

5982c

FIRST BOOK OF FORESTRY

BY

PHILBERT ROTH

CHIEF OF THE DIVISION OF FORESTRY, UNITED STATES DEPARTMENT OF THE
INTERIOR, IN CHARGE OF THE WORK IN THE GOVERNMENT FOREST
RESERVES, AND FORMERLY ASSISTANT PROFESSOR OF
FORESTRY IN CORNELL UNIVERSITY

1902

GINN & COMPANY

BOSTON · NEW YORK · CHICAGO · LONDON

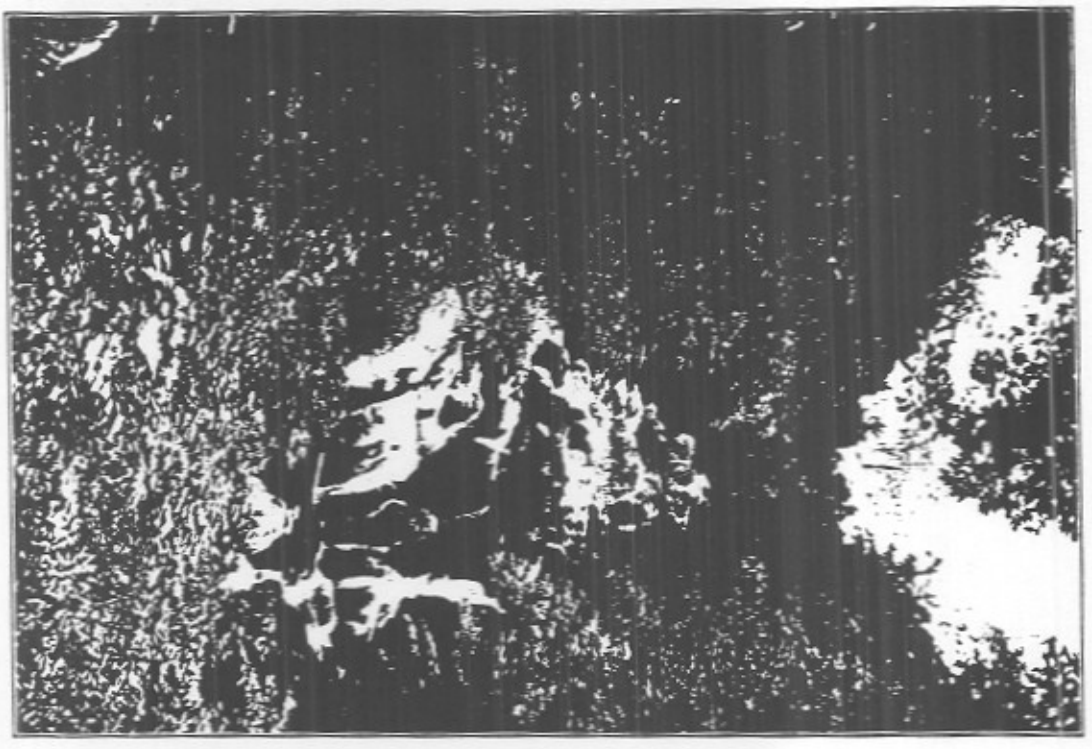


FIG. 1. In the Woods

REM-1

ENTERED AT STATIONERS' HALL

COPYRIGHT, 1902

BY FILIBERT ROTH

ALL RIGHTS RESERVED

3115

The Athenaeum Press
GINN & COMPANY, PROPRIETORS - BOSTON - U.S.A.

PREFACE

DURING the last twenty years the general interest in forestry has grown with remarkable rapidity in all parts of our country. The federal government has set aside large forest reserves, and several states have established reservations or parks. The private owners of large tracts of forest lands are employing trained foresters to care for their property, and an improvement in the smaller holdings is everywhere noticeable.

Forestry is taught in two special schools in America, and elementary courses on the subject are given in several colleges and preparatory schools. A desire has been expressed to introduce this useful and interesting study into our public schools and country homes, and this volume is an attempt to provide a book on the subject which shall satisfy this demand. In keeping with this purpose there has been no attempt to write a text-book or manual of forestry; but an effort has been made to present in simple, non-technical language some of the general principles underlying the science, and to state the methods which are employed and the objects to be attained in the practice of forestry.

Early association with the well-kept forests of Germany, observations made in the widely differing forest districts of our own country, and three years' experience in teaching forestry have helped to make the responsible task of preparing this book a pleasure. While, as a matter of course, the many excellent German works on forestry have served as a basis and a guide

in writing the book, yet an effort has been made to use our own woods for illustrations and to adapt the subject-matter to American conditions.

The collecting of the illustrations has been greatly facilitated by the kindness of Dr. L. N. Britton, Col. Wm. F. Fox, Prof. J. A. Holmes, Messrs. Newell and Gannett of the United States Geological Survey, Dr. J. T. Rothrock, Prof. I. Gifford, and Mr. Gifford Pinchot, Chief of the Bureau of Forestry of the United States Department of Agriculture. To these gentlemen I extend my sincere thanks.

Especial thanks are due to Mrs. Anna B. Comstock of the Bureau of Nature Study of Cornell University, whose kind interest and request called this book into existence. Her good judgment has proved of great value in the arrangement of the subject-matter, and her assistance in seeing the book through the press has made its early publication possible.

FILIBERT ROTH.

CONTENTS

PART I—THE FOREST

	PAGE
THE WILDWOODS	1
WHAT LIGHT AND SHADE DO FOR THE WOODS	14
WHAT DIFFERENT SOILS DO FOR THE WOODS	18
WHAT MOISTURE DOES FOR THE WOODS	24
WHAT HEAT AND COLD DO FOR THE WOODS	32
WOODS AND THE MOUNTAINS	37

PART II—FORESTRY

RAISING OR KEEPING UP THE FOREST	41
COPPICE WOODS	45
THE ORDINARY TIMBER FOREST	53
STARTING THE YOUNG GROWTH UNDER SEED TREES	61
STARTING THE YOUNG GROWTH BY SEEDING FROM THE SIDE	71
STARTING THE YOUNG GROWTH BY ARTIFICIAL PLANTING OR SOWING	76
REVIEW OF METHODS	95
CARE AND PROTECTION OF THE FOREST	97
THINNING AND CLEANING	98
PROTECTION AGAINST INJURY FROM THE ELEMENTS	104
PROTECTION AGAINST ANIMALS	115
PROTECTION AGAINST INJURIOUS PLANTS	131
USE OF THE FOREST	133
CUTTING TIMBER	135
ESTIMATING AND MEASURING TIMBER	164

	PAGE
RESIN AND TURPENTINE INDUSTRY	171
SEEDS AND MATT	177
PASTURAGE	178
GAME AND FISH	180
THE BUSINESS OF THE FOREST	182
SPECIAL KINDS OF FOREST	181
The Wood Lot	181
WATER LANDS	193
FOREST PLANTATIONS ON PRAIRIES	195
SAND DUNES	198

PART III—RELATED TOPICS

THE FOREST AS A PROTECTIVE COVER	203
THE FORESTS OF OUR COUNTRY	209
SOME HISTORY	211
THE WOOD	217
SOME STRUCTURAL FEATURES	217
SOME PHYSICAL PROPERTIES	227
SOME CHEMICAL PROPERTIES	230
WOOD AS COMPARED WITH IRON	232
HOW TO DISTINGUISH OUR COMMON TREES	238
CONIFERS	240
BROAD-LEAVED TREES	246
HOW TO USE THE KEY	256
APPENDIX	
I. THE DOYLE-SPRINGER LOG SCALE	259
II. TABLE OF CIRCLES	260
III. LIST OF WOODS AND TREES	261

LIST OF ILLUSTRATIONS

FIG.	PAGE
1. In the Woods	<i>Frontispiece</i>
2. Beech Woods	3
3. The "Long-Boiled" Oak of the Forest	5
4. The "Short-Boiled" Tree of the Open	7
5. Badly Healed Knot	8
6. The "Blaze" as it appeared when first made	10
7. The "Blaze" partly healed over, as it appeared seven years ago	11
8. The "Blaze" just covered, as it looks now	12
9. Nature's Methods are Wasteful	13
10. Even Spruce is made to "clean" itself	15
11. "Leanders" on White Pine and Balsam	19
12. Longleaf Pine	21
13. Too Dry for Forest	25
14. Too Much Water kills	27
15. Used to Water	29
16. Cypress Swamp	31
17. Palmetto	33
18. Coniferous Forests alone climb our High Mountain Ranges	39
19 a. Coppice Woods	42
19 b. Coppice Woods	43
20. Stump and Sprouts	47
21. The Wrong Way to cut the Stumps	49
22. The Right Way to cut the Stumps	49
23. A Little Light starts Young Growth	55
24. Young Growth of White Pine under Old Seed Trees	67
25. Natural Seeding from the Side	73
26. White-Pine Cone, Seed, and Seedling	77
27. Drill Board	81
28. Seed Beds	83
29. Seedlings	86
30. Planting in Old Burned-over Slash Land in Adirondacks	87

	PAGE
31. Planting Tools	89
32. Pine Grove from Planted Seed	91
33. An Oak Grove from Artificial Seeding	93
34. Which should come out?	99
35. Thinned, but will need it again	101
36. A "Burn"	103
37. Tangle after Fire	105
38. The Camp Fire as it should be	107
39. Trenching a Forest Fire	111
40. Fighting Fire in the Adirondacks	113
41. The Fires have cleaned up	114
42. A Fire "Slash" in the Adirondacks	117
43. The Imported Elm Leaf Beetle	119
44. Pine Weevil: Adult Beetle, Pupa, and Grub, or Larva	120
45. Scale Insect on White-Pine Leaves	121
46. Bark Beetles and their Work	122
47. A Destroyer of Forest and Shade Trees: the White-Marked Tussock Moth	123
48. Fall Webworm	125
49. One of the Greatest Enemies of the Forest	127
50. Cutting Spruce in the Adirondacks	135
51. The Tools we use	137
52. Skidding Spruce Logs in the Adirondacks	138
53. "Scalloping" or measuring and stamping or marking Spruce Logs	139
54. The "Landing" on Ampersand Creek, near "Driving Time"	141
55. Rolling in Spruce Logs on Ampersand Creek	143
56. Tangle on Bastard Cut	151
57. Rift or Quarter-sawed	151
58. End of Log, showing Rift and Bastard Cuts	153
59. "Bigtree" Logging in California	157
60. Cypress Logging in Florida	159
61. Diagram to show how a Forty-Acre Lot is covered in estimating Timber	167
62. Calipers for measuring the Diameter of Trees	171
63. Measuring the Height of a Tree	171
64. Scale Rules	173

	PAGE
65. In a Turpentine Orchard	175
66. Game	181
67. Tapping the Sugar Maple	181
68. Old-fashioned Way of boiling Maple Sap	185
69. Black Locust Plantation, Merce County, Kansas	187
70. The Yaggy Catalpa Plantation, in Reno County, Kansas	196
71. Sand Dune along the Coast	197
72. Sand Dune in Holland, after Reclamation	199
73. How the Forest regulates Erosion	200
74. How the Land erodes after the Woods are gone	205
75. General Forest Map of the United States	207
76. Cross Section of Oak (upper), King-Porous Wood; Hard Pine (lower), Non-Porous Wood	211
77. Diffuse Porous Woods	219
78. Non-Porous Woods	220
79. Wood of Spruce	220
80. Spiral Grain	221
81. Shortleaf Pine	222
82. Alternating Spiral Grain in Cypress	222
83. A Bird-eye Board	223
84. Wavy Grain in Beech	224
85. Section of Knot	225
86. Effects of Shrinkage	225
87. "Shelf" Fungus on the Stem of a Pine	229
88. Fungus Threads in Pine Wood	231
89. Conifers with Leaves in Bundles	231
90. Conifers with Leaves not in Bundles	241
91. The Crotch	242
92. Broad-Leaved Trees with Simple, Alternate, Tooth-Edged Leaves	243
93. Broad-Leaved Trees with Simple, Alternate, Tooth-Edged Leaves	245
94. Broad-Leaved Trees with Simple, Alternate, Tooth-Edged Leaves	247
95. Broad-Leaved Trees with Simple, Alternate, but Lobed Leaves	249
96. Leaves Simple, Alternate, but with Entire Edge, and Trees with Opposite Leaves	251
97. Compound Leaves, but Alternate	252
98. Compound Leaves, Opposite	253

the red fir disappears, and the forest is one of balsam and hemlock with cedar. As we reach a height of five thousand feet the complexion of the forest changes entirely; the dense forest of tall mountain balsam and hemlock suddenly gives way to open, more or less interrupted alpine park woods, composed of short, limby trees belonging to entirely different species, the alpine balsam and hemlock.

