (Hickory.)  
(*Carya amara*.)  
(Bitternut; Swamp Hickory; Pig Nut.)
28. *HICORIA ALBA* ..... MOCKER NUT. (Hickory.)  
(*Carya tomentosa*.)  
(Whiteheart Hickory.)
29. *HICORIA GLABRA* ..... PIGNUT. (Hickory.)  
(*Carya porcina*.)  
(Bitternut.)
30. *JUGLANS NIGRA* ..... BLACK WALNUT.  
(Walnut; Walnut-tree.)
31. *JUGLANS CINEREA* ..... BUTTERNUT.  
(White Walnut.)
32. *JUNIPERUS VIRGINIANA* ..... RED JUNIPER.  
(Red Cedar; Cedar; Juniper.)
33. *LARIX LARICINA* ..... TAMARACK.  
(*Larix americana*.)  
(Larch; American Larch.)
34. *LIRIODENDRON TULIPIFERA* ... TULIP-TREE.  
(White-wood; Yellow Poplar; Tulip Poplar.)
35. *NYSSA SYLVATICA* ..... BLACK GUM.  
(*Nyssa multiflora*.)  
(Sour-gum; Trunelo; Pepperidge.)
36. *OSTRYA VIRGINIANA* ..... HORNBEAM.  
(Hop hornbeam; Ironwood.)
37. *PICEA MARIANA* ..... BLACK SPRUCE.  
(*Picea nigra*.)  
(Spruce.)
38. *PICEA CANADENSIS* ..... WHITE SPRUCE.  
(*Picea alba*.)
39. *PINUS RIGIDA* ..... PITCH PINE.
40. *PINUS STROBUS* ..... WHITE PINE.  
(Pine.)
41. *PINUS RESINOSA* ..... RED PINE.  
(Norway Pine.)
42. *PINUS DIVARICATA* ..... JACK PINE.  
(*P. banksiana*.)  
(Scrub Pine; Gray Pine.)



43. *PLATANUS OCCIDENTALIS* ..... SYCAMORE.  
(Button-wood; Plane-tree; Button-  
ball.)
44. *POPULUS TREMULOIDES* ..... ASPEN.  
(American Aspen; Poplar; Popple.)
45. *POPULUS GRANDIDENTATA* ..... LARGETOOTH ASPEN.  
(Poplar; Popple.)
46. *POPULUS BALSAMIFERA* ..... BALM OF GILEAD.  
(Balsam; Balsam Poplar; Cotton-  
wood; Poplar.)
47. *POPULUS DELTOIDES* ..... COTTONWOOD.  
(*Populus monilifera*.)  
(Carolina Poplar; Poplar.)
48. *PRUNUS SEROTINA* ..... BLACK CHERRY.  
(Wild Black Cherry; Wild Cherry;  
Rum Cherry.)
49. *PRUNUS PENNSYLVANICA* ..... WILD RED CHERRY.  
(Pin Cherry; Pigeon Cherry; Wild  
Cherry.)
50. *PRUNUS VIRGINIANA* ..... CHOKE CHERRY.  
(Wild Cherry.)
51. *PTELEA TRIFOLIATA* ..... HOPTREE.
52. *QUERCUS ALBA* ..... WHITE OAK.  
(Stave Oak.)
53. *QUERCUS MACROCARPA* ..... BUR OAK.  
(Mossycup Oak; Blue Oak.)
54. *QUERCUS PRINUS* ..... CHESTNUT OAK.
55. *QUERCUS ACUMINATA* ..... CHINQUAPIN OAK.
56. *QUERCUS RUBRA* ..... RED OAK.  
(Black Oak; Spanish Oak.)
57. *QUERCUS COCCINEA* ..... SCARLET OAK.  
(Red Oak; Black Oak.)
58. *QUERCUS PALUSTRIS* ..... PIN OAK.  
(Swamp Spanish Oak; Swamp Oak;  
Water Oak.)
59. *QUERCUS PLATANOIDES* ..... SWAMP WHITE OAK.  
(*Quercus bicolor*.)  
(Swamp Oak.)
60. *QUERCUS VELUTINA* ..... YELLOW OAK.  
(*Quercus tinctoria*.)  
(Black Oak.)
61. *SALIX NIGRA* ..... BLACK WILLOW  
(Willow.)
62. *SALIX AMYGDALOIDES* ..... ALMONDLEAF WILLOW.  
(Willow.)
63. *SALIX FLUVIATILIS* ..... LONGLEAF WILLOW.  
(*Salix longifolia*.)  
(Sandbar Willow.)
64. *SALIX DISCOLOR* ..... GLAUCOUS WILLOW
65. *SALIX CORDATA MACKENZIE-* (Pussey Willow; Willow.)  
*ANA* ..... MACKENZIE WILLOW.  
(Heart-leaved Willow.)
66. *SASSAFRAS SASSAFRAS* ..... SASSAFRAS.  
(*Sassafras officinale*.)  
(Saxifrax; Sassafao.)
67. *TFUYA OCCIDENTALIS* ..... ARBORVITAE.  
(White Cedar; Cedar; American Ar-  
bor Vitae.)
68. *TILIA AMERICANA* ..... BASSWOOD.  
(Linden; American Linden; White-  
wood.)
69. *TSUGA CANADENSIS* ..... HEMLOCK.  
(Hemlock Spruce; Spruce.)

70. ULMUS PUBESCENS ..... SLIPPERY ELM.  
(*Ulmus fulva.*) (Red Elm.)
71. ULMUS AMERICANA ..... WHITE ELM.  
(Soft Elm; Swamp Elm.)
72. ULMUS RACEMOSA ..... ROCK ELM.  
(Cork Elm; White Elm.)

### TREES INTRODUCED FROM UNITED STATES.

- ABIES CONCOLOR ..... WHITE FIR.  
(Balsam Fir.)
- ABIES NOBILIS ..... NOBLE FIR.  
(Red Fir.)
- AESCULUS GLABRA ..... OHIO BUCKEYE.  
(Buckeye.)
- CATALPA CATALPA ..... CATALPA.  
(*Catalpa bignonioides.*)
- CATALPA SPECIOSA ..... HARDY CATALPA.
- CHAMAECYPARIS THYOIDES ... WHITE CEDAR.  
(*Chamaecyparis sphaeroidea.*) (Swamp Cedar; Juniper.)
- COTINUS COTINOIDES ..... AMERICAN SMOKE-TREE.  
(*Rhus cotinoides.*)
- GLEDITSIA TRIACANTHOS ..... HONEY LOCUST.
- MAGNOLIA ACUMINATA ..... CUUMBER-TREE.
- MORUS RUBRA ..... RED MULBERRY.
- PICEA ENGELMANNI ..... ENGELMANN SPRUCE.
- PICEA PARRYANA ..... BLUE SPRUCE.  
(*Picea pungens.*) (Colorado Blue Spruce.)
- PINUS PONDEROSA ..... BULL PINE.  
(Yellow Pine.)
- PSEUDOTSUGA TAXIFOLIA ..... DOUGLAS SPRUCE.  
(*Pseudotsuga douglasii.*) (Red Fir; Douglas Fir.)
- ROBINIA PSEUDACACIA ..... BLACK LOCUST.  
(Locust.)

### TREES INTRODUCED FROM OTHER COUNTRIES.

1. ABIES NORDMANNIANA ..... NORMANN'S FIR.
2. ACER PSEUDO-PLATANUS ..... PLANE TREE.  
(Sycamore.)
3. ACER PLATANOIDES ..... NORWAY MAPLE.
4. AESCULUS HIPPOCASTANUM ... HORSE-CHESTNUT.
5. AILANTHUS GLANDULOSA ..... AILANTHUS.  
(China.)
6. BETULA ALBA ..... SILVER BIRCH.
7. CARPINUS BETULIFOLIA ..... EUROPEAN HORNBEAM.
8. FAGUS SYLVATICA ..... EUROPEAN BEECH.
9. FRAXINUS EXCELSIOR ..... EUROPEAN ASH.
10. GINGKO BILOBA. (China) ..... GINGKO.  
(Japanese Maidenhair Tree.)
11. JUGLANS REGIAEA ..... EUROPEAN WALNUT.
12. LARIX EUROPAEA ..... LARCH.
13. MORUS ALBA. (China) ..... WHITE MULBERRY.
14. PINUS AUSTRIACA ..... BLACK or AUSTRIAN PINE.
15. PINUS SYLVESTRIS ..... SCOTCH PINE.
16. PINUS MUGHO ..... MUGHO PINE.
17. PICEA EXCELSA ..... NORWAY SPRUCE.

