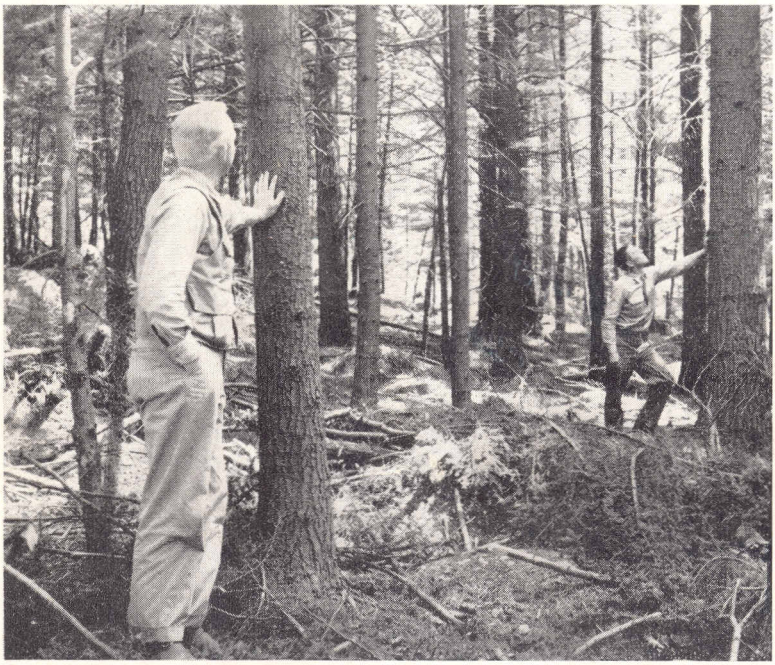
Extension Bulletin 88 June, 1948

The Management of Farm Woodlands in New Hampshire

By K. E. Barraclough



UNIVERSITY OF NEW HAMPSHIRE
AGRICULTURAL EXTENSION SERVICE
DURHAM, N. H.

The picture of the cover of this bulletin shows a properly managed woodlot

Published and distributed by the University of New Hampshire, Durham, N. H., L. A. Bevan, Director of Agricultural Extension, in furtherance of the purposes provided for in the Acts of Congress of May 8 and June 30, 1914, The United States Department of Agriculture co-operating.

New Hampshire Forestry and Recreation Commission Co-operating

TABLE OF CONTENTS

The Management of Farm Woodlands in New Hampshire

By K. E. Barraclough

New Hampshire's Physical Characteristics are such that approximately 80 per cent of the state's area is better suited to growing forests than to any other purpose. The pioneers and early settlers greatly reduced the original forest areas as they cleared the land. But as social and economic conditions changed, New Hampshire people came to realize more and more that much of this cleared land was unprofitable for agricultural purposes and gradually allowed it to return to a forested condition. Of the 31 per cent of the state's land now managed by farmers, 48 per cent is forested.

If all New Hampshire forest lands were intensively cultivated for growing timber, wood products could be the leading industry and would aid the people of every town and city in the state. But the forest industry, even without the benefit of management, has an important relationship to the general economy. Figures show that during 1946, the estimated roadside value of all forest products harvested was $14,687,825. The average annual lumber cut during the five-year period, 1941-1945, was 351,520 million board feet, that of pulpwood 314,400 cords, and of firewood 353,400 cords. The annual losses from fire, insects, disease, wind, and ice are set at 214,900 cords, and the total annual depletion from cutting, fire, insects, and disease is estimated at 1,658,093 cords. Assuming the annual growth of new wood to be 900,000 cords, based on an average growth of ⅕ cord per acre on 4½ million acres, leaves a deficit of 758,093 cords which represents the annual reduction of forest capital.

More than 16,000 people were employed on woods and mill operations in 1944. This is 22 per cent of all New Hampshire wage earners. The greatest advantage to our people is to process our native forest products locally and as completely as possible. In this processing, forest products increase eight to ten times in value from the standing trees to the consuming public.