Thus, we see that our inference was correct: the high mountain woods of our country are generally conifers, composed of few species, and are usually more or less stunted at higher altitudes. Similarly these woods change from below upwards, decreasing in complexity of composition as well as in size and quality of the timber; and their vigor, or rate of growth and capacity to maintain and renew themselves, also decreases.

PART II

FORESTRY

RAISING OR KEEPING UP THE FOREST

WE have learned something of different woods, of their appearance and composition, and how they are modified by different climates, soils, and other conditions. We are now ready to see what man does with the forest.

When the pioneer settler in the backwoods clears his farm he is anxious to destroy the forest as fast as possible, for every acre of "clear land" is a big step toward independence. In many places, especially of late years, he has been able to sell at least the better kinds of logs; but in the most cases, now as formerly, the wood is wasted. The trees are cut into pieces small enough to handle and the neighbors are invited to a "log rolling"; they pile up the logs and branches into "log heaps," and when the weather is suitable these log heaps are set afire. Fire and plow prevent the return of the forest.

This is not forestry; it is proper forest destruction, such as goes on in the settlement of every forest-covered country. The forest gives way to the field.

When the lumbermen cut the spruce in many parts of our eastern states, or the white pine in the hardwoods of Michigan or Wisconsin, they disturb the forest so little that only the experienced eye notices the fact that the

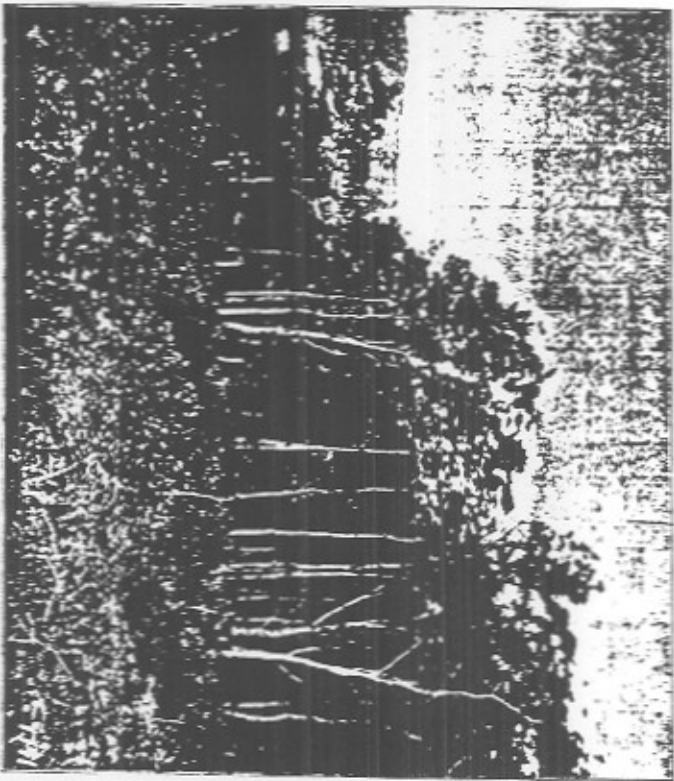


FIG. 19a. Coppice Woods
(After Graves)

land has been "logged over." On the sandier "pinery" lands, where the forest is nearly all pine, the case is quite different. Here the lumberman usually leaves a

"slash." Most of the forest is gone; a few young trees, some worthless cripples, and a small number of isolated stunted hardwoods still maintain the semblance of woods; while the ground is densely strewn with the tops of the

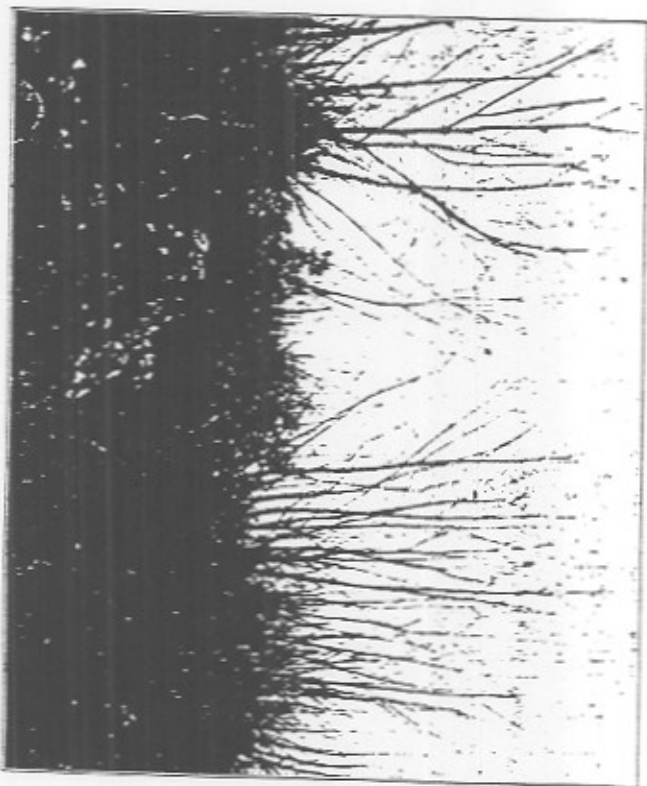


FIG. 19b. Coppice Woods
(After Graves)

fallen pine. In one or two seasons these tops are dry; they take fire from some cause or other, the slash burns over, and instead of the former forest there is now a waste, which may remain in this unproductive condition

for many years. Generally the lumberman does not concern himself in either case about the forest or slash he leaves behind; his business is to get out of the forest whatever he can utilize or sell; he treats it as a ripe field; he harvests,—but he does not sow. He does not intentionally destroy any forest; he merely harvests, but does not care for and protect it, and thus make an effort to keep up the forest and to grow a new crop of timber. For this reason, and to the extent that he fails in this, he is not a forester.

On the other hand, the farmer who has a piece of woodland, where, during the winter months he cuts his firewood and fencing and a few logs for the repair of buildings and implements, and during certain years, when prices are high, cuts some logs for the neighboring sawmill, but, at the same time, looks after the piece of woods, cleans it of dead timber and other rubbish, thus keeping out fire and insects, and otherwise makes an effort to keep the land covered with forest,—such a man practices *forestry*. His forest may be small or large, his ways of doing may be simple and imperfect, so that his woods do not contain as many trees as they should; the trees may not be the best kinds for the particular locality and soil; they may not be as thrifty as they should and could be; but nevertheless here is a man who does not merely destroy the woods, nor content himself with cutting down whatever he can sell, but one who cares for the woods as well as

uses them, one who sows as well as harvests. He is a forester, and his work in the woods is forestry. Since his forest is small, the work is simpler, and it will be a good opportunity to learn how he cares for the woods; for trees start and grow in just the same way, whether in small or large forests.

COPPICE WOODS

Here is a piece of wildwoods in one of the picturesque valleys of northern New Jersey. The soil is loam, very rocky, and with too many large rocks on top of the ground to encourage its use for plowland. The woods, mostly chestnut and oak, appear rather scrubby, and we miss the large stately trees of the virgin forest; there appear to be no old trees, and nearly all trees seem to be in clusters about old and much disfigured stumps. Evidently they started as sprouts—but here comes a native who can tell us more about this:

“Yes, this is an old settled district, and the old woods were cut down more than a century ago. Since then these woods were cut over several times. Formerly, when firewood was much in demand for iron furnaces, the woods were cut over about every twenty years, but of late we leave the trees to grow larger, so that they make good railroad ties and telegraph poles, besides firewood, and this requires that they be at least thirty-five or forty

for many years. Generally the lumberman does not concern himself in either case about the forest or slash he leaves behind; his business is to get out of the forest whatever he can utilize or sell; he treats it as a ripe field; he harvests, — but he does not sow. He does not intentionally destroy any forest; he merely harvests, but does not care for and protect it, and thus make an effort to keep up the forest and to grow a new crop of timber. For this reason, and to the extent that he fails in this, he is not a forester.

On the other hand, the farmer who has a piece of woodland, where, during the winter months he cuts his firewood and fencing and a few logs for the repair of buildings and implements, and during certain years, when prices are high, cuts some logs for the neighboring sawmill, but, at the same time, looks after the piece of woods, cleans it of dead timber and other rubbish, thus keeping out fire and insects, and otherwise makes an effort to keep the land covered with forest, — such a man practices *forestry*. His forest may be small or large, his ways of doing may be simple and imperfect, so that his woods do not contain as many trees as they should; the trees may not be the best kinds for the particular locality and soil; they may not be as thrifty as they should and could be; but nevertheless here is a man who does not merely destroy the woods, nor content himself with cutting down whatever he can sell, but one who cares for the woods as well as

uses them, one who sows as well as harvests. He is a forester, and his work in the woods is forestry. Since his forest is small, the work is simpler, and it will be a good opportunity to learn how he cares for the woods; for trees start and grow in just the same way, whether in small or large forests.

COPPICE WOODS

Here is a piece of wildwoods in one of the picturesque valleys of northern New Jersey. The soil is loam, very rocky, and with too many large rocks on top of the ground to encourage its use for plowland. The woods, mostly chestnut and oak, appear rather scrubby, and we miss the large stately trees of the virgin forest; there appear to be no old trees, and nearly all trees seem to be in clusters about old and much disfigured stumps. Evidently they started as sprouts — but here comes a native who can tell us more about this:

“Yes, this is an old settled district, and the old woods were cut down more than a century ago. Since then these woods were cut over several times. Formerly, when firewood was much in demand for iron furnaces, the woods were cut over about every twenty years, but of late we leave the trees to grow larger, so that they make good railroad ties and telegraph poles, besides firewood, and this requires that they be at least thirty-five or forty

shipment. Of old maple, birch, oak, and other hardwoods, only about thirty per cent of all the wood is in valuable logs, and seventy per cent is cheap firewood, while in good pine or spruce over seventy per cent is usually cut into valuable logs.