18. POPULUS ALBA .....	WHITE POPLAR.
19. POPULUS PYRAMIDALIS .....	LOMBARDY POPLAR.
20. QUERCUS PEDUNCULATA .....	ENGLISH OAK.
21. SALIX ALBA .....	WHITE WILLOW.
22. SALIX FRAGILIS .....	CRACK WILLOW.
23. TILIA EUROPAEA .....	LINDEN. (Lime-tree.)
24. ULMUS CAMPESTRIS .....	ENGLISH ELM.
25. ULMUS MONTANA .....	SCOTS or WYCH ELM.

### NATURAL FOREST IN CONTRAST TO WOODLOT

The forest has been spoken of as an organism and the forest tree finds its best development as one of a community. Proper soil conditions, influence of trees upon each other, etc., are all lacking in the common woodlot or in the case of the roadside tree. It should be understood that the woodlot and roadside tree grow under different conditions from the forest tree, the former lacking many factors which influence the latter.

To understand the abnormal state of roadside and woodlot trees it is advisable to study the conditions of the forest.

The forest may be discussed in relation to the forest floor and the trees themselves. The forest floor meaning the soil, humus, leaf litter and undergrowth.

The nature of the soil in the forest is greatly influenced by the protection and cover afforded by the trees and by the amount of humus it contains.

Humus is formed by the decomposition of foliage, twigs and other organic elements falling to the ground. It makes heavy soil less stiff and sandy soils more binding. It aids in preparing food for the trees and possesses great capacity for absorbing water. Humus is very essential to the proper development of trees. The lack of it in the woodlot, owing to driving winds, makes a great difference between woodlot and forest. The litter of leaves, etc., has less opportunity of collecting and forming humus in the open woodlot.

In the natural forest, where normal conditions prevail the undergrowth is composed of the more delicate plants which are not a menace to the reproduction of tree species. When an opening is created in the forest, soil conditions are such that tree seeds have an opportunity to germinate and grow before the opening is filled with grass and weeds, as is the case with the average woodlot. In the forest the tree seeds fall to the ground and are protected from sudden changes of temperature and moisture conditions by the leaf litter. Of course in many cases the leaf litter is a hindrance, as it prevents the seed from reaching the mineral soil. In the woodlot the seed may fall on the mineral soil, but the lack of protection prevents it from properly germinating.

After germination of the seed in the forest the young seedlings have protection which gives them a chance for a time. If an opening occurs by the falling of one or more trees these seedlings spring up to fill it. If the opening does not occur the seedling may be shaded out and die.

The writer has passed through woodlots in May and early June where thousands of young seedlings had made a start. By the end of August these had all disappeared. What causes their disappearance? Not always stock grazing, but often drying out from lack of protection; this lack of protection being usually due to the want of leaf litter and humus as well as to the open condition of the woods.

It is difficult to say of what value a denuded soil is in relation to tree growth. On some sand formations in Ontario there stood in the original forest some splendid trees. After clearing the land, a few good crops were secured, but soon the sandy soil became weakened as it lost its covering of humus. To-day some of these lands are waste sand dunes, as may be seen in Fig. 21.

Trees in the forest with tall, clean stems have passed through many stages. We are apt to think that they always grew in their present isolated surroundings. When young these trees grew with many companions and passed from the seedling stage into the thicket or pole stage. Frequently some were crowded out to die. The tall forest tree we see to-day is the survivor of a long struggle and its roots may be taking up ground which in its youth produced a few hundred saplings.

The thicket or pole stage served its purpose. If the tall forest tree had been growing in the open it would have large branches a few feet from the ground and would never have reached the great height to which it has attained. To survive in the struggle, the tree in the thicket has to spend most of its energy in height growth during its early life, in which time the side branches are shaded out and die while very small. This cleaning of branches gives a clean stem on which a growth free from knots may be developed in the years to come.

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## THE WOODLOT.

### INTRODUCTION.

The woodlot is a part of the farm which in too many cases has been neglected and looked upon as of no real value in its relation to the farm. It has furnished the owner with fuel and building material and frequently revenue by the sale of a few logs to the local mill. In many cases, however, the woodlot has not been considered as being a permanent resource or a necessary part of the farm economy.

In early days the woodlot was considered important as being a source of fuel, but when the farmer discovered the charms of anthracite coal one of the most evident arguments in favor of its existence seemed to

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Fig. 2.

Black Cherry in the College woodlot with Ironwoods in the background.

pass away. At the present time many farmers in older Ontario depend almost entirely upon the supply of coal for fuel. Local mill operators have frequently been allowed to go through the woodlot and take out the best timber, leaving only a slash. The owner has felt satisfied with the ready cash that such an operation left him and quick returns is a strong argument in favor of denuding the land.

No arguments are advanced in these pages to show that the use of the land for wood crop production would give greater financial returns than its use for other farm purposes. Neither will we discuss the percentage of land which should be under trees, as this is a question which must be settled by the individual owner. Many farmers in Ontario find that from the standpoint of labor and management they are limited in the amount of land which they can profitably cultivate.

The following pages take it for granted that the owner desires to make the woodlot a permanent and paying part of the farm.

#### GROUND FIRES AS RELATED TO THE WOODLOT.



Fig. 3—Effects of Ground Fires on White Oak.

injure a tree with heavy bark, frequently affects the tree very seriously. The injury is of two kinds.

*Injury to Soil.* Fire should never be allowed to run through the woodlot. By burning off the leaf litter and vegetable mould or humus the soil is greatly weakened. As was pointed out in previous pages, the healthy development of the forest tree is dependent upon the humus condition of the soil.

*Injury to Reproduction.* Ground fires also destroy the seed and young growth and make it much more difficult for seeds to germinate in the future. The natural seedbed of humus soil covered with the leaves gives a protected, natural seedbed which is necessary for reproduction.

*Injury to Old Trees.* Ground fires frequently pass through the woods in spring and by the middle of the summer the woods seem to have recovered. This is not the case, for usually large trees, which seem to have bark thick enough to withstand the small amount of heat of a ground fire, are injured in a manner not at once visible to the observer. The heat from a ground fire, which it seems is too small to

By burning off the humus and litter the soil is left unprotected so that it lacks moisture during the dry season, as well as weakening the soil in regard to food supply for the trees. Frequently the burning kills the shallow roots or leaves them unprotected.



Fig. 4—Woodlot to the left of the fence has been protected from stock.

The living tissue beneath the bark of the tree close to the ground becomes so heated that it is either killed or partly destroyed. The first visible effect may be seen in the form of a fungus growth about the base of the tree. This parasitic fungus gradually weakens the tree, making it subject to insect pests, and finally causing its death, but the real and first cause was the innocent looking ground fire.

## STOCK GRAZING.

Probably one of the most serious hindrances to the proper growth and development in the woodlot has been caused by grazing. There were many, a few years ago, who claimed that grazing did not injure the woodlot.

Experience has shown, however, that in the Ontario woodlot grazing must always be injurious. Many examples, as in Fig. 4, may be seen in Ontario where the comparison of grazed and ungrazed woodlots show the result. While the injury is admitted by many, there are those who claim that the woodlot is of more value in protecting the cattle during the heat of the day and giving them pasturage than for wood producing purposes. It is very difficult to compare the rental value of the woodlot used for purposes of pasturage and that of the woodlot used exclusively for wood protection. One thing is certain, that to have a permanent woodlot where conditions are favorable for tree growth the stock must be excluded.

Domestic animals are frequently classed as to the amount of injury they inflict on the woodlot. From the standpoint of browsing the degree of injury may be placed in the following order: Goats and sheep, horses, cattle, swine, the first mentioned being the most injurious and the last being least.