Ownership of Woodlands

Some 35,000 people, including farmers, have title to a few acres of woodland in lots up to 5,000 acres. Large holdings are in the hands of paper companies and timber companies. The Federal Government is the largest holder of publicly owned lands. Table I on page 6 gives the ownership of forest land in New Hampshire.

Relation to Crop and Pasture Land

For the most part, the proportion of a farmer's land in woods, pasture, and crops depends upon the farm's location, the fertility and workability of the soil, and how much work the owner wants to put into it. But the proportion seldom shows a carefully prepared land-use plan. Broadly speaking, a farmer should plan to devote land that is easily cultivated to tillage crops,

Table I.—Ownership of Forest Land in New Hampshire*

Publicly Owned	Acres	Percentage	
National Forest (1)	649,000	13.8	
Other Federal Forest Land (3)	8,000	0.2	
State Forests (2)	50,308	1.1	
State College Forests (2)	1,142	0.02	
Miscellaneous State Owned Forest (2) (including water board 2,800)	4,178	0.1	
County Forest Land (2)	3,925	0.08	
Town Forests (2)	52,502	1.1	
Total, Public Forest Land	769,055		16.4
			0.
Semi-Public Institutional	11,921		0.3
Privately Owned			
Farm Woodlands (4)	1,086,00	23.2	
Industry and other private owners	2,804,717	60.1	
Total, Private Forest Land	3,890,717		83.3
Total, All Forest Land	4,671,693		100.0

(1) White Mountain National Forest, 1944 average was 663,907 of which 649,00 were considered forest land.
(2) N. H. Forestry and Recreation Commission Records 1945.
(3) Northeastern Forest Experiment Station Data 1945.
(4) U. S. Census 1940 adjusted by Forest Service 1946.

*Compiled by H. I. Baldwin, State Forestry and Recreation Commission.

and to establish pasture lands that may be kept free from brush and tree growth without undue investment in labor, time, and money.

New Hampshire farmers should reclaim the thousands of acres of neglected pastures in the state or convert them into woodlands. In general, a farmer will not find it practical to combine his woodlands and pastures for grazing purposes. Such a practice affects both the trees and the grazing animals. It reduces the quality of the timber and also tends to lower the milk production of animals that are allowed to graze over large woodland areas.

There is no definite formula for deciding upon the amount of woodland best suited to a farm unit. It is an individual problem, depending upon the owner's industry, the type of farming he carries on, and local conditions and situations. The farmer should have sufficient acreage in growing timber of different ages to provide his men, teams, and equipment with work during the winter or during periods when there is little agricultural activity. He should be able to cut and market enough forest products to supplement materially his annual farm income. But if he owns too much woodland, he may find himself land-poor. And if he speculates in timber, as some farmers do, he may discover, after his land is stripped, that the cut-over areas are a liability that will eventually take away the profits from the timber sale.

History of New Hampshire Farm Woodlands

Primeval Forests

In general, the primeval forests of New Hampshire were in mixed stands which varied somewhat according to climate and soil conditions. South of

the White Mountains were mixtures of the better hardwoods (ash, maple, oak, birch, hickory, basswood, and cherry) and varying amounts of white pine and red pine and hemlock. On the lighter and exposed soil softwoods dominated, and pitch pine was found mixed with other pines. Toward the north and on the higher elevations extending into southern New Hampshire spruce and fir dominated but often were mixed with the northern hardwoods (beech,

Old growth pine.

birch, and maple). Tamarack and often cedar were mixed with spruce and other northern species on wet and swampy lands; spruce and fir were common on the flats. The higher elevations were given over to spruce and fir, and the slopes and low ridges favored the northern hardwoods with various mixtures of spruce and fir. Weed species (gray birch, pin cherry, and poplar) did not dominate the forests as they do today. They appeared only in areas where burns and blowdowns had occurred.