In managing large pieces of selection forest it is best to treat one part after another, and not to pick all over the tract. Thus, if a man has sixty acres of such forest, he would best cut over about five acres this year, five the next, and so on, and in this way get over the entire sixty acres every twelve years. This would give twelve years' rest to the five acres first cut, during which time there would be no cutting and dragging of logs and other material, and at the same time the cutting would recur often enough to keep the woods properly thinned and cleaned.

STARTING THE YOUNG GROWTH UNDER SEED TREES

In the selection forest old and young trees are mixed in such an irregular way that it is difficult to know how many trees there are a hundred years old, eighty years old, etc. This makes it difficult to regulate the business of the forest, to know how much is growing, to cut about the same amount of the same kinds and of similar sizes. Moreover, many a fine young tree thirty or forty years old is damaged by the felling of a large neighbor, and many good trees have to be taken out before their time because

they were injured in logging. For this reason many foresters have changed this method as follows:

Suppose a ten-acre stand of spruce or beech has reached the age at which the owner wishes to cut it (maturity, or age of rotation). Instead of cutting only a tree here and there, he thins out the entire stand, taking out about twenty per cent of the trees. After a few years more, when he expects a seed year (a matter which every forester watches closely) or when an abundance of seed has been produced during the summer, he cuts out more of the trees, leaving only about fifty to seventy per cent of the original stand, so that the crowns of these trees, which are so tolerant of a great amount of shade, would be separated by about two or three yards, thereby allowing considerable light to get to the ground. The marking out for this cutting (for every tree is marked by the forester) is done in the early fall when the foliage is still on the broad-leaved trees, and the cutting is done the following winter. In the spring the seedlings spring up and grow under the protection of the mother trees, which shield them from sun, wind, and frost. After three years, when the seedlings are well started and are in need of more light, about half of the old trees are cut out; and a few years later, when the young plants are about one or two feet high, the remaining seed trees are removed, and any spots which have no young plants are stocked with plants from a nursery. In this way the forest is harvested, and a new

growth started under seed trees in the period of about ten or fifteen years, which makes this new crop of trees covering our ten-acre lot near enough of an age to be treated alike and harvested together, producing a stand of uniform age. Some twenty or thirty years later the stand is thinned for the first time.

Where the forest consists of a mixture of oak, ash, elm, maple, etc., the method is about the same, only the seed trees are fewer, representing only about half or less of the original stand. Moreover, it is well in these mixed stands to give the young plants more light and remove the last of the seed trees earlier, since the young plants need more light and care less for protection.

In pine, only about twenty-five to thirty per cent of the trees need to be left for seed trees. Some men leave only about a dozen trees per acre. The seed trees should be removed when the young plants are two years old, since the young pine does not tolerate much shade.

All kinds of trees can be reproduced in this way, but the success varies considerably with different kinds and in different localities. In Europe, where this method has been tried a long time, it is commonly used for beech and balsam, less often for spruce, seldom for pine and oak.

In our own country, where land is cheap and labor dear, this method will give good results in all our large pineries, East and West, in the spruce forests of the eastern states and Canada, and in the majority of our hardwood forests.



FIG. 24. Young Growth of White Pine under Old Seed Trees

In our northern states, where the oak is more sensitive to shade, it will need to be given a little advantage in order to keep elm, maple, etc., from crowding it. Other sensitive trees, like hickory, chestnut, and walnut, need watching and should be planted before the other kinds get started.

The age at which the trees should be cut — the rotation — naturally varies for different places; it is longer for cold districts and slow-growing trees than for warm localities and rapid growers, and of course it depends also on the size of trees to be raised. In our temperate region and on better soils most of our hardwoods make good-sized timber in an eighty- or one-hundred-year rotation; on poorer lands — mountain districts such as the Adirondacks and Alleghenies — one hundred and fifty to two hundred years are needed. The white pine makes salable material at sixty years, good lumber at one hundred; the red fir, white cedar, and redwoods of the Pacific will do the same, while spruce and balsam for pulp purposes may be managed on a still shorter rotation.

In carrying out the method of starting the young growth under seed trees several things should be kept in mind. The pieces of forest which are taken in hand at any one time should not be too large. Thus, if a man had a forest of a thousand acres, worked on a hundred-year rotation, and wished to have it in such order that a fifth of all his woods were between eighty and a hundred years old, a fifth between sixty and eighty years, etc., then he might

take two hundred acres in one piece and thin for seed trees, get a new crop started, and harvest everything on the two hundred acres; then take up the next two hundred acres; and in five twenty-year periods he would have harvested and renewed the woods on the entire thousand acres. But this would not be good; most likely his large open stand of seed trees would invite the winds; the old trees would blow down, and the young trees suffer from drought. For this reason it would be much better to pick out five forty-acre or ten twenty-acre pieces, and treat each by itself. To pick these cuttings, or, as they have been called, "felling areas," is not always a simple thing and requires good judgment as well as a knowledge of the woods and the lay of the land.

Generally it is better in our country to work from east to west, to prevent the regular west and northwest winds from throwing the trees; but in a hilly country this must be modified. In picking out the cuttings it is but natural that pieces where considerable young growth exists come first; and also that a really thrifty stand of timber is left and a less thrifty one taken instead, since the latter is not growing as much timber as it should, and, therefore, is not earning so much rent.

On all points where the wind is likely to do much damage, and also in the border of the woods, it is better to use the simple selection method by which the woods are left more intact, and are, therefore, more resistant.

Wherever it is possible, as in all small woods in settled districts, care should be taken not to leave fall places or empty spots, and if the young growth has not started well or evenly, planting from a nursery should help out.

Where this method is to be introduced in our own wild-woods of mixed stands the work must be suited to the case. If, for instance, we have a sixty-acre piece of woods, there would most likely be some parts stocked with old trees, some other parts where old and young are mixed, and some pieces where the ground is covered largely with young trees.

In this case it would be best to begin on the pieces of old timber. But since the crowns of our old trees are so very large, the directions about having the crowns three to five yards apart for seed trees could not easily be followed. The cutting of a large oak would often separate the neighbors by twelve yards or more. For this reason the large trees would be picked over, so that a selection system would be applied at the start. But instead of coming back at long intervals, the selection here would be repeated as often as the gaps are restocked with young growth. In this way one piece after another is renewed. If it were desirable to have the woods in a regular shape, and have it renewed in five twenty-year periods, of course one fifth, or twelve acres, would have to be cut over and renewed during twenty years. At first this would not be very strictly adhered to, and if the regular cutting does

not furnish enough timber, or if any of the other parts of this piece of woods are in need of thinning or clearing, the cutting would be extended to these parts.

In large woods the forester would need a map wherein he could readily see just what condition every acre is in, so that he might study and plan the work at his house. In carrying out the plans the cuttings would be marked out in the woods as well as on the map.

To make this map requires not only a survey in which boundary lines are run, as in ordinary surveying, but it needs an examination and an estimate, or better, a measuring of the trees,—all of them, if they are very valuable, or at least of sample pieces or stands; and it also requires a careful noting of any young growth, and a description of the land, the slope, the soil, the drainage. Whether the ground is covered with grass, weeds, and shrubbery, or is bare, should also be indicated, for all this knowledge is helpful and even necessary to a proper planning of the work.

STARTING THE YOUNG GROWTH BY SEEDING FROM THE SIDE

Along the Potomac, in Maryland, many old fields which were cleared and tilled in the time of George Washington are covered to-day by dense stands of jack pine. In the same way numerous old, abandoned fields in North

Carolina and Virginia are covered with pine. In this case the pine is a fine tree, called by the people of those districts shortleaf pine, and on account of its disposition to cover old fields it is also called old-field pine. It is cut in large quantities for saw-logs, and it is not an unusual sight to see men log this pine on land where the old corn rows are still visible. Evidently the seed from which these pine trees sprang came from the neighboring forest and was blown across the fields. Being so successful in many cases, this way of reproducing the forest has been used by the forester, and since the seed comes from the neighboring forests, the ground is *seeded from the side* and not under the seed trees, as in the method described before.

In using this method it is customary to fell all trees on a strip fifty to seventy-five yards wide, or about twice as wide as the trees are high, and then to wait until the strip is fairly covered with young seedling growth; then to cut another strip, widening the original strip by another seventy-five yards, and so on, until the entire piece is cut over. Of course any young growth is saved as much as possible in cutting the timber, and in valuable forests any places which are not covered within a reasonable time, say three to six years, are filled by planting. Since the seed is carried by the wind, it is well to extend the strips north and south, and begin on any particular piece along the east line, so that the prevailing westerly winds will carry the seed over the strip.

Where the forest is large there are as many strips worked at once as is necessary to cover the entire forest within the time of rotation. Thus, if we want the pine to be cut when eighty years old, and always allow each strip

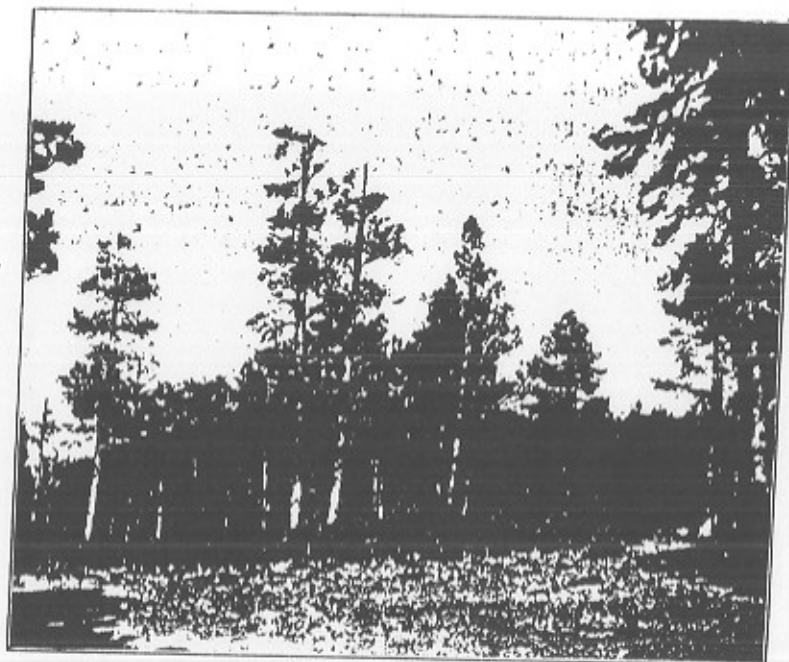


FIG. 25. Natural Seeding from the Side
Young pine encroaching on cleared land. (After Bureau of Forestry)

five years' rest to seed and start a young growth, the forest might be divided into a number of parcels such that each parcel would be about sixteen strips wide, and this could be cut in eighty years' time.

Where the wood is still in the ordinary irregular mixture of old and young trees the larger trees on the western half of each parcel would grow old and produce too little wood before the time for cutting, and it is better to take out the oldest timber all over the parcel from time to time whenever convenient, independently of the regular cutting on the strips. If it is desirable to cut about the same amount of timber every year, as, for instance, where a pulp mill or sawmill is dependent on such regular supply, it is necessary with this, as with all methods, that the yearly cut should not be greater than the yearly growth. In woods where too much timber is young sapling stuff the cut must at first be kept proportionately below the normal amount. Just what this cut should be can only be found by making such a survey as was indicated in the previous chapter.