Injurious effects of allowing stock to run in the woodlot may be discussed in its relation to the soil, the reproduction or young growth and the older trees.

*Soil.* While the effects of grazing on the soil may be least noticeable, it is very important. Destruction of young growth soon opens the woodlot to drying winds which carry off the humus-forming leaves and greatly lessen the moisture content of the soil. Light begins to enter and reach the ground, causing grass and weeds to start which soon develop a stiff sod. Trampling of the soil causes it to become impervious, thus allowing the water to run off rapidly instead of being held in the soil as is the case in normal conditions. After these unfavorable conditions have come to prevail, the tree seeds find it very hard to germinate and soon there is no reproduction taking place.

*Young Growth.* The leaves and tender branches of the young growth in the woodlot are eagerly browsed by the animals. Some species of trees are less liable to browsing than others. The Ironwood seems to be particularly immune from browsing, so that in many Ontario woodlots that have been grazed the larger percentage of the young growth is composed of Ironwood.

Cattle have been noticed standing in good, fresh clover, greedily devouring the leaves from limbs of Sugar Maple which were thrown into the pasture. Evidently they enjoyed a change in diet.

*Old Trees.* The trampling of the soil, the destruction of young growth, which should protect the soil from sun and wind, and the formation of an impervious sod all aid in lessening the vigor of growth of



the standing, full grown trees. In this case the injurious effects are scarcely noticeable to the common observer owing to his lack of knowledge as to what healthy tree growth actually means. The annual amount of wood production is far below what it should be when the soil conditions are in an abnormal state from grazing.



Fig. 5—Tops of trees dying from effects of stock grazing.

Many woodlots contain trees that have not reached maturity, but whose tops are dying. Such trees are spoken of as being stag-headed. Stag-headedness is caused by lack of nourishment and moisture in the soil, a result of grazing.

### WEED TREES.

Many woodlots contain a large percentage of weed trees or inferior species. Weed trees such as Ironwood, Hawthorn and Blue Beech have gradually taken possession as an undergrowth.

Everything seems to favor the development of these species. In cutting operations these trees are seldom disturbed. The stock in grazing prefer the leaves and branches of the better species, thus giving these weed trees another advantage. The seedlings of the Ironwood and Blue Beech seem very hardy and vigorous and can stand a great amount of shade, so that they get an early start in the struggle for possession of the soil. When once the Ironwood has obtained a footing its dense foliage so shades the ground that better species cannot develop beneath it. In many woodlots from seventy-five to eighty per cent. of the trees under three inches are made up of Ironwood (Fig. 2).

### INFERIOR SPECIES.

The question of the inferiority of a species is relative and depends on local conditions.

Inferior species, as Poplars and Slippery or Red Elm, are often growing on soils which are capable of producing much better species. Then in some cases the woodlot has gradually become filled with Sugar Maple when it might be wise to introduce other species.

### DEFECTIVE AND OVERMATURE TREES.

The average woodlot contains many defective and overmature trees. The defective trees are of various descriptions. Trees with old fire scars, trees injured while young by the felling of neighboring trees, trees wantonly scarred by the careless blow of an axe, trees broken and deformed by wind or snow, are all forms which should gradually be removed. Overmature trees frequently show a tendency to become stag-headed and if left standing gradually deteriorate in value. Such trees are a menace to the surrounding growth and frequently in felling destroy more than their own value.

### IMPROVEMENT CUTTING.

Cutting operations which aim to overcome the above defects, namely, weed trees, inferior species, defective and overmature trees, are spoken of as "Improvement cuttings."

In the farm woodlot all cutting for firewood should be made from such trees. It is not to be understood that it is advisable to go through the woods and cut down all the above mentioned trees without regard to the future of the area thus cut over. The first consideration should be to protect the soil, that is, do not cut down a tree or a group of trees unless you are certain that there will follow another crop. If you do not get reproduction the following season it is almost certain that grass and weeds will come in and the soil will soon lose its valuable character as

related to tree growth. Whether you can depend on the area reproducing from the seed of neighboring trees or whether it will be necessary to use artificial means can only be judged by local considerations.

#### THIN BORDERS AND OPEN SPOTS.

The borders of woodlots become thin owing to various factors. This outside portion of the woods is more subject to winds and storms which cause windfalls, dry out the soil and blow away the leaves which should go to form vegetable mould. Frequently the border is overcut, as the owner does not trouble going to the interior of the woods for his fuel, etc. In time the soil deteriorates, grass and weeds follow, and then we have the characteristic border which is neither woodland nor pasture.

The development of large open grassy spots in the woodlot is usually due to the effects of grazing. The old trees have been taken out and the young growth destroyed by the stock until grass has taken possession and formed an impervious sod in which the tree seeds find it impossible to develop.

The above conditions may be improved in the case of the thin borders by planting evergreens or coniferous trees about the border in order to form a windbreak. Norway Spruce and White Pine will be found to be two of the best species for this purpose. One or two rows of Norway Spruce planted along the fences, especially on the west side of the woods, which is the side most subject to winds in Ontario, would make a splendid protection.

Open spots in the woods if covered with grass could be improved by roughly breaking the sod and allowing the seeds to reach the mineral soil. Such breaking can be done with a disk-harrow or plow. In some cases where there is no young growth to injure, it may be advisable to turn in hogs as they frequently make a good seed bed by their rooting in search of grubs, seeds, etc.

These measures are to be adopted when the surrounding trees are bearing seed. If there is little chance of such areas being seeded from neighboring trees or if the owner desires to introduce better species into his woodlot he may resort to planting.

Planting of this nature may be done by using the young plants or by sowing seed. With the exception of nut trees, it will be advisable to use plants rather than seed. Methods of planting the woodlot are similar to the methods of planting described elsewhere. While the general methods are similar, there are many bare spots which may need special attention owing to the small amount of light which is able to reach the ground. When breaking the sod with disk or plow is impractical it is usually possible to break spots about twelve to fifteen inches square with the mattock. In these spots nuts can be dibbled or plants inserted.

The success of planting and the vigor of growth depends on the question of light as well as the condition of the soil. In general the locations that have enough light to allow a development of grass may be successfully filled with young tree growth.

The woodlot should have a definite boundary with a belt of evergreens especially on the side from which the prevailing winds come. Too many woodlots have no definite boundary, but are surrounded by slash. Keep a definite boundary well stocked with trees and soon the woodlot will have every acre productive.

#### COPPICE.

Coppice is a form of growth in the woodlot which is little understood by the average owner. Trees are reproduced from seed, cuttings, suckers and shoots. Coppice growth originates from shoots or suckers developing from the stump or root collar of previous trees. These new shoots depend upon the root system of the original tree for nourishment. In Fig. 6, one-year-old shoots may be seen which have developed from



Fig. 6 - One year old Chestnut Coppice.

a Chestnut stump. All native deciduous or hardwood trees have the power of reproducing in this way, especially where trees are cut young and at the proper season. Evergreens, with a few exceptions, as Arborvitæ, never reproduce in this way. Certain species, as Chestnut, Basswood, the Oaks, Elm, Poplar, Birch and Soft Maples seem to develop these shoots more freely and vigorously than other species.

In many woodlots, especially in the southern part of the Province, a large percentage of the growth is of this nature rather than of seedling

origin. Fig. 7 shows at least two generations of coppice. An old Chestnut stump about three feet in diameter has, growing from its base, a coppice Chestnut about twenty-six inches in diameter, and from this is



No. 7—Three generations of Chestnut Coppice.

growing a six-inch Chestnut which is the third generation. The twenty-six inch tree developed from the root-system of the old stump, but in  
2 BULL. 155.

time produced a root system of its own which is now helping to support the six-inch tree. In this case the coppice is developing before the parent tree has been cut. In Fig. 6 the coppice developed after cutting of the parent tree.

To obtain good tree growth of coppice after cutting certain considerations must be given attention.

*Age of Parent Trees.* Coppice from overmature trees will not produce strong growth, as the old root system has lost its vigor. Coppice loses its vigor of growth by following the system too far, the third and fourth generations becoming weak and decrepid. In many woodlots dwarfed and stunted growth exists from the above causes.



Fig. 8—Chestnut Coppice, five years old, in need of thinning.