Present-Day Forest Lands

After 300 years of forest exploitation, reckless clearing, and abandonment of farmlands, there are now, broadly speaking, but two types of forest land. One is the land which has been once or several times culled but never cleared; the other has reverted to woodland after a century or more of use as cultivated agricultural land. Since 1900, both types have been logged by clear cutting, leaving a heavy debris of slash. Fires have frequently followed these cuttings. All this has resulted in a steady falling off in the composition of the new timber crops which have followed the cuttings. There have been fewer and fewer seed-bearing trees of satisfactory age and species, but the light-seeded, inferior species, such as gray birch, poplar, and pin cherry (which are more adapted to survival in exposed areas) have constantly increased. Thus, even where there has been a sufficient amount of desirable reproduction (as in the older mixed stands like the culled remnants of virgin forests), the seeding of weed species or the excessive development of hardwood sprouts have steadily eliminated desirable trees.

Types of Forest Growth Today

Today, we find a great difference in the composition of timber stands in the various sections of New Hampshire. From the White Mountains northward, the two common types, spruce and fir, and the northern hardwoods (beech, birch, and maple) are either clearly defined or mixed together in varying degrees. Larch and northern white cedar are common in the swamp areas of this region. Spruce, fir, and northern hardwoods extend into the central and even the southern parts of the state, along the high lands between the Connecticut and Merrimack rivers and on the southern slopes of the White Mountains into the Lakes Region.

Second-growth northern hardwood.

In the southern section of New Hampshire, generally at elevations below 1000 feet, are white, red, and pitch pines, hemlock, and the transition hardwoods (oaks, maples, birches, basswood, white ash, and cherry). These species are grouped in stands of various make-up, such as pure pine stands, pine with mixtures of hardwood and often hemlock, and hardwood stands of different mixtures, depending upon the soil, elevation, and previous use of the lands.

Softwoods are in greater evidence than hardwoods on lighter soils. Hardwoods are more common on medium and heavy soils. Although soil conditions influence the type of forest growth, much depends upon previous cutting practices. The chance for re-seeding of desirable crops is usually much less after clear cutting than when a partial cutting is made. In many instances, hardwoods follow the clear cutting of a desirable timber crop. Very often, too, owners of woodlands cut the young hardwoods which follow clear cutting of softwood timber for use as fuelwood. Such a practice reduces a promising stand of timber into a worthless growth of sprout hardwoods which becomes increasingly inferior with each cutting of fuelwood. Again, softwood that has seeded into abandoned fields is often so scattered and the individual trees are bushed out to such an extent that the timber is of little or no value.

Future of Farm Woodlands

There are now thousands of acres of farm woodlands in New Hampshire that are not producing merchantable timber. Nor will they produce it for generations to come unless the owners follow a definite policy of weedings, improvement cuttings in young stands, and in merchantable stands for the purpose of obtaining the natural reproduction of suitable species. Unfortunately, stands on some farm woodlands have been reduced to such poor quality that the growth cannot be converted into good timber unless the owners go to unreasonable expense.

Table II.—Extent of the Forest Regions of New Hampshire*

Softwood Areas	Acres	Percentage	Hardwood Areas	Acres	Percentage
Pine (1)	1,346,149	29.2	Birch, Beech, and Maple (2)	1,241,541	26.7
Spruce and Fir (2)	995,101	20.8	Oak (2)	769,617	26.5
			Miscellaneous (3)	319,285	6.8
Total Softwood	2,341,250	50.00	Total Hardwood	2,330,443	50.0

Total All Regions Acres 4,671,693 Percentage 100

(1) U. S. Bureau of Entomology and Plant Quarantine. Blister Rust control date, January 1, 1946.
(2) U. S. Forest Service estimate 1946 adjusted for total forest area.
(3) Residual figures.

*Compiled by H. I. Baldwin, State Forestry and Recreation Commission.