What this growth should be can be learned from the following table :

FOR PINE

NUMBER OF CORDS OF WOOD (LOGS AND CORD WOOD) WHICH MAY BE EXPECTED ON ONE ACRE OF LAND IF PROPERLY COVERED

<i>When the Stand is Old</i>	<i>On Site No. 1, or Good Pine Land</i>	<i>On Site No. 3, or Inferior Pine Land</i>
Years	Cords	Cords
40	40	25
60	70	40
80	95	55
100	110	65

Since much of this wood in our forests is wasted, the entire top being left in the woods, the slab and sawdust being usually burned as rubbish, it requires about three cords, or about two hundred and seventy cubic feet (solid), to make one thousand feet board measure.

Thus, even on the poorer land, our stand of pine would cut about thirteen thousand feet board measure per acre when sixty years old. In most of our Virginia and North Carolina pineries it would do much better. Generally, however, even well-kept woods are not fully stocked, and if a fully stocked wood cuts a hundred cords, a forest in which only seven tenths of the ground is covered with trees would cut only seven tenths of that amount, or seventy cords.

Dense woods of beech or spruce, or both in mixture, cut more than pine, and most of our mixed hardwoods growing on better soil could be made to cut at least as much as the pine.

Seeding from the side can, of course, be expected to succeed only with trees like the pine, spruce, red fir, cedar, birch, poplar, elm, and others the seed of which is light enough to be blown some distance.

In Europe, where it has been tried, this method has not given general satisfaction; the soil is exposed too long to sun and wind and thus loses of its fertility; grass, weeds, and bramble cover the sunny eastern edge of the strip, and often the seeding is too imperfect for those countries

where land is very valuable and must never be left idle. In our own country Nature indicates the use of this method for a large portion of the pines of the South, and parts of the Rockies, and also in the red fir forests of the Pacific coast, where millions of acres of burns have been most beautifully restocked in this manner without any care on the part of man. The chief advantages of this method are that it does away with the tedious marking; that, in felling, the men are not hampered by the fear of injuring young growth or standing timber; and that the skidding and hauling is not interfered with by standing timber and young growth, and therefore can be done much cheaper.

STARTING THE YOUNG GROWTH BY ARTIFICIAL PLANTING OR SOWING

On many of the old farms in Massachusetts, New Hampshire, and other eastern states, portions of the land have become worn out by long tillage and use. They became pastures and, finally, almost useless brush lands. Some of these were planted or sowed to white pine, and land which sixty years ago was worth almost nothing to its owner, since it could earn no rental worth mention, is now covered with a forest of white pine worth one hundred and fifty dollars and more per acre.

This way of dealing with the forest, to cut clean and then replant, is a common method in European countries

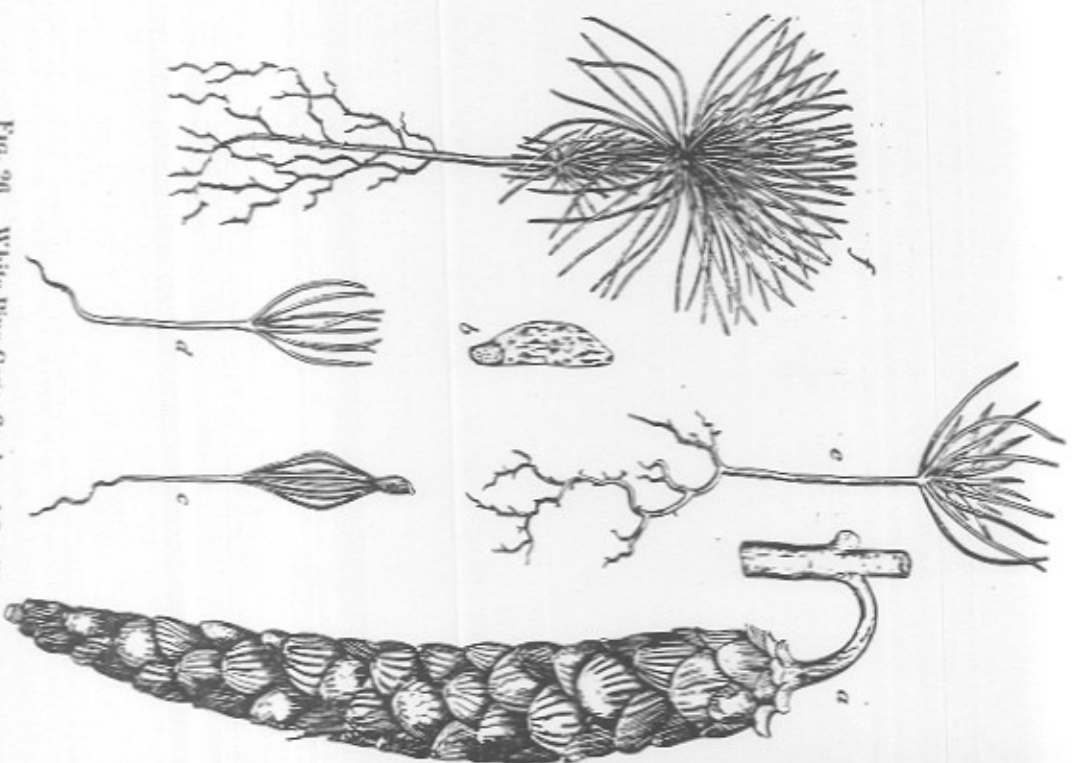


Fig. 26. White-Pine Cone, Seed, and Seedling

a, cone; b, seed with wing; c, d, e, plant of first season; f, plant two years old
(After Division of Forestry)

and much used in the pineries of North Germany, and in the spruce forests of Saxony and other districts. In our own country this method has not yet been used systematically in the care of forests, but many thousands of acres of what was formerly forest lands and large areas of prairie land have been planted and converted into useful forests.

The method is the simplest; the logging can be done at any time, in the cheapest manner, and the reproduction or starting of a new growth is simple and satisfactory.

With the natural seeding under seed trees or in clear strips one spot has thousands of seedlings on a few square rods, so that not one plant in a hundred can possibly live; and the next spot is left without any growth and must either be left idle or be replanted. All this is avoided by planting, for if done well it is usually successful, and the plants are sufficient in number and yet do not crowd each other. They therefore grow fast and symmetrically, with good healthy crowns, and the sticks are not so slender as if grown in dense thickets.

Since this method requires a large number of plants, we shall have to learn something about tree seeds, where and how to get them, how to raise plants, and how to plant them.

Nursery and Planting.—The seeds of most of our forest trees are still so high in price at seed stores that it is well to collect them whenever possible. Thus, the seed of our pines, spruces, and cedars costs from two dollars to

five dollars per pound; that of ash, maple, and birch from one dollar to two dollars, and even acorns cost twenty-five cents and more per pound. It pays, therefore, to gather our own seed; for, besides being cheaper, the seeds we gather are fresh and, being matured in our own locality, are apt to furnish plants well suited to our climate.

There are a few kinds like the elms, the willows, the poplars, and also the silver and red maples which ripen their seeds in spring and early summer; but most trees ripen their seed in the fall, the majority in September and October. Some kinds bear seed nearly every year; most kinds bear every two or three years with a specially good seed year at longer intervals.

Large seeds, like those of oak, beech, chestnut, hickory, and walnut, can be picked up when they fall, and the same is true of the pods of locusts and catalpa. The seeds of basswood, maple, and ash may be beaten off the tree and caught on a sheet spread out on the ground; or they can be gathered by cutting the best bearing twigs with shears, either from the ground or from a ladder.

This way of cutting the twigs or picking off seeds is the best also for elm and for trees where the seeds are in cones or balls, as with the yellow poplar (tulip poplar), sweet gum, sycamore, birches, and conifers. The seed of willows and poplars rarely needs to be gathered, as these trees are easily grown from cuttings.

The seeds which ripen in spring and early summer, as those of elm, poplar, and willow, must be sown as soon as ripe, for they do not retain their vitality very long.

The small cones of birch, yellow or tulip poplar, and balsams fall apart easily when dry, and then the seeds and scales (chaff) may be separated; but the cones of pine, spruce, larch or tamarack, hemlock, and white cedars remain intact and have to be dried, preferably in a warm room, until the scales open and let the seeds drop out.

After we have gathered the few kinds of seeds from which we wish to raise plants we have to take care of them, for seeds are not only eagerly eaten by mice, but they spoil by drying out or by heating and molding.

Different seeds behave very differently in this respect. The seeds of pine, spruce, and other conifers may be kept in bags hung up in a dry, cool shed, but the majority of seeds of broadleaf kinds, especially all the fleshy ones, are best kept in sand.

For this purpose the bottom of an ordinary box is covered with a two-inch layer of sand (not dry, but moist like ordinary earth); then a layer of seeds one half to one inch thick is spread out on the sand; this is covered with a two-inch layer of sand, then a layer of seed, and so forth. When filled the box is nailed up and may then be placed in a cool cellar or else put into a pit dug in the

garden, deep enough to receive the entire box. After the box is set in, earth is shoveled over it to cover it at least six inches deep and make a small mound to shed the water. This should be still further guarded by a covering of boards or slabs. The seed thus kept should be sowed immediately after it is taken out in the spring.

To save the trouble of keeping the seed over till spring, it is often better, where mice are not too numerous, to

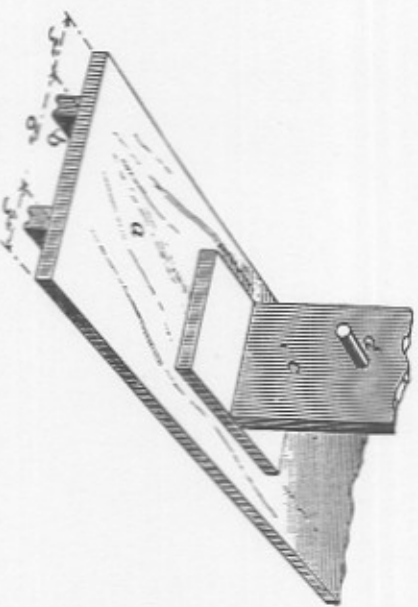


FIG. 27. Drill Board

a, board; *b*, sheet to make the drill; *c*, upright board with handle; *d*

sow the seeds in the fall. This may well be done with all fleshy seeds, like those of oak, beech, chestnut, hickory, walnut, maple, ash, etc., but seeds of conifers and most seeds which can stand only a very thin cover of earth should be kept till spring.

Seed Bed.—To raise plants of broad-leaved trees any good garden beds will do; for pine and other conifers most gardens have too much stable manure, and a small spot in the woods is often better. Broad-leaved kinds need a good loam, but can stand quite heavy clay; but the conifers fare better on a sandy soil. All seed beds should be plowed or spaded deeply to loosen the soil for the roots, and the land should be well fertilized with phosphate of lime, well rotted compost, or forest mold. All this is easily done where only a few thousand plants are to be raised; for a bed four by twelve feet is capable of producing a thousand or more of such plants as pine and spruce.

For this reason some prefer raising tree seedlings in boxes in the house, or under glass, and in many cases this way is the cheapest and most convenient. Of course where a large forest has to be supplied every year with plants it is necessary to have a large nursery.

Sowing.—In sowing large seeds it is generally better to plant in drills, which may be made with a narrow garden hoe; but for small seeds the drills should be pressed into the ground with a drill board, shown in Fig. 27, where the two cleats make the drills. In boxes and where space is valuable broadcast sowing may be employed. With most of the broad-leaved kinds the drills should not be closer than twelve inches; for conifers six inches suffices.