*Time of Cutting.* Coppice is best produced by cutting in late winter or early spring. Late fall or early winter cutting often allows frost and moisture to loosen the bark. The coppice shoots originate beneath this outer bark and if it is destroyed there is small chance of shoots developing.

*Height of Stump.* In cutting with a view of obtaining coppice, the stump should be cut as closely to the ground as possible. It is desirable to obtain resulting shoots as near the ground as possible. Coppice which originates high up on the stump does not become vigorous. Frequently we find trees in the woodlot with the base partly rotted and such trees are often of coppice origin. In this case the shoot developed from a

high point on the original stump with the result that as the old stump decayed the new coppice growth was left weakened at the point of contact.

*Number of Sprouts on Stump.* As may be seen in Fig. 8, a great many sprouts may develop from one stump. It will be found that in a few years a few of these will outgrow the others. Not more than three of these sprouts should be left for a final crop. After the first year a large proportion of the poorer sprouts could be cut out, care being taken not to injure the others. In another year or two the rest of the poorer sprouts should be taken out, leaving two or three of the strongest. Those to remain should be chosen with regard to their location on the stump, having thought as to what their future development will be.

*Frequency of Application.* As was pointed out, coppice loses its vigor of reproducing after a few cuttings. When two or three generations of trees of coppice origin have been taken off it is advisable to endeavor to obtain new growth of seeding origin. Nuts may be sown in where favorable spots can be found, or planting may be resorted to if desired. In any case the area should be gradually restocked with trees of seedling origin.

## FOREST TREE PLANTING.

### INTRODUCTION.

The planting of forest trees for wood crop production and for soil protection has been carried on for many years in older countries, as Switzerland, France and Germany. The price of lumber and fuel and the necessity of providing for the future have caused many in Ontario to think of the question of reforesting denuded lands.

Tree planting naturally brings our thoughts to roadside, park or orchard planting, which are familiar to the native of Ontario. With the labor and cost of such planting we are liable to think of the task of reforesting as beyond our powers.

In the older portions of Ontario, where dangers from fire are very small, forest tree planting is possible and practicable. The planting of absolute agricultural soil is not advised, but there is in many agricultural sections of the Province considerable waste land in the form of steep hillsides, sandy or rocky soils, which could, with profit, be covered with trees. The following pages will deal with tree planting in relation to the farm and small land owner.

### CHOICE OF SPECIES.

In forest planting we are limited to certain species of trees owing to various factors. Some of these factors are: (1) hardness and rate of growth, (2) nature of soil to be planted, (3) kind of wood crop desired, (4) availability and cost of planting material.

In choosing species to plant, the original growth of forest in Ontario gives us some knowledge as to the possibilities of our native trees for reforestation. In following pages a description of the original distribution may be found which might be referred to in this connection. Of the evergreens some of the more important species in relation to replanting are: White Pine, Red Pine, White Cedar or Arbor Vitae and White Spruce.



Fig. 9—Twenty-five year old Larch plantation, covering the site of an old gravel pit.

Of the native species of hardwoods the following give promise of usefulness: Red Oak, White Elm, Rock Elm, White Ash, Black Locust, Black Walnut, Black Cherry, Sugar Maple, Manitoba Maple or Box Elder, Whitewood or Tulip.



A few foreign trees have proven their worth in this country in relation to hardiness and rate of growth. Of these the most important are: Norway Spruce, Scotch Pine, and European Larch.

From results shown in several plantations in Ontario, the European hardwoods will probably have a small place in future planting work in this country.

One of our best guides in replanting will be found in the original natural distribution of trees. Through many generations certain species have become adapted to certain areas having certain conditions. Such distribution may be spoken of as geographical, and local. Geographical distribution depends on climatic factors, as temperature, amount of rain-



Fig. 10—Black walnut plantation lacking soil protection.

fall and atmospheric moisture. Local distribution depends on local variations, as quality of soil, drainage, exposure, etc.

The following is the geographical distribution of native trees in Ontario, and the foreign trees are placed where present experience shows them to belong. This classification is arbitrary in regard to the dividing lines, that is, scattered trees may extend beyond the boundaries given. Species are classed with regard to their northerly limit and those found in the northern area may of course be common in the southern area. In each of these divisions the species find their northern limit.

From the "height of land" to the north, may be found: White Spruce, Black Spruce, Tamarack, Balsam Fir, Paper Birch, Black Ash, Jack Pine, Aspen, Balm of Gilead, and Arborvitæ.

From the "height of land" south to a line running from Goderich to the north shore of Lake Ontario: White Pine, Red Pine, White Elm, Yellow Birch, Sugar Maple, Hemlock, Basswood, Beech, White Ash, White Oak, Ironwood, Red Cedar, Butternut, B'tternut, Red Oak, Black Cherry, Rock Elm, Swamp White Oak, Black Willow, Red Maple, Box Elder, Silver Maple (Nordmann's Fir, Larch, Scotch Pine, Mugho Pine, Norway Spruce).

From the Goderich and Lake Ontario line to the south: Black Walnut, Shagbark Hickory, Chestnut, Pin Oak, Chestnut Oak, Chinquapin Oak, Sycamore, Tulip-tree, Black Gum, Papaw, Serviceberry, Hackberry, Flowering Dogwood, Blue Dogwood, Coffeetree, Sassafras, Black Locust.

#### (1) *Hardiness and Rate of Growth.*

A species might be hardy and still its rate of growth and development be so slow as to preclude its use in practical planting. To illustrate this the Black Walnut is found throughout an area extending from the southern part of Ontario to the Gulf States and from the New England States to Kansas and Nebraska. Within this area the Black Walnut probably has its fastest rate of growth and development in the central region, as Indiana and Tennessee. In southern Ontario its growth and development is such that its use in replanting should be very limited. The fancy prices paid for Black Walnut have been for trees from 200 to 400 years old. The White Pine is distributed over an area extending from Manitoba to Newfoundland and from the height of land in northern Ontario to Tennessee and Georgia. The region of its best development is in the Lake States and Provinces. There is probably no better species for planting work in Ontario. Ontario is near the centre of its range and in this Province it may be found thriving in all classes of soil from wet heavy locations to light sandy ridges.

Of our two common Oaks, the White and Red, it might be thought that the White would be the better to use in planting work, as it demands a better price in the market. However, it is probable that Red Oak will give the best returns for the following reasons: White Oak is a comparatively slow growing tree in Ontario, whereas Red Oak makes a good growth even in waste types of soil. In replanting we must consider species which will give best returns on waste land and not put too much faith on those which have brought fancy prices in the past. Frequently these high priced species grew on soil which to-day cannot be used for forest crops.

#### (2) *Nature of the Soil.*

The nature of the soil must influence the choice of species. No arbitrary division can be made, as the choice can only be decided with relation to local characteristics of the situation to be planted. However,

some general divisions can be made which will aid the prospective planter. In nature we find White Elm and Arborvitæ growing in dry situations on high land, but these same species have a better development in low moist soils. Some light, shifting, sandy soils produced magnificent trees, but when cleared left the soil unprotected. Such soils may at first require species adapted to poorer sites, but after protection has been obtained more valuable species making higher demands on the soil may be used.



Fig. 11—Beech tree, with 60 feet of clean stem, growing on non-agricultural soil.

The soils of denuded lands are very deceptive in relation to tree growth, as may be shown by the following: In Durham County there are sandy ridges which in some localities are blowing and shifting badly. The sandy soil in these places would seem too dry for any kind of growth. However, upon going down about six inches we find plenty of moisture throughout the summer, and this dry looking soil is well suited for tree growth.

The following general classification may be made as a suggestion based so far as native species are concerned on original and present distribution in Ontario. It must be noted in this classification that species are placed from the standpoint of endurance; that is, certain species will endure extremes of dry and wet, but would of course grow in the medium condition of fresh soil. In forest planting it is necessary to find species which will endure the extremes.

Classification made in relation to moisture content of soil:—

*Very Wet Soil:* Arborvitæ, Tamarac, Black Ash.

*Wet Soil:* Norway Spruce, White Spruce, White Pine, White Elm, Bur Oak, Red and White Maple, Tulip.