Values of Different Kinds of Trees

Determination of Values

The value of a tree is determined by the demand for it in the form of lumber, cellulose, or other raw material. A tree that makes rapid growth, acquires a good form, is generally resistant to insect and disease attacks, and has strong durable wood that is easily worked, is a valuable commercial tim-

Old field, white pine stand.

ber tree. Good-quality white pine, red spruce, sugar maple, and white ash always have a ready market. Red pine has a ready market for telephone poles. A process is used to treat red pine poles so that the wood does not decay in contact with the soil. Usually, there is a fair market for the aver-

age run of hardwood growing on farm woodlands, especially in northern New Hampshire. The pulp industry is using more and more hardwood and softwood of all species.

White ash is valuable commercially, and woodland owners who are not too far from wood-using plants which use ash receive high stumpage prices for it. When valuable hardwood in limited quantities is some distance from a processing plant, it is often difficult to find a market; and if a buyer is found, the transportation cost to the wood-using plant is often excessive.

Changing Markets

The markets for forest products are constantly changing, a fact that often places a premium on a species that previously had been of little importance.

Classification of Values

New Hampshire timber trees may be classified on a basis of value as follows:

Valuable Species	Intermediate Species	Inferior Species
Balsam Fir	Beech	Alder
Basswood	Black Birch	Blue Beech
Black Cherry	Black Oak	Gray Birch
Hemlock	Beech	Ironwood
Hickory	Elm	Pasture White Pine
Red and White Pine	Red Maple	Pitch Pine
Red Spruce	Trembling Aspen	Pin Cherry
Sugar Maple	White Maple	Willow
White Ash		
White Birch		
Yellow Birch		

Growth and Yield of Wood and Timber

Things Upon Which Growth and Yield Depend

The growth and yield of wood and timber on farm woodlands depend upon the nature of the soil, the kind, quality, and density of growth, and the way in which a stand of timber is managed. Young stands of timber grow much faster than stands that have reached maturity. Fully-stocked stands of even-aged white pine on good soils often increase in growth at the rate of over 1000 board feet per year. However, the average even-aged pine stands grows at the rate of 500 board feet and less per acre.

Average Annual Growth

An estimated average annual growth for all woodlands in New Hampshire is one-fifth of a cord per acre. Such limited growth per acre results from past treatment of woodlands. Overcutting, grazing, and burning result in the under-stocking of most stands.

The total annual growth of saw timber in New Hampshire is computed as shown in Table III, page 11.

Table III.—Annual Growth of Saw Timber in New Hampshire*

Region	Softwood	Hardwood	Total
	Million Board Feet		
Pine - Hardwood	117.8	156.2	274.0
Pine	9.3	.5	9.8
Northern Hardwood	1.6	15.3	16.9
Spruce - Hardwood	32.2	42.8	25.0
Spruce - Fir	12.7	.7	13.4
	173.6	215.5	389.1

Includes sawtimber growth in all ages and types. Taken from Forest Reappraisal U. S. Forest Service, 1945.

*Compiled by H. I. Baldwin, State Forestry and Recreation Commission.

A tree grows in height and diameter. It grows faster in height during early life which is from 25 to 50 years. Its rate of growth in height is an excellent index of its adaptability to the soil and slope on which it is growing. The faster the height growth of a tree, the better the soil conditions for it, and the greater the volume of wood that can be grown per acre for that particular kind of a tree and other kinds of trees that do well under similar conditions.

14,000 cords of pulpwood in one pile from the forests of northern New Hampshire.

The increased growth of a tree in diameter is caused by addition each year of a new layer or ring of wood and a new layer of bark. In early life, diameter growth is relatively slower than height growth. As the tree becomes older, (around 20 years for white pine), there is a period when the diameter growth is rapid, unless its growth is retarded by neighboring trees. Diameter growth is influenced by the spacing of the trees in a forest. The approximate yearly diameter growth of trees in a forest may be observed by cutting an average tree and examining the annual rings on the stump. An increment borer is a convenient instrument for determining the yearly diameter growth of a standing tree. As the diameter of a tree increases, the

more rapid is the annual volume of wood increase in the tree. A relatively thin layer of wood laid on a tree of large diameter and height represents more wood volume than a thicker layer on a short tree of small diameter. In managing a stand of trees, the aim should be to maintain diameter growth of the well-formed, healthy trees in the stand.