As soon as they are in the ground, conifer seeds should be covered about one half inch; maple, ash, etc., about

Fig. 28. Seed Beds
Part of the screens are covered with brush to give a denser cover



one inch; oak, hickory, walnut, and also black locust, about two inches. An old rule says that tree seeds should have a cover three times as deep as the seed is thick. After covering, it is well to roll or press the surface of the ground with a board or roller. To prevent the drying out of the ground it is best to give the seed bed a cover of brush or else cover it with a screen. (See Fig. 28.) This screen is placed on the ground until the seedlings push out of the soil; then it should be raised, at first four inches, later on twelve inches for conifers, and for broad-leaved trees two feet, so as not to hinder the plants in their growth. This screen protects the plants against sun and wind, and thus keeps them from drying out.

Some broad-leaved trees and also the pine can sometimes be raised without the screen, but all kinds do better if thus protected; while some kinds, like spruce and balsam, do not get on well without it, and should have it all of the first and at least part of the second year.

Many seeds will germinate within a few weeks after sowing; some few, like ash, basswood, larch, and even white pine, often "lie over," *i.e.*, a part of the seed does not come up until the second year. To prevent this the seed should be soaked for several days before sowing.

The majority of fresh or properly kept tree seeds are good, and from sixty to eighty per cent of all seeds may be expected to germinate; but of those of balsams, birch,

elm, ash, and maple generally less than half are good, while of yellow poplar seed ninety per cent is commonly worthless.

The number of plants which are obtained from a pound of seed depends, of course, on the number of seeds in a pound, on the per cent of good seeds, and also on the vigor of the seedlings.

The number of seeds in a pound varies within wide limits. In the light and winged seed of birch there are over four hundred thousand grains to the pound; in Norway, shortleaf, and Scotch pine, red fir, and spruce, about seventy thousand; in white pine, about thirty thousand; in white ash, about ten thousand; in basswood and sugar maple, about seven thousand, while in walnuts there are only about thirty nuts per pound. In sowing, the seeds should be well spaced so that about three to five grains of coniferous seeds come to one linear inch of the drill. Acorns and nuts are dropped about two to three inches apart, and in the case of most of the smaller seeds of broad-leaved trees one to three seeds are sown to each inch of drill.

Seedlings.—If properly cared for, *i.e.*, hoed, weeded, and, if need be, watered, and carefully sheltered, the little seedlings should take a firm hold of the ground and become fully established during the first summer. Pine, spruce, and other conifers generally remain small the first season, usually growing to a height of only one

and a half to three inches; those of most of the broad-leaved kinds in the temperate zone of our country grow usually to a height of six to twelve inches the first year,

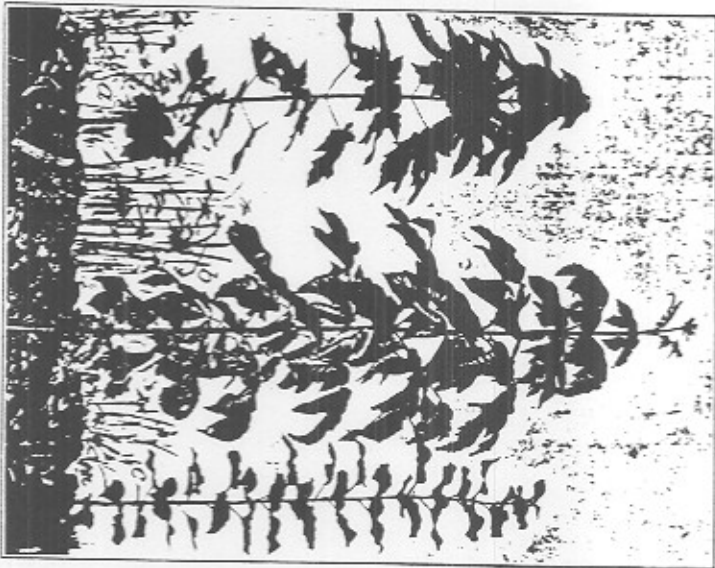


FIG. 29. Seedlings. (All two years old and about three feet high)
a, maple; b, box elder; c, aspen

and some of them, like catalpa, black locust, and the walnuts, grow commonly to a height of twelve to twenty-four inches.

During cloudy weather and in the fall the screens should be removed or used sparingly, to give the seedlings sufficient light. During the winter the tiny little plantlets of conifers may be protected with a cover of branches or leaves, but generally they do well enough without cover.

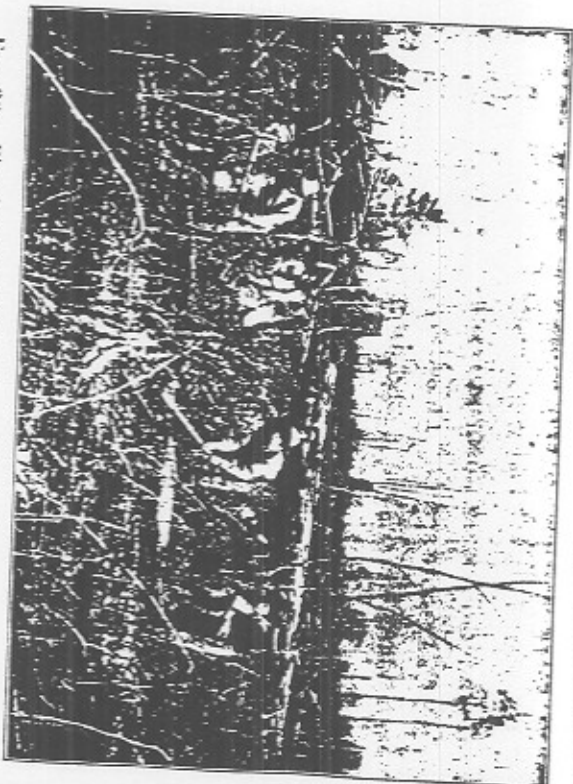


FIG. 30. Planting in Old Burned-over Slash Land in Adirondacks

For the taller, broad-leaved seedlings a "hilling up" is usually desirable, and where tender kinds, such as hickory and chestnut, are to be raised in colder localities a cover of brush and straw is desirable.

Planting.—The plants of such trees as the elm, catalpa, and black locust, and most of our hardwoods may well

be set out in the woods when one year old; and even beech and pine do well if set out at this age. Pine plants do better if set out when two years old, and spruce and balsam in their third year. When it is desirable to have stout and hardy plants, as in planting on poor soil or in places exposed to wind and sun, it is best to take the plants from the seed bed when one, or even better, when two, years old and set them in another bed in the garden, giving them more space. This transplanting makes stout, bushy, long-rooted plants, and is much used in raising spruce, balsam, and oak. Generally it costs as much to transplant a thousand plants as it costs to raise them in the seed bed to the second year.

Where the trees are set out on forest soil with stumps and small brush and rotten logs and other rubbish in the way, they are placed wherever there is good space, but preferably not closer than five feet apart. The planting is best done by two men, one digging the holes with a mattock, the other setting out the trees.

The plant should not be set deeper than it stood in the seed bed; the soil must be filled in neatly and firmly about the roots, so that the plant cannot readily be lifted out by the top after planting. In this way two men can plant eight to twelve hundred small plants per day. By using the spadelike iron shown in Fig. 31, *B*, where the hole is made by one thrust, the plant held in by a boy, and the hole closed by a second thrust, the two men can plant

as many as fifteen to twenty hundred per day. This method does very well in sandy soil and with two- to three-year-old conifers.

On prairies, where the land may first be plowed and harrowed, the trees may be set in regular rows, and the

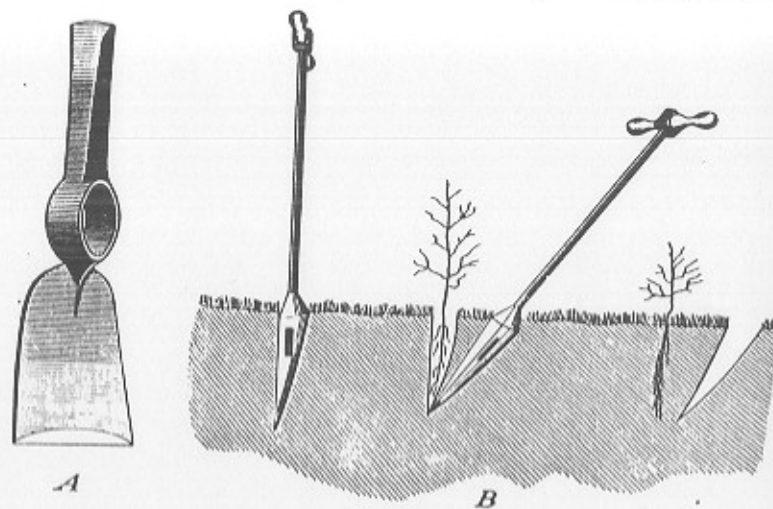


FIG. 31. Planting Tools

A, ax-mattock, one of the best tools used in the woods; *B*, planting dibble, used in loose soil and for small plants

larger plants of broad-leaved kinds may well be set out in furrows.

In all kinds of planting, but especially with pine, spruce, and other conifers, the greatest difficulty is found usually in trying to keep the plants in a fresh, healthy condition. If they are bought at a nursery, a thousand

or more miles away, they are apt to heat and mold if packed too closely, and dry out if packed too loosely. The best method is probably to ship them in large baskets, packed in bundles and with the roots wrapped with damp moss. Seedlings of pine, spruce, and other conifers should never be allowed to dry at their roots; in fact, a few minutes of such drying in bright sunlight is often enough to kill them.

During planting, the bunch of seedlings carried along should not be held in the hand but kept in a pail with wet moss and a little water, and in warm, sunny weather the pail should have a cover of wet sacking. The broad-leaved kinds are much more hardy, but in all cases success in planting depends on keeping the plants fresh. Planting in spring is universally preferred, though fall planting is often equally good.

Sowing in the Forest.—Where seed is cheap and where the soil is in good condition, as on newly clear-cut forest land, many people prefer to sow the seed directly on the land and thus save all the trouble of raising plants. With the seeds of oak, chestnut, hickory, walnut, beech, locust, maple, ash, and basswood this is a very good way; and even for pine and spruce excellent results are obtained by this method. In sowing, the man hoes small spots about twenty-four inches square, scraping the ground a little toward the center to make this part the highest; he then drops three to five seeds in about the middle and

covers them lightly, pressing the ground afterward with the hoe. In this way he goes back and forth, sowing wherever there is room, but so that the spots are at least

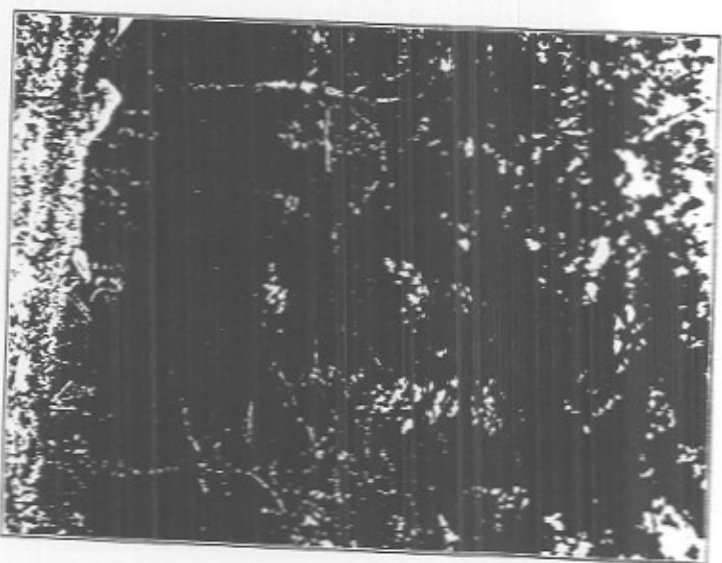


FIG. 32. Pine Grove from Planted Seed
(After Graves)

five feet apart. Where mice are numerous, and where insects, sun, and wind, together with a poor soil, combine to injure the seedlings, this method is not reliable.