*Fresh Soil:* White Oak, White Ash, Rock Elm, Black Cherry, Sugar Maple, Black Walnut, Chestnut.

*Dry Soil:* Red Pine, Scotch Pine, European Larch, Red Oak, Chestnut, Black Locust.

*Very Dry Soil:* Scotch Pine, Red Pine.

Classification made in relation to tenacity by which we say a soil is stiff or loose, heavy clay soil and light shifting sand being the two extremes:—

*Heavy Clay Soil:* Norway Spruce, Arborvitæ, White Pine, White Elm, Rock Elm, Red and White Maple, Black Cherry, Black Locust.

*Loose Sandy or Gravelly Soil:* Red Pine, Scotch Pine, European Larch, White Pine, Chestnut, Red Oak, Black Locust.

*Very Dry Shifting Soil:* Scotch Pine, Black Locust.

### (3) *Kind of Wood Crop Desired.*

The choice of species may be influenced by the local markets. In a fruit district the demand for posts and stakes may be so important that it would be well to plant species which would furnish this demand. Fencing material is always in demand in an agricultural country like Ontario, so that Black Locust, Arborvitæ, Red Oak, and Chestnut should always be safe investments in planting.

### (4) *Availability of Planting Material.*

The prospective planter will be limited in his choice of species, by the availability and cost of planting material. Our native Red Pine is probably suited to sites similar to Scotch Pine, and it might even prove a better tree for replanting work. However, the price of Red Pine seed and the cost of nursery plants, place Red Pine out of our consideration at present. Scotch Pine seed is quoted by a German dealer at 85c. per pound, while an American dealer quotes Red Pine seed at seven dollars per pound, and is unable to fill orders.

The following comparison of prices of planting stock may be of interest in this connection. These prices are for season of 1906-07, and are quotations per thousand at point of shipment, for plants fit for final planting. Better quotations may be had for 10,000 or 100,000 lots.

Species.	Age or size.	North America	Europe.
Scotch Pine.....	6 in. to 10 in.	\$ 6.00	\$1.20
Norway Spruce.....	10 " " 12 "	15.00	2.00
Larch.....	10 " " 12 "	20.00	2.90
White Pine.....	6 " " 10 "	16.00	3.00
Red Pine.....	No quotations.	.....	.....

### SIZE AND QUALITY OF PLANT.

We have come to think of the operation of planting trees as very laborious and expensive. The average person in this country thinks that the operation consists in digging a large hole and placing in it a tree or sapling of from six feet to twelve feet in height. On the other hand, the forester uses a small plant from 6 inches to 18 inches high for the following reasons: The smaller plant does not cost as much as the larger. It is less expensive to place in position. Its chances of becoming established are better than in the case of the larger plant. In moving and planting the small seedling or transplant the root system of the plant does not become as greatly injured as is the case with the larger plant.

## NURSERY GROWN VS. NATIVE PLANTING STOCK.

Nursery grown planting stock will in most cases be more advisable than that taken from the native woods. A seedling taken from the woods has had the protection of surrounding trees; it has a loose, ranging root system which must necessarily be considerably injured in lifting to transplant. In most cases it will cost more to collect plants growing scattered throughout the woods than it will to buy them from nurserymen.



Fig. 12—(a) Nursery grown White Pine, showing the effects of transplanting.  
(b) Seedling from the woods, showing loose, ranging root system

The nursery grown plant is specially treated to stand the handling necessary in making plantations. It is grown in the open without protection, and by transplanting has been made to develop a compact root system. The more compact the root system, the easier it is to place it in final position in the ground and properly cover the roots.

## TIME OF PLANTING.

The transplanting or moving of a plant is an operation which seriously affects the constitution of the plant. It should be done at a time when it will least affect the growth of the plant. If the transplanting can be carried out without disturbing the soil about the roots of the plant and without subjecting the plant in its new surroundings to new

conditions, the operation might be performed almost any month of the year. As this is impossible in forestry where the operations are usually on a large scale, we must do the work during a season when the plant is in a resting stage. For the climate and conditions of Ontario the early spring seems to be the most suitable. The planting of evergreens is being successfully carried on between the middle of August and the middle of September.

... HANDLING OF PLANTING MATERIAL.

In cases where the prospective planter receives his planting material from a distance by freight or express it should not be left lying at the office or sheds any longer than possible. No matter how well the material may have been packed there is danger of overheating, moulding, or excessive drying taking place in the express office or shed owing to lack

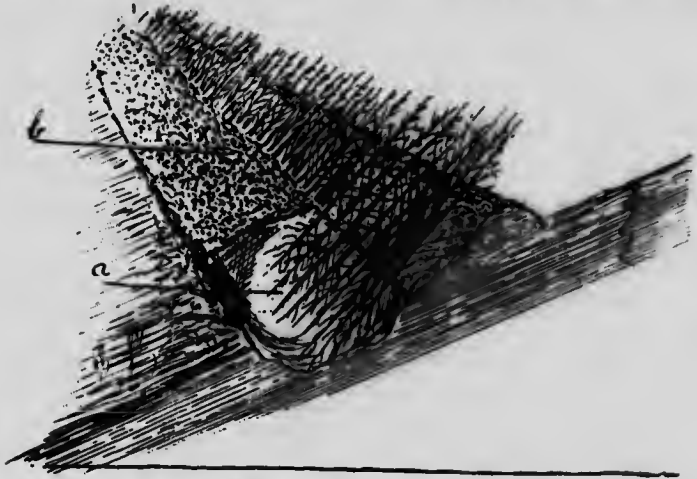


Fig. 13—Heeling in plants. Roots of the plants are placed in trench (a) and then firmly covered with soil (b).

of air. The treatment upon taking the stock from the express office depends upon local conditions. Where possible, it is best to unpack the plants in the shade. They should never be subjected to the direct rays of the sun. Where the planting cannot be done at once it will be advisable to unpack the plants and heel them in, in some place protected from the sun. Heeling in is simply covering the roots of the plants with soil as in Fig. 13.

The plants are usually shipped in bundles of from 25 to 50 or 100, and if bundles have been packed tightly it may be advisable to break them open and loosen them up before heeling in. Where possible, the trees should be heeled in near or on the place of planting, and if there is a stream of water near the planting ground it would be well to heel in close by this.

When the work is to be done at once, the quantity of planting stock small and the plants have not been lying in transit very long, it may not be necessary to heel in.

#### DENSITY OF PLANTING.

In making plantations, it is necessary to plant closely enough so that the ground may be well shaded to prevent the growth of grass and weeds. Close planting also protects the ground and forms the needed humus in a shorter time. The closeness of planting depends also on the species and the desired wood crop. If trees with clean, tall stems are desired, it will be necessary to plant closely enough so that natural pruning will take place; that is, as was pointed out in previous pages, the lower side branches will die from shading and the height growth of the



Fig. 11—Bil effects of wide planting, showing the development of large limbs close to the ground.

tree will be rapid during the early years of its life. Some species, as Oak and Walnut, do not form a perfect ground cover, and mixtures must be made to obtain this condition. Much difference of opinion exists as to the proper spacing of plants in planting work. The number of plants and the spacing need not be fixed, but may vary with local conditions. For most species with which we are interested in Ontario the spacing should not be over six feet.

Number of plants required to plant an acre of land in squares:—

3	ft.	0	in.	between the rows	.....	4,840	plants.
3	"	6	"	"	.....	3,556	"
4	"	0	"	"	.....	2,722	"
4	"	6	"	"	.....	2,151	"
5	"	0	"	"	.....	1,742	"
5	"	6	"	"	.....	1,440	"
6	"	0	"	"	.....	1,210	"

The area may be planted in regular lines if roughness of the site does not prevent it, but if land is broken by stumps, rocks, etc., it may be necessary to distribute the plants wherever possible. The more regular the planting is done the easier it will be to find and protect the plant against being overtopped by weeds, etc. Also dead plants may be easily located and replaced. It will be easier to properly distribute the planting material over the area where regular lines are followed. The following

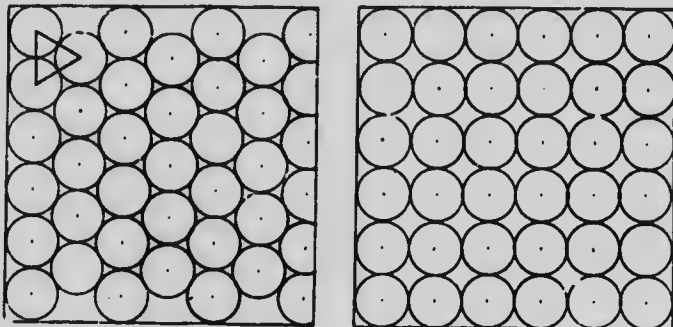


Fig. 15—Two methods of spacing plants—alternate and opposite.

diagrams illustrate two methods of regular distribution over an area. Alternate distribution gives the plants more growing space than where they are placed in squares.