A knowledge of annual rate of growth is of prime importance in calculating the amount of timber that can be cut from farm woodlands each year or in a period of years. Although detailed studies of growth are too complicated for most woodland owners to attempt, they can make certain simple observations. All too often, woodland owners cut their trees when they are starting to earn them the most money each year.

For example, the actual measurements taken on a 34-year-old white pine showed that it contained 70 board feet. If the tree is left to grow for ten more years (assuming that it maintains approximately the same rate of growth in diameter each year), the board-foot volume of the tree will be 130 board feet.

Growth of White Birch

On many northern New Hampshire woodlands, pure stands of white birch come in after land abandonment, a cutting, or a light burn. White birch has a ready market for lumber, turn stock, squares, pulpwood, and many other uses.

Table IV.--Merchantable Volume of White Birch of Average Density*

Age	Volume on Good Sites cds.	Volume on Poor Sites cds.	Age	Volume on Good Sites cds.	Volume on Poor Sites cds.
30	13.3	7.9	60	30.8	22.0
40	19.6	12.4	70	34.8	25.8
50	26.1	17.3			

*From U. S. Department of Agriculture Bulletin No. 166.

Growth of Inferior Species

Inferior species, such as gray birch, poplar, and pin cherry, which are rapid-growing and reach maximum growth in about 25 years, have seeded in on many woodlands areas and may hinder the growth of more desirable species. However, they may serve as a nurse crop while more desirable species are becoming established. Gray birch is of little value, except for cheap fuel, but poplar is used for pulpwood and excelsior wood. It has a ready market if located reasonably near a pulp mill or excelsior plant.

Table V.—Yield Per Acre in Fully-stocked, Even-Aged Stand of Hardwood of the Grey Birch Type*

Age	Volume per acre on good site cords
20	18.1
25	20.5
30	20.6

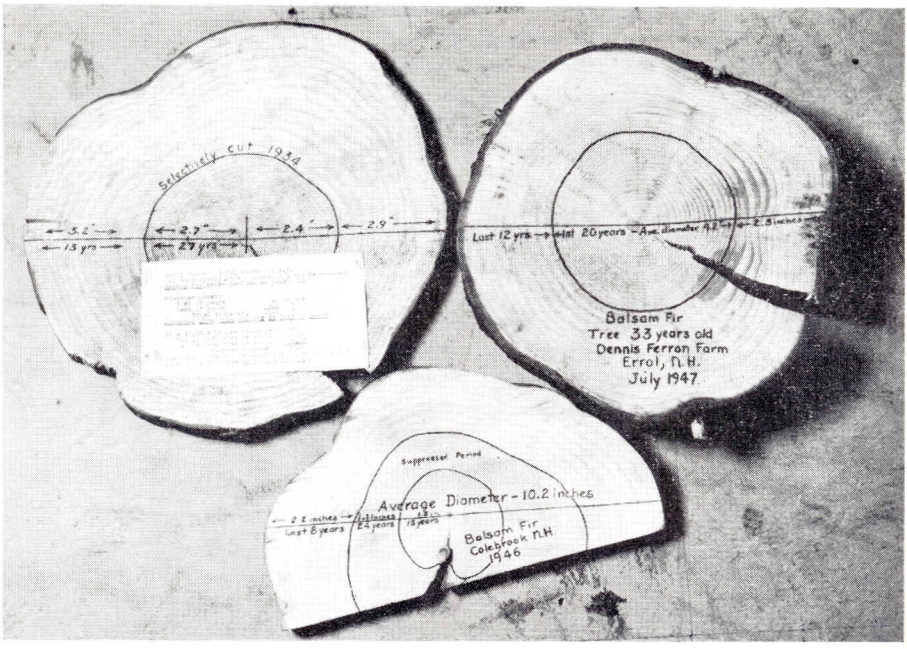
*From U. S. Department of Agriculture Bulletin No. 166.