Occasionally wild seedlings may be found in great abundance in the woods. When these plants are still small, *i. e.*, from one to two years old, they usually thrive if transplanted; but older plants, especially if taken from rather dark woods, are generally too spindling and rarely do well.

Poplars and willows are best started by cuttings. These are pieces of young shoots, one to two years old, gathered in March and cut into twelve-inch pieces. These pieces are bundled and then buried until spring opens, when they are set out either in the garden, if we wish plants or else at once in the woods, where they are to remain permanently. In the garden they may be planted in a trench made with spade or plow; and in the woods they are stuck into a slanting hole made with the spade, about two inches of the cutting being left to project from the hole. In both cases the earth is packed firmly by tamping.

In our prairie regions, of course, all trees must be planted; the forest is yet to be made. Here planting, chiefly of broad-leaved kinds, has proved most successful. Later on, when the woods exist, conifers may be added.

In our forest lands such trees as poplar, willow, birch, elm, and even maple, basswood, and ash, need introduction here and there; but in our hardwood forests they will usually be numerous enough without special care.

Hickory, walnut, and even oak, chestnut, and beech may well be started by planting the seed; thus, generally,

the main object of forest nurseries is to produce conifers and only secondarily to start such kinds as do not exist in a given locality, or common broad-leaved trees for poor soils and difficult waste lands.

The method of cutting clean and replanting, though used successfully for many years and in many places, and

used in forests which have paid the highest yearly rental of any in the world, has, nevertheless, been criticised by many foresters. Usually it is claimed that it costs too much; that it leaves the ground bare for several years and thus exposes it to sun and wind; and,

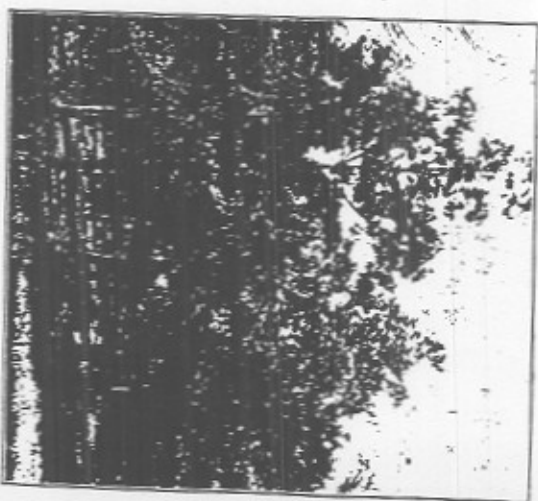


Fig. 33. An Oak Grove from Artificial Seeding
(After Graves)

finally, that it induces the people to grow forests composed of one kind of trees, either spruce alone or pine alone, and thus increases the danger from insects and disease; for if a spruce forest is attacked by a spruce-loving caterpillar, the insect finds so much food that its numbers increase

all the more rapidly, and a whole forest may be destroyed. Experience in Saxony, involving thousands of acres annually, shows that planting is not costly, for it costs there only about two per cent of the total or gross income of the forest. But even if it should not be well to clear off large tracts of forest and then replant, it will be safe to do so on better lands in a temperate climate and for small areas; and it is probable, also, that it will prove satisfactory for larger areas situated near good markets, like some of our spruce forests which supply pulp mills in their midst.

Aside from this it will always be found not only helpful, but even necessary, to assist Nature in restocking the forest; for, however carefully dealt with, mistakes produce fail places, and therefore every one who cares for a forest should know how to plant and sow and should at all times be ready to do so.

It would be misleading, however, to infer that the planting of forests is always profitable in the ordinary sense of the word. Like the pioneer's clearing of forests for plowland, and like the farmer's labor of raising the bread and meat of the nation, so the planting and raising of forests, though one of the most necessary of human occupations, rarely produces those large returns which a speculative age expects from a "paying" investment. But like the conversion of the wilderness into productive farms and pleasant homes, so the planting of the forest is sure to reward in the end.

REVIEW OF METHODS OF STARTING NEW GROWTH IN FORESTS

We have now looked over the various ways which different people employ to keep up different kinds of forests. Of course every one of these principal ways may be, and actually is, modified or changed by different men to suit particular cases. In this way there are a good many kinds of coppice, using different trees and different rotations; one man leaves only a few trees in his standard coppice, another holds over so many trees that the standard coppice approaches the timber forest. In the same way one man picks over his whole tract of selection forest every year; another works one fourth of it until this fourth is all cut over and stocked with new growth, and then goes to the next fourth, etc. In this way his selection forest becomes more regular and approaches the common method of starting the young growth under seed trees.

We have learned, too, that whatever the system of management may be, the starting of a new growth—the reproduction, the keeping up of the forest—is the main feature in the mind of the forester, and his methods are described, named, and compared with this chief object in view.

The table on the following page will help us to fix in our memory the principal methods of reproduction, each giving rise to a particular form of forest.

THE SIX PRINCIPAL METHODS OF REPRODUCTION

METHOD	HOW THE CUTTING IS DONE	THE TREES START FROM	WHERE THE METHOD MAY BE USED
1. <i>Coppice</i>	All trees are cut off	Sprouts	Only for broad-leaved trees, preferably oak and chestnut, on fairly good forest soil and in mild climate. Same as a copse. For standards use oak, chestnut, ash, also pine
2. <i>Standard Coppice</i>	Part of the trees are held over to grow to larger size, and are cut at the end of the second or third rotation	Main crop from sprouts, the standards preferably from seed or plants	For all kinds of forests, on all kinds of land, and for cold and warm climates. The best way for difficult mountain forests and wherever it is hard to keep forest growth. All kinds of forests, less good in cold climate, on poor soil, and in exposed (down-beaten) places
3. <i>Selection</i>	The largest and oldest trees and also the worthless and crowding younger trees are picked out	Mostly from seed	
4. <i>Under Seed Trees</i>	The piece of land is cut over two to four times within 10-20 years; the first cut merely thins out, the second leaves only the seed trees, the third cut gives light to the young growth, the fourth cut removes the bad of the old trees	Seed	
5. <i>Natural Seedling from the Side</i>	Strips 50-75 yards wide are cut clean and left until seeded, when a new strip is cleared	Seed carried by the wind from neighboring forest	Only with trees which have light seed—pine, spruce, red fir, white cedars, cherry, poplar, etc.—and only in warmer localities and where seed falls abundantly and freely, and where the soil is not covered too hardly with grass and brush
6. <i>Artificial Seedling or Planting</i>	All timber is cut	Seed, or nursery plants	All kinds of forests, good and poor soil, cold and warm climate. Simplifies the business, makes cheap logging, and prevents useless crowding of young plants

CARE AND PROTECTION OF THE FOREST

A piece of wildwoods, as we have seen, may do very well without the care of man; young growth will start up where old trees die and fall; in the dense thickets the more vigorous choke out the weaker, the taller shade down the shorter; the tolerant crowd out the intolerant. A gap made by the storm is filled in sooner or later by trees starting as sprouts, or by trees whose seeds have been carried there by the wind. Large openings made by fire are restocked, here slower, there faster, according to the circumstances; and large areas of forest destroyed by some caterpillar are gradually reforested by those kinds which this particular insect does not feed upon. This would seem to tell us that forests need no care. But this is true only if we are satisfied with the small amount of good growth which most wildwoods make. Where man wishes the forest to produce a larger amount of wood and wool of particular kinds and sizes, more or less care is necessary. In the stately forests of red fir and cedar of the Puget Sound country, where a good forest soil, mild and humid climate, and excellent kinds of forest trees combine to make a forester's paradise, a little care might suffice; but even in these districts the old trees hinder the young, and the young trees crowd each other, and thus the trees themselves call for help, for interference, for improvement.

vigorous ones which project above the general level of the canopy of the woods. The three next best trees are marked as No. 2; they represent the thrifty trees whose crowns make up the body of the canopy. Let us call the trees of class No. 1 and No. 2 the *dominant* trees. The trees No. 3 are weaker; they form a small part of the canopy and give little promise of ever making good trees. Those of No. 4 are being crowded out, and those like No. 5 are dying or dead.

If our piece of forest were twenty-five years old and the trees about thirty feet in height and we might thin out every ten years, we should take out only trees of the fourth and fifth classes; and also such trees of the third class, and even of larger size, as interfered evidently with some better trees. This would be repeated in ten, in twenty, etc., years, until the timber should be cut.

In places where the pole wood cut during the first and second thinning could not be sold, this process would cost some money; for the material cut in the thinnings should really be taken out to prevent the development of too many injurious beetles. For this reason a more thorough thinning would, in most cases, be better; and then most of the trees of even the third class would be taken out.

Where the young growth starts from natural seedlings, so that often twenty and more trees start on one square foot, the crowding begins very early and it would be

better if the majority of little plants were taken out or destroyed before they are a foot high. To do this well would cost too much, and the forester usually leaves the thicket to itself until it is about twenty years old, when he thins it out in much the same way as described above.

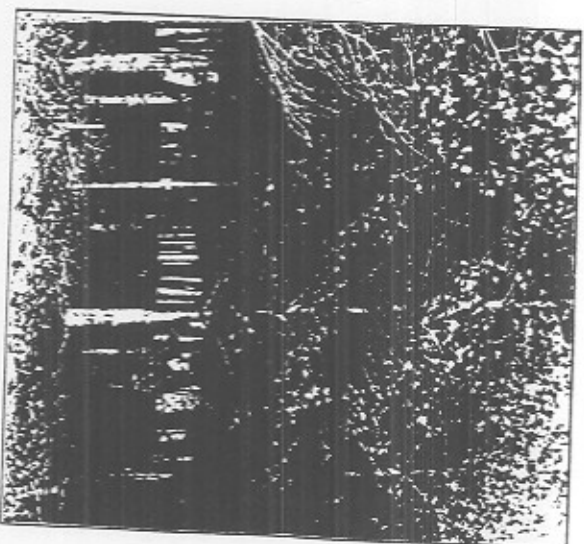


FIG. 35. Thinned, but will need it again

To get a better idea as to how much ought to be cut it may be said that for pine on good pine land there ought not to be left more than ten trees on one square rod at the age of twenty, four at forty, two at sixty, and one at a hundred years, as tabulated on the following page.