#### METHOD OF PLANTING.

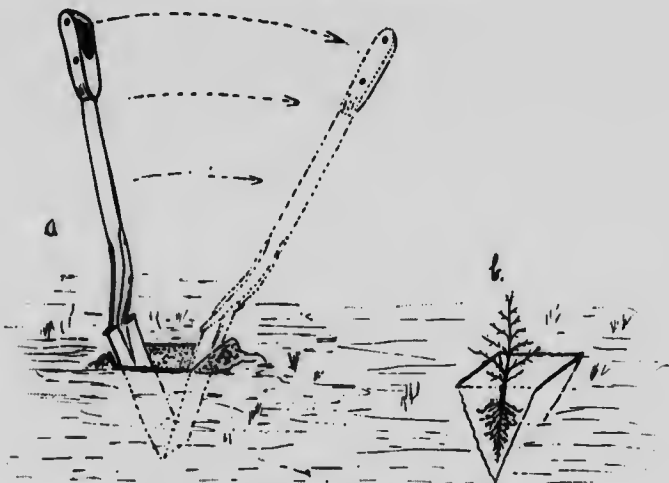


Fig. 16—Method of planting in loose soil.

Different classes of soils present varied problems in planting work. Cultivated soil which is usually good agricultural land; light gravelly



or sandy soils which cannot be cultivated for fear of blowing, washing out, etc., and rough rocky or steep land which it would be impossible to cultivate, need certain differing treatment.

The ease and speed with which planting may be done depends upon the looseness of the soil. Where soil has been cultivated the operation is a simple one and can be done with a common spade. The planting hole can be made by driving in the spade and moving it backward and forward, giving an opening as seen in Fig. 16a. If the soil is very sandy and loose, the plant may need to be placed in position before the spade is removed to prevent the filling up of the planting hole. In some cases the soil may be worked about the roots with a planting peg, as

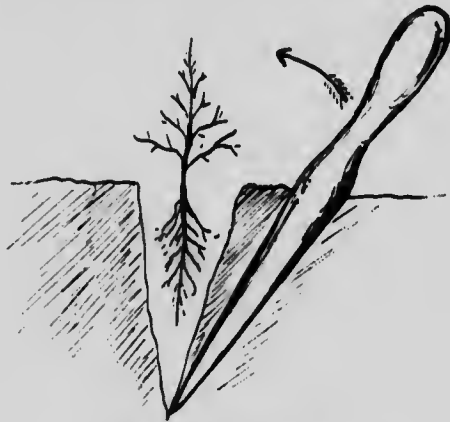


FIG. 17—Planting peg.

Fig. 17, which can be made in a few minutes. Frequently the planter discards the above tools and prefers to place the soil about the roots with his hands, which method is probably as satisfactory as any. After the roots have been covered it is very necessary to firm the soil, which may best be done with the foot. The roots should always be firmly covered.

The plants should be transferred from the spot where they are "heeled in" or packed to the planting hole by carrying in a pail. This pail should contain muddy water the consistency of a batter and the plants should have their roots submerged in this batter. Plants should be immediately transferred from pail to planting hole and covered at once. The roots of the plants should not be allowed to have the direct rays of the sun for a moment. In no case should the plants be dropped in advance of the planter. Openings or holes should not be made far ahead of the planter, as it gives the soil an opportunity to dry out.

A man and boy can do this work very well together, and two working together will obtain the best results. One preparing the planting holes, the other placing the plant and covering it.

In light sandy soils which have a thin turf or covering of grass and weeds, it is advisable to strike out *very shallow* furrows with the plow

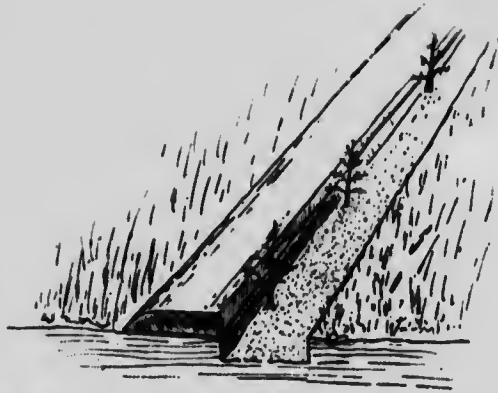


FIG. 18—Light planting furrow with plants placed on the protected side.

as in Fig. 18. These furrows should be shallow, so that the plant will not lose the advantage of any humus which may be in the surface soil. The furrows will act as planting lines and will also aid in future inspection. The overturned sod will give the plant protection from grass and weeds if the plants are placed near the side, as in Fig. 18. The soil in this furrow will also have a better moisture content than surrounding surface soil. In many cases the plant is better protected from winds.

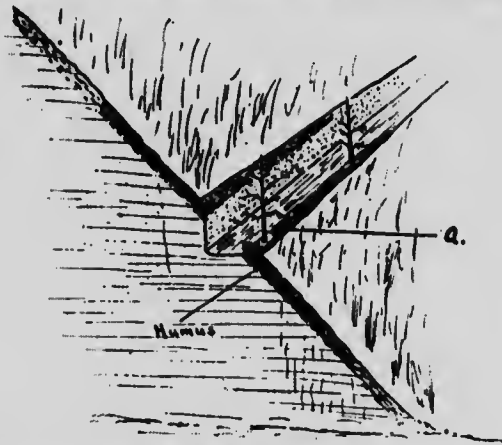


FIG. 19—Furrow on hillside showing plant placed in humus soil at (a).

The plow can also be used in hillside planting where it is possible to put horses. By running furrows for planting lines along the side of the hill a ledge is left, as in Fig. 19, which will aid in the operation. In planting on this ledge the plant should be placed near the outside, as in Fig. 19a, so that it will have the surface soil which contains most humus. This furrow has advantages similar to the case cited above. In cases

of running furrows of this nature on a hillside, the plowing should commence on the highest point, so that rolling turf will not interfere with operations. Never run a furrow with the slope or "up and down" the hill, as washing might occur.

If it is desired to plant in rough conditions where the running of furrows is impractical, other methods may be followed. Where there exists a dense turf in stony soils the mattock or grub hoe (Fig. 20) may be of great service. The sod can be cut off with the grub hoe or mattock and the soil loosened with a pick, or in case of using the mattock by using the pick like part of the mattock. In very rough planting one man can handle the mattock and prepare the planting spot, another prepare the planting hole with the spade, and a third do the planting.

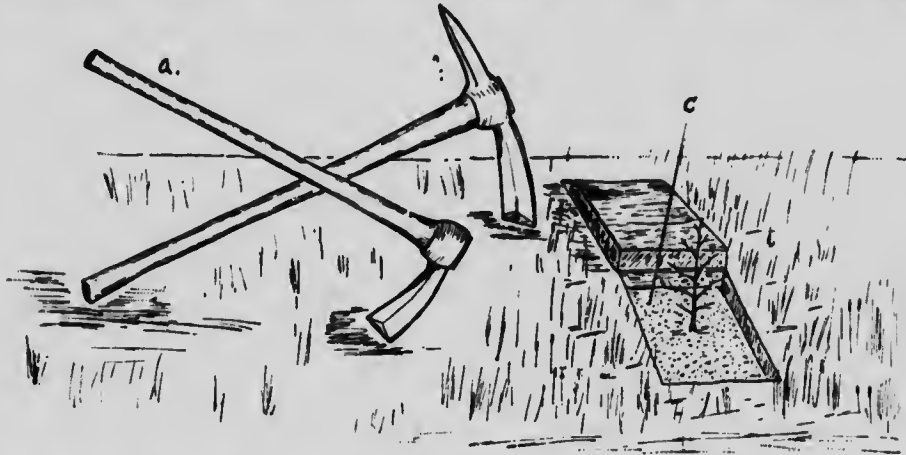


FIG. 20—*a.* Grub hoe. *b.* Planting mattock. *c c.* Sod cut away for planting hole.