Table VI.—Yields Per Acre of Well-Stocked, Even-Aged Second-Growth Stands of Trees on Average Sites*

Age, Years	Northern Hardwood				White Pine		Transition Hardwoods				Red Spruce		
	Cord Wood	Saw logs, plus cord wood		Current Annual Growth	Vol. per acre	Current Growth	Cord Wood	Saw Logs plus cd.wd.		Current Annual Growth	Peeled Pulp Wood	Saw Logs	Current Annual Growth
	Volume per acre						Volume per acre				Volume per acre		
	Cords	Ft. B.M.	Cords	Ft. B.M.	Ft. B.M.	Ft. BM.	Cords	Ft. B.M.	Cords		Cords	Ft. B.M.	Ft. B.M.
30	20.8	.....	.....	.....	9,600	.....	20.4	.....	.....	.....	.....	.....	.....
40	26.7	2,000	24.3	.....	23,500	1,390	29.4	1,920	9.1	.....	11.7	1,200	.....
50	32.8	4,500	22.9	250	36,600	1,310	36.0	4,780	12.3	286	29.1	6,200	500
60	36.5	8,200	22.6	370	46,900	1,030	41.1	8,660	10.2	388	44.2	13,300	710
70	40.0	10,900	20.6	270	56,100	920	45.6	4,710	7.1	405	54.2	20,300	700
80	.....	.....	.....	.....	64,000	790	49.8	15,380	6.1	267	60.0	24,800	450

Transition Hardwood: Red oak, white ash, red maple, basswood, yellow birch, aspen, sugar maple, beech, poplar, birch, and others.
Northern Hardwood: Sugar maple, yellow birch, beech, basswood, ash, and others.

**Management of Farm Woodlands, Guise.*



Difference in size of rings, resulting from selective cutting.

Farm Woodland Management

Farm woodlands should be managed so as to yield a continuous supply of forest products with the least effort on the part of the owners. Naturally, a farmer who strips the timber from his lands sacrifices the future income from his own property; and, if the people located near him follow his policy of clear cutting, he eventually helps to eliminate an important source of income for the community.

Plan for Growing Timber

If a farmer is to manage his woodlands properly, he must decide where timber should be grown on his farm. Then he should make a plan that can be used in growing, reproducing, and marketing a continuous supply of quality forest products. This plan need not be detailed — it may not even be on paper. But he should have clearly in mind how he intends to cut his timber in order to keep a continuous crop of trees on the land.

Estimate for Cutting

A farmer may well look upon his timber as a bank account that earns him a certain rate of interest each year. For example, if he has allowed the growth on his woodlands to reach the point where he has one million feet of merchantable timber, and the annual rate of growth is 3 per cent, his annual cut should be 60,000 feet if he is to keep his capital intact. If he does not cut for five years, the cut could be 300,000 feet. But most farmers, in order to put their woodlands in good growing condition, find it necessary to

overcut at the start in order to remove inferior material. Poor-quality stumpage should be marketed when the market is active and the demand for forest products is strong.

Natural Reproduction

Suitable timber crops may be established with little difficulty if the farmer uses good sense when he harvests merchantable timber. But it is difficult for most people to visualize the possibilities because no hard and fast rules can be made as to how merchantable timber should be cut in order to assure natural re-seeding. The following suggestions may help with the possibilities of cutting various types of merchantable timber to establish the natural reseeding of suitable trees.

Clear Cutting

Pine Stands. In even-aged pine stands, clear cuttings are often justified if made during a seed year, or if advanced reproduction is already established at the time of cutting. The practice is especially feasible if the trees are of poor quality and there is an opportunity to market them advantageously.

On the lighter soils, leaving pine seed trees will sometimes result in the re-stocking to pine, although it is not a practice that can be generally recommended. When seed trees are left, there should be at least 12 firm-rooted trees with good tops well spaced over each acre. It is seldom possible to find suitable seed trees that