THE NUMBER OF TREES ON ONE ACRE IF FULLY STOCKED

WHEN THE STAND IS MADE	FOR PINE			FOR SPRUCE	
	On a Good Site	On an Inferior Site	On a Good Site	On an Inferior Site	
20 years	1000	2000	—	—	
40 "	700	1500	1000	2000	
60 "	500	1000	500	800	
80 "	300	600	300	400	
100 "	175	350	250	300	
120 "	160	200	225	275	

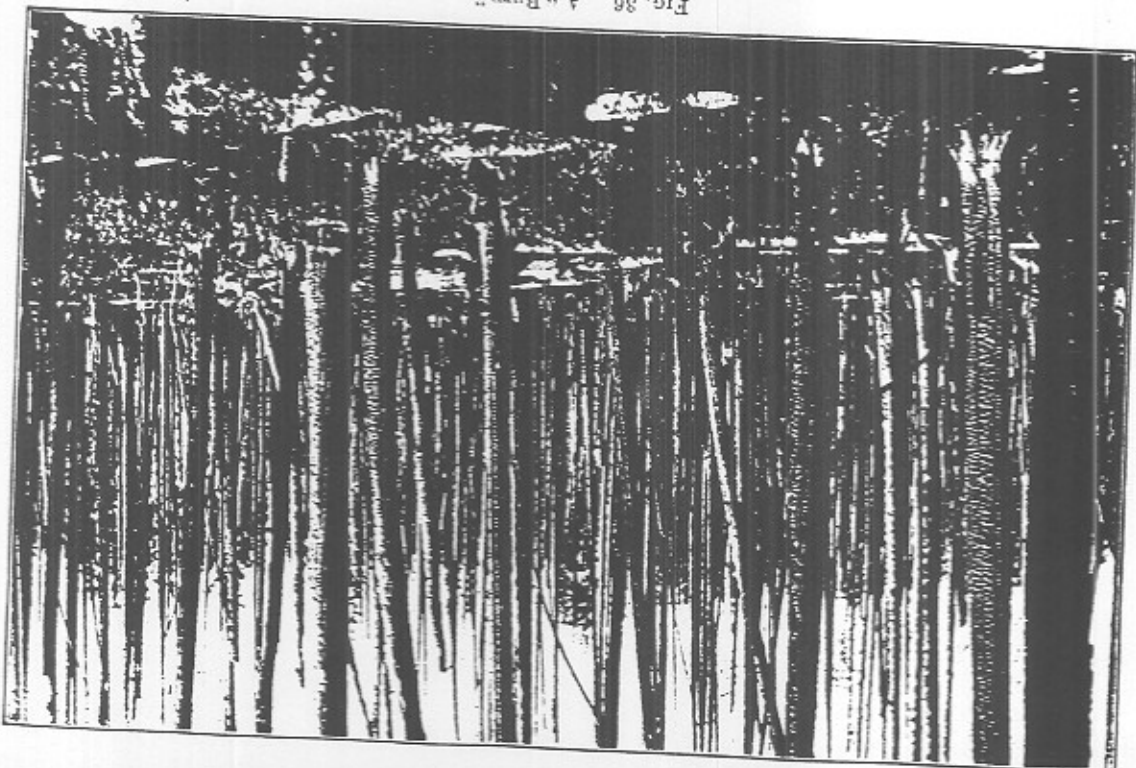
By dividing these figures by 160 (the number of square rods in an acre) we can readily find how many trees we may leave on one square rod.

Many foresters are guided by the crowns and thin just enough to keep the crowns from crowding.

Naturally enough, trees which, like spruce, balsam, beech, and maple, can tolerate much shade, are thinned later, and must be thinned less thoroughly, if they are to clean themselves and grow smooth stems, than the intolerant kinds, which clean more easily. On the whole, thinning is one of the most difficult things the forester has to learn, and much good sense and care, as well as experience, are needed to do it well.

That injured and crippled trees and also those with unduly spreading crowns should be taken out is self-evident. After a thinning our woods should be evenly and well stocked with as perfect trees as can be produced.

FIG. 86. A "Burn"
Priest River Reserve, Idaho. (After Gaunett)



is necessary that the wood of dead trees be converted into dust to prevent the ground from becoming covered with dead timber. Such a cover would bring all forest growth to a standstill, there would no longer be room for trees, and its destruction by fungi, therefore, is useful. It is Nature's way of clearing the ground for new generations of trees. But, like many useful things, these fungi overdo their work, and at the slightest provocation attack good, thrifty trees. Thus, if a wind tears off the large limb of a maple, beech, birch, poplar, or other perishable kind of tree, fungi at once begin their work of destruction; the interior begins to decay; limbs and stem are hollowed out; the tree is weakened and becomes an easy prey to bark beetles or a storm. Once on the ground, a few years in our moister districts suffice to convert the trunk and all into a powdery mass of decayed wood, which is spread out by insects and water, and thus helps to improve the soil for a new growth. Though the trees with perishable woods are more subject to this injury than those in which resin and other substances make the wood more durable, yet all kinds of our trees suffer more or less. Thus, even the durable cypress is injured by a fungus, which causes it to become "pecky;" and our white cedars are generally "hollow butted," the stump being decayed so much that it is a common defect of cedar timber.

From this it appears that clean woods, composed of thrifty, uninjured trees, suffer much less from injurious

fungi, and also that especially the more sensitive trees, like maple, beech, spruce, etc., cannot stand being hacked and scalped with the ax, or barked in felling and dragging out timber, but are almost sure to suffer further injury if thus hurt.

In the South and West the mistletoe is a factor in the destruction of trees. In California many of the noble white oaks are yielding their lives to this parasite.

USE OF THE FOREST

We have already learned how to start new growth and how to care for it, and thereby keep up the forest. Let us now consider what we may get from the forest and how the material is usually taken out and used.

To primitive man the forest gave meat, shelter, and fuel. At the beginning of our era the people of central and northern Europe, and nearly all of the people of North America, obtained their food by hunting and fishing. With us to-day the forest no longer furnishes meat; the people are too many, the forests too small.

But while it no longer furnishes our meat, it still supplies the great mass of our fuel, as well as the lumber and timber for the houses which shelter us. In addition it was the forest, with its large, soft, easily shapen timbers, which alone made it possible for the ancient Phoenicians to trade with the people of the North Sea, and for Columbus

to find the New World; and even to-day a large part of our people and goods are carried in thousands of wooden ships, landing at hundreds of miles of costly wooden wharfs. Our thousands of miles of railway rest on millions of wooden ties, and cross on thousands of miles of wooden trestles and bridges. The grain and goods of our land are hauled in wooden boxes and barrels, on wooden wagons, in wooden cars, and are housed in wooden structures; and, in spite of the great progress of our times, we still finish even the finest of parlors in wood; we prefer a wooden chair and table to any other, and the choicest of furniture is of wood in its natural colors and appearance. One of our greatest needs, that of cheap paper, was supplied only when man learned to make paper from the common product of our forest. Nor is this all, for the very mines which supply us with coal for fuel and with iron for our manufactures require millions of feet of timber every year, if they are to be worked with any degree of economy.

Thus, we see that the forest was necessary to the savage; that on the forest depended the progress of our race; and that even to-day, in this age of steel, the product of the forest is used in greater quantities and supplies a greater variety of demands than ever before.

Let us examine a little more in detail the ways in which some of our farmers utilize their woods.

CUTTING TIMBER

Season.—Generally the work in the woods is done in winter. This is better, since the cold retards or prevents

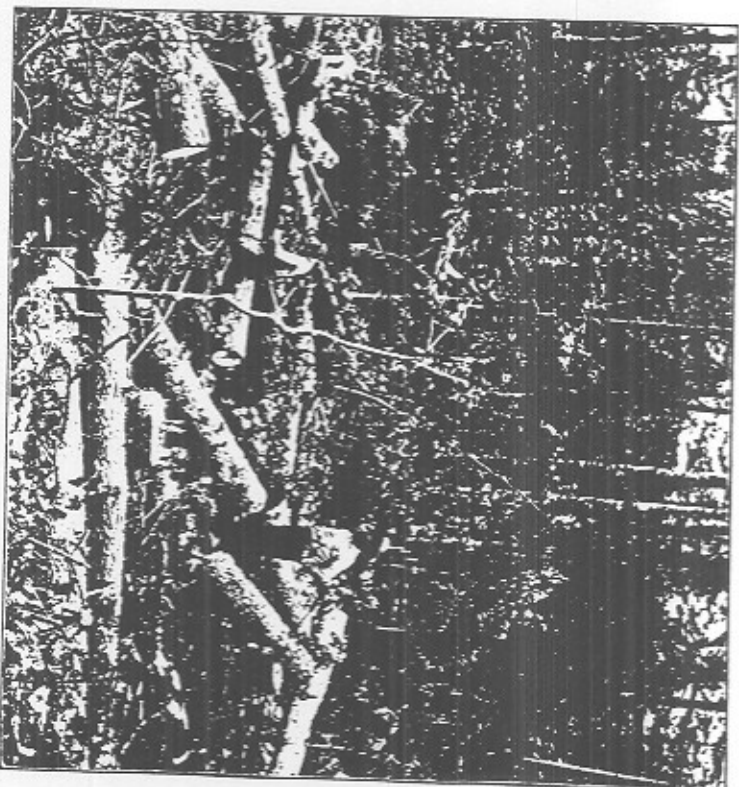


FIG. 50. Cutting Spruce in the Adirondacks
(After W. P. Fox)

fungi from spoiling the wood by "bluing" or discoloring, or by starting decay. It is also much better on account

of insects, for during winter these pests are inactive, practically dormant, and thus they do not injure the timber which is cut, nor does the felling lead to an increased multiplication of these ever-present enemies of the forest. Besides this, there is little work on the farm during winter, and thus help is more easily procured. To this must be added, in colder districts at least, the advantages gained by a good fall of snow, which makes it so much easier to drag and haul timber.

Firewood.—For this it is customary to use only such pieces as will make nothing better. For ordinary house use, all tops, the trunks of short, crooked, or otherwise unsalable trees, and in many cases even stumps, are used. If the firewood is to be sold, it is better to grade it so that the better and poorer kinds are not mixed, as is so often done; for a few sticks of poor wood give the whole pile a bad appearance and thus lower its price. Usually firewood is cut in four-foot lengths and stacked in piles four feet high and eight feet long, such a pile being one cord. A cord is a legal measure, and as such requires that the pile be four feet wide, or in ordinary cases that the pieces be cut four feet long. Where people buy stove wood sixteen to eighteen inches long, the cord is frequently meant to be a pile of this short wood four feet high and eight feet long, and thus is really but about a third of a cord.