However, no definite rules can be laid down, and the arrangement must be settled for the individual case. In some lands it might take two men with mattocks to prepare ground for one planter. In all rough planting of this nature it is advisable to follow as definite lines as possible so that future inspection may be possible as well as insuring a proper stocking of the area.

Good soil will usually send up a dense growth of weeds that would in many cases choke out young plants. Such soil where possible should be fallowed before planting and cultivation carried on for at least two years after planting, which would give the young trees a splendid start.

In some cases soil which produces rank weed growth will be located so that it will be impossible to cultivate. In such locations it will be necessary to go through the plantation, once or twice during the summer, with a scythe and free any plants which are being overtopped by weeds. Only the most reliable workmen can be depended upon to do this, as careless workmen will invariably cut off or cut back young plants.

In planting on this kind of soil, it is important to plant in somewhat regular lines so that the plants may be located easily. It is also necessary to use strong, well developed transplants. After first or second season the plants will get above the danger line of weeds.



FIG. 21—Drifting sand land in Norfolk County to be reforested.

In many waste types of land, such as Fig. 21, the grass and weeds are so sparse that they do not endanger the young plant. Frequently in such cases the growth of weeds or grass make a good protection, especially in the winter.

In some of the sandy soils of Ontario it is necessary to protect the plants in the most exposed situations from the drifting sand. The danger may be that the plants will be covered with drifting sand or that the sand may blow away and leave the roots exposed. This may frequently be averted by scattering brush or other debris between the planting rows in the threatened areas.

The best results on the above areas will be obtained by planting evergreens so that protection may be had both summer and winter. For the most exposed locations, Scotch Pine will be the most advisable tree to plant. The more protected spots in a planting area might be filled with White Pine, Red Oak, Black Locust.

## PLANTING OF NUTS.

Species which have seeds and seedlings subject to many dangers if sown in rough, wild places should be reproduced by using the nursery plant.

Many of the nut tree species, however, can best be propagated by planting the nuts in final position rather than by using nursery stock. Nut tree seedlings are generally quite hardy after germination, making it quite safe to plant them in rough places.

The common nut trees growing in Ontario are White Oak, Bur Oak, Red Oak, Black Oak, Beech, Chestnut, Bitternut Hickory, Shagbark Hickory, Butternut, and Black Walnut. Of the above species, Red Oak and Chestnut give promise of being the most useful and practical in waste lands, especially where the soil is light and sandy. Red Oak, White Oak, Chestnut, Shagbark Hickory, and Black Walnut are found naturally in loamy soils. Bur Oak and Bitternut Hickory are found in the heavier classes of soils.

The collecting of nut seeds need not be described, as everyone has had some experience. Care should be had not to gather such nuts as Black Walnuts too green. The safest time to collect is after the nuts have naturally fallen to the ground.

White Oak acorns in the southern part of the Province frequently germinate in the autumn shortly after falling. Acorns which have started to germinate will need careful treatment in handling. If the acorns are collected upon falling to the ground and placed in a cool, dry place, there will be little




FIG. 22 — Showing root development of one year old white pine and red oak.

danger of autumn germination.

Nuts may be planted in the autumn or stored and planted in the spring. Autumn planting has some drawbacks. The edible nuts are frequently found by squirrels or other rodents before they have germinated. In wet soils and cold, damp seasons the nuts may lose their germinating power from decay.

The care and storage of nuts needs some attention. The nut may have the husk taken off, although there is less danger of drying out if it is not removed. Drying out is the greatest danger to be feared after nuts have been collected. In no case should they be placed in artificially

heated rooms. After collection the nuts should be spread out in some dry, cool place for a few days until they are well matured. Care should be taken both in storing and maturing not to leave nuts piled so deep that they mildew. While maturing they should be turned over occasionally.

Seed may be stored by putting them on a well drained spot and covering them with leaves or hay over which may be placed a light covering of brush. Storing in a pit, as shown in Fig. 23, is a safe method. Layers of nuts (a) six to ten inches deep covered with leaves or small twigs (b) and topped off with soil (c) three to four inches in depth, provides good storage. A light covering of brush or hay over the pit will prevent

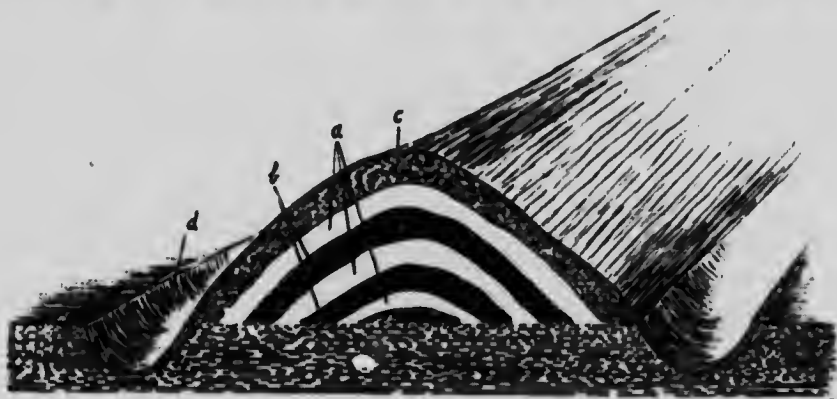


FIG. 23—Cross section of pit for storing nuts.

washing of the top dressing of soil. A ditch at the side, as in Fig. 23, (d), will give drainage. The bottom of the ditch should be well below the general level.

Nuts can also be safely stored by stratifying them in sand. Stratifying seed is done by making a layer of sand and then a layer of seed mixed with sand. This may be done in a well drained trench or in a box. In the case of storing in a box the box should be covered lightly with soil. If left standing unprotected it will dry out and injure the seed.

The preparation of the planting area will be similar to that described in previous pages. Where planting is to be done in sod it will be necessary to cut away a square of sod, as in Fig. 20. Planting the nut is very simple and may be done with a sharp-pointed stick or dibble. With this instrument a hole is made in the planting spot and the nut dropped in. In loose soils the nut can be sufficiently covered by a stamp of the heel. When the soil is heavy it may be necessary to cover the nut by prodding with the dibble. The nut should be planted deeper in loose than in heavy soils. The depth should be from two to three inches, depending upon the looseness of the soil.

Red Oak and Black Walnut should not be planted alone to form a plantation. These species do not form crown cover or canopy enough to protect the soil and obtain the desirable forest soil condition. Mixtures of Red Oak and White Pine will probably give good results, although our lack of experience with native species makes it difficult to advise mixtures. In many waste lands there are spots in which the soil is better than that of the general area. In waste sand lands there are frequently low areas where the moisture content of the soil is better than the average. In planting such lands where the White Pine is being used to stock the area, these spots could be filled with Red Oak.

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#### PLANTING IN SWAMP OR MARSHY LAND.

Frequently there exists on the farm a portion of low or swamp land which has been cleared of trees but which cannot be drained satisfactorily for cultivation.

Swamp land planting presents certain difficulties which make it advisable to give definite instruction as to treatment. When continual overflowing exists during spring or rainy seasons, little can be done in the way of practical planting. Before spending time or money in swamp planting the possibilities of future drainage should be considered. Many swamp soils, when drained, will become valuable agricultural lands. In exceptional cases, where tree growth is desired, mounds can be thrown up on which lowland species can be planted.

In most Ontario types of swampland there exists many spots which are higher and better drained than the main part of the swamp. On such spots, in the natural conditions in Ontario, we frequently find White Pine thriving well. The better class of such spots may be planted with White Pine, White Spruce, Arborvitæ, White Elm, Red Maple and Silver Maple. The poorer parts of the area may be stocked by using cuttings or slips of Poplar and Willow.