In all cases there is much air space between the pieces of such a pile, and though the pile contains one hundred

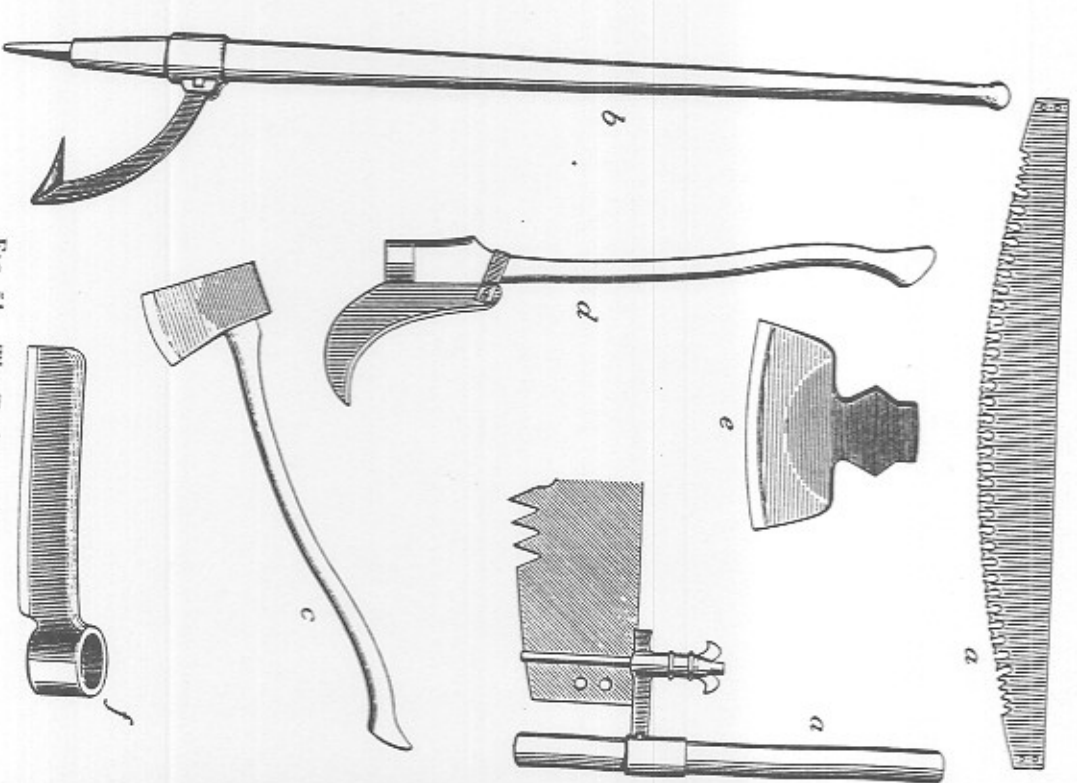


FIG. 51. The Tools we use
a, crosscut saw; *b*, peavey, to turn logs; *c*, ax; *d*, billhook; *e*, broadax, to hew logs; *f*, froe, to split or rive shingles

and twenty-eight cubic feet, there are only about ninety cubic feet of solid wood in a regular cord.

Larger pieces are split to allow a better drying or seasoning, and split wood is always preferred to round pieces.

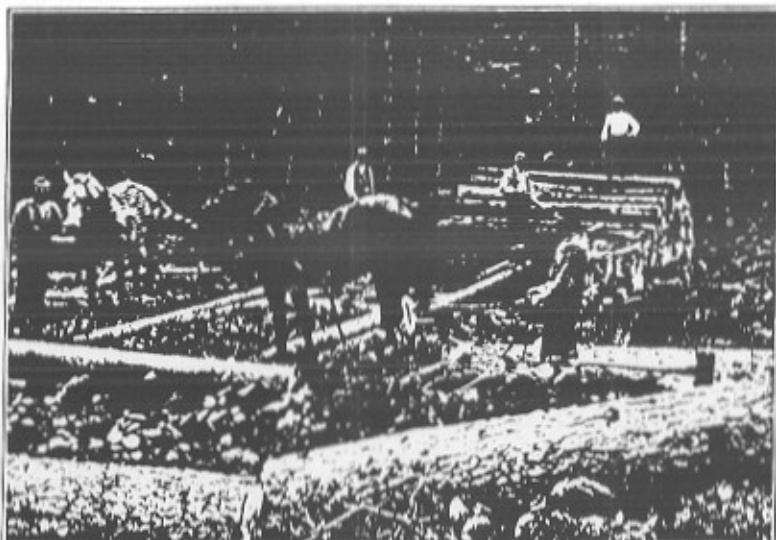


FIG. 52. Skidding Spruce Logs in the Adirondaeks
(After W. F. Fox)

A cord, as ordinarily cut, contains about two hundred pieces and weighs, when fresh, about four to five thousand pounds.

For ordinary use the heavy woods, like oak, hickory, beech, maple, etc., and especially the "second growth," are preferred. The lighter kinds, like poplar and basswood, are not readily sold for this purpose.

Of late years many farmers haul their firewood in large pieces to some convenient place near the house, and saw it into stove lengths with horse power or threshing engine.

Since firewood cannot be used economically without

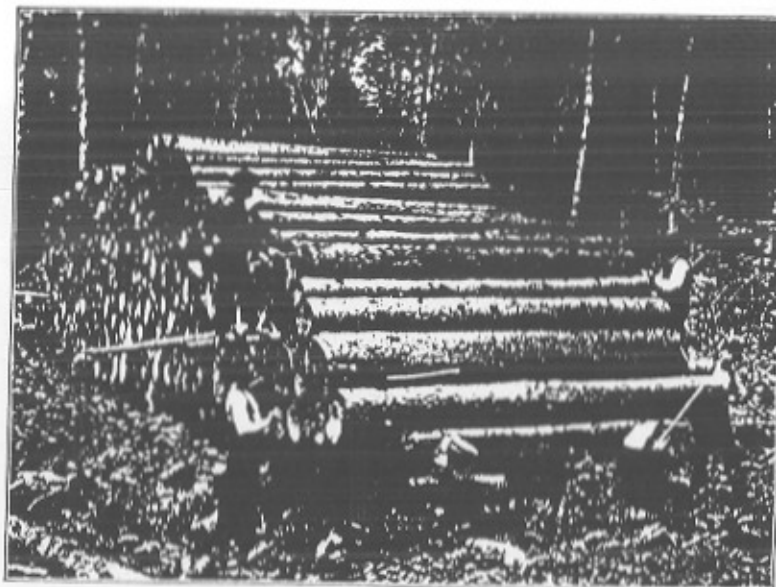


FIG. 53. "Scaling," or measuring and stamping or marking
Spruce Logs
(After W. F. Fox)

being first seasoned, it is often advisable to keep firewood one year on the pile, so as to get this advance in value and at the same time make easier hauling.

To leave firewood in large piles in the woods is always a bad policy, for nearly all kinds of wood commence to

protected wolves of our forest, are free to chase the game day and night, as, for instance, in many parts of the South and West, it is impossible for deer to maintain themselves.

THE BUSINESS OF THE FOREST

When a farmer carries on forestry on his thirty-acre piece of woodland he looks after it himself, plans and conducts the cutting, planting, and thinning, sells the wood, and thus performs all parts of this business, just as he does his farming. He may hire some men, he may even keep a book to see just how much his piece of woodland is bringing in, but it is a very simple kind of record. In the same way his plans are perfectly simple. He may manage it all as a piece of selection woods, cutting over a three-acre piece each year, using the same road to haul out his wood, or he may treat it as a coppice; but, in any case, he needs no map or book to see where the oldest timber is located, and what parts are in need of thinning. Half an hour's walk will show all this, and a few hours' time will suffice to mark out all the trees he wishes to take out the coming winter.

Suppose, however, he has two thousand acres of woods in four pieces, thirty miles from his home; then the case is quite different. It would take a month's faithful walking to examine this amount of land as a good forest should be examined. Moreover, he needs to note down

at every step what he sees, or else he would forget it before he could reach home. But of what use is it to note down what he sees on a particular spot, unless he knows where that spot is and can send a man there, if he wants to do so? This means, then, that he should survey it first and establish some marks in the woods. Then he examines and estimates or measures the timber and describes his land. But after he has a map and description, to have it orderly he must keep it in some kind of book, arranged in some definite order. Here the book-keeping begins, for this survey and this examination cost some money, which he must charge against his forest. Then he wants to *manage* this forest.

We will suppose he decides to treat it as a selection forest, and suppose also that he can sell the wood and timber, and wishes to use his forest to furnish work for teams and outfit, and also for his men, whether tenants or neighbors. In this case he will wish to do some logging, perhaps, every winter; and he will need, about every ten years, to return to each part of his woods to make sure that it is properly cleaned and thinned. He would have to log over about two hundred acres a year, and this would be a considerable business in itself. To do this he would need a foreman, better a forester, and a small crew of men, and considerable bookkeeping would be necessary to keep his accounts in proper order. But to handle a foreman and crew means *administration*; to survey,

subdivide, map, and measure his land and timber, to plan where, what, and how much to cut and plant, to improve by roads, ditches, and otherwise,—all these mean to *regulate* his forest. We have here, then, a simple form of *forest administration and regulation*.

When this forest grows to twenty-five thousand acres, in perhaps thirty pieces, the owner needs several permanent foresters who know what to do and how to do it. Each of these men takes a portion of this land and carries on the business, making reports at regular times to the owner, or his office, so that the owner, like a storekeeper, knows every day about how his forest business stands. Thus, forest administration and regulation, up to certain limits, grow in complexity as the forest grows larger and more diversified, and both are necessary for order and good business.

SPECIAL KINDS OF FORESTS

So far we have been considering forests in general, but there are a few important cases which deserve special attention.

The Wood Lot

The farmer's small forest of twenty to forty acres is often entirely neglected, as a thing neither forest nor field and hardly worth paying any attention to. And

yet it is in this form that a very large and a very important part of our forest wealth exists, and here is where

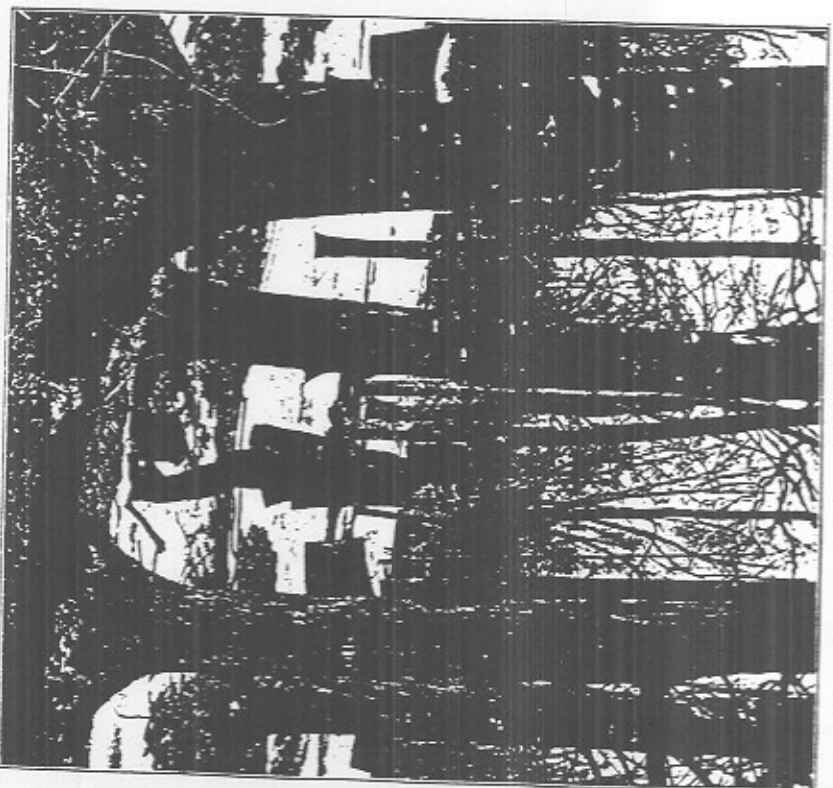


FIG. 67. Tapping the Sugar Maple
(After W. F. Fox)

the best kind of forestry is frequently met with, and where the most careful attention and the greatest outlay