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#### PLANTING CLUMPS FOR PROTECTION TO STOCK.

On stock and dairy farms clumps of trees afford valuable protection during the heat of the day. It is a common sight to see animals retreat to the shelter of trees which may happen to stand in the field. In permanent pastures and even in fields occasionally used for pasturage small clumps of trees could be planted in corners on waste portions of the field if any existed. It would be necessary to fence in such planting and give it protection till the trees reached a size of three or four inches in diameter.

Deciduous trees, as Box Elder, White Elm, or Soft Maples, would be best suited for such work. Box Elder and White Elm grow fast, de-

velop plenty of shade, and stand the abuse to which they must be subjected by the animals.



FIG. 24—Stock protection clump of white elm and box elder, in the background.

#### PROTECTION BELTS.

Belts or rows of trees are frequently planted for protection to orchards, fields or buildings. There is no doubt about the advantage of such planting. Stock in protected barns will need less feed. Protected houses will need less fuel. Orchard or field crops benefit by having protection. The drying winds of summer do less harm where tree protection exists. Orchards heavy with fruit are often protected so that loss from wind-falls and broken branches is lessened. Protected fields of clover, fall wheat, etc., hold the snow longer in the spring, which gives protection from frosts and loss of moisture from evaporation.

Throughout the Province of Ontario the prevailing winds are westerly, which should be taken into consideration in planting shelter belts. That is, to protect buildings or fields it is wise to plant on west, south-west and north-west sides.

The most satisfactory protection is to be had by planting evergreens, as Norway Spruce or native White Spruce. These evergreens give protection both summer and winter by forming a dense growth down to the ground. Arborvitæ, Hemlock and White Pine are sometimes used in such planting, but the Spruces are the best.

Where one row of Spruce is to be planted, the trees should be spaced from six to ten feet apart. When two rows is desired the trees should be eight to ten feet apart in the row and the rows eight feet apart. The trees should be planted alternately as in Fig. 15 (page 28). Where trees are to be planted as a protection to buildings, it may be advisable to plant



a mixture of evergreens in clumps rather than a straight row of Spruce. This would require more space, but would have a better appearance. In such planting the trees should not be planted too near the building, as they may become a nuisance when full grown.

Planting material may be of two kinds. Small seedlings from ten to twelve inches in height, costing about eight dollars per thousand, or transplants which may be anywhere from ten inches to several feet in



FIG. 25—Protection belt sheltering peach orchard.

height, costing fifteen dollars and upwards per thousand. If the prospective planter does not feel like paying prices for large transplants it may be of advantage to buy the small seedling or transplant and keep it a year or so in the garden where it can be cultivated till ready for final planting. Ten to twelve inch plants can be put in the garden in rows twelve to eighteen inches apart and ten to twelve inches apart in the row. Planting can be done as described in previous pages.

#### PLANTING ALONG PERMANENT FENCES.

The question of securing fence posts at a reasonable rate and their short life after being placed in the ground is a problem confronting the agriculturist in Ontario. One solution of the problem may be found in

planting trees along permanent fences. In a short time it will be possible to attach the wires to these trees.

The trees can be planted every sixteen feet or even every eight feet as the owner desires. Strong, vigorous plants should be chosen for such work and in the case of using evergreens, transplants should be used as the fence lines are frequently filled with dense grass and weeds which

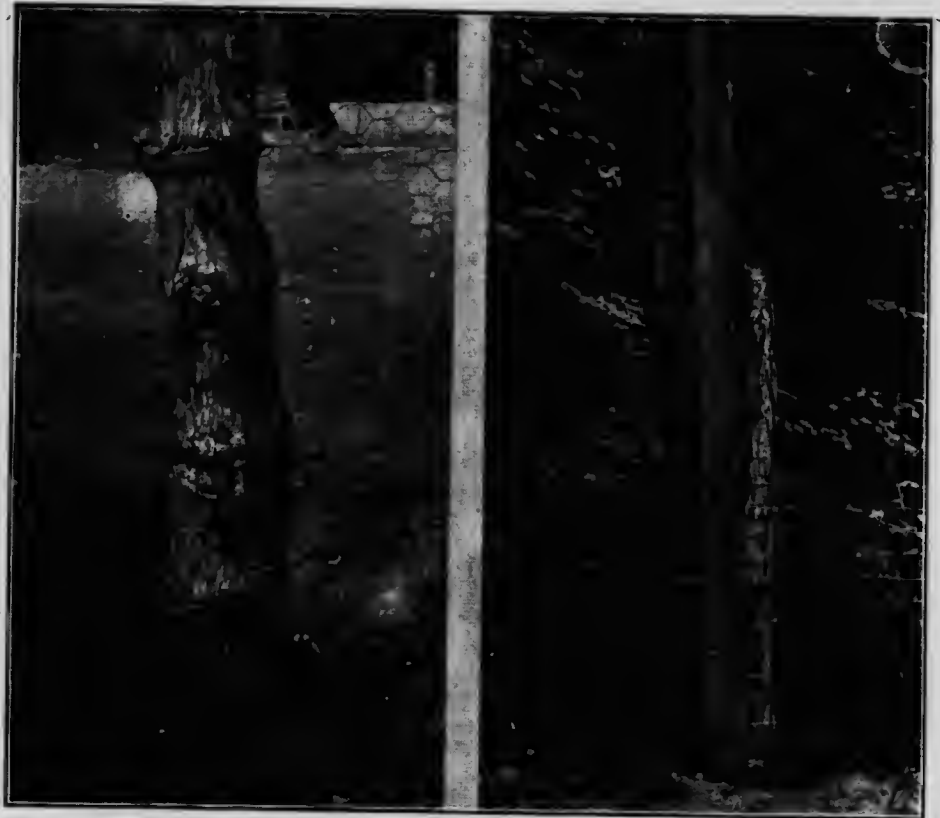


Fig. 26—Proper and improper method of attaching wire fence to trees.

will endanger the young plant. More attention can be given the making of planting holes and the actual planting than in the case of waste land planting. Where a rail fence now exists and there is no chance to cultivate, the planting hole should be made by cutting away a large sod about two feet square, as in Fig. 20. Occasionally it may be practical to cultivate a strip four to six feet wide along a fence which can be moved a few feet after the trees have grown. Preparation of this strip by summer fallowing will give results in future tree growth which will repay the effort. Whether planting is done in planting holes or on a prepared strip, future cultivation will give best results. This cultivation should be carried on for two years at least—longer will pay—until the trees have become well established. It will be an advantage to mulch the trees

with grass or old manure. The trees should be inspected during the summer to see that weeds, etc., do not overshadow them. In case the owner does not want large trees along cultivated fields, the first planting can be done every sixteen feet and a few years later trees can be planted between. When the first trees become too large they can be cut off the height of a common fence post and later the fence can be attached to the younger generation of trees as the older ones decay.

The choice of species for this work must be given some considera-



Fig. 27. Banks which could be protected by tree planting.

tion. The fastest growing species will be Box Elder, Hardy Catalpa and Black Locust. In the southern portions of the Province and in the best classes of soil, moist soils Hardy Catalpa may prove valuable for this purpose. Black Locust will grow on the poorest of locations and will be of more general value than Hardy Catalpa. Sugar Maple may be employed in this work, although the growth will be slower than the preceding species and it requires very good soil. Some may desire to plant nut producing trees so that a return may be had from nut crops. Black Walnut, Shagbark Hickory, and Chestnut would be the most valuable in this case. The Chestnut would grow on the lighter soils, while the Black Walnut should be planted in good, rich soil. If evergreens are desired, Norway Spruce, White Spruce, Larch and Arborvitæ will give best results. The Arborvitæ should be placed in moist soil, while Larch will stand dry, poor locations.

In placing wire on trees, care should be taken not to injure the tree more than necessary. Fig. 26 shows two methods common in Ontario. Where the strip of wood is used in which to place staples, the tree gradually forces the strip over the head of the nail and in time it may be necessary to put in new nails. As a rule, large bolts or heavy spikes are used to fasten this strip to the tree. The use of such large fastenings is unnecessary and usually a much smaller nail will hold just as well. For an inch and a half strip two and a half inch nails are sufficiently large.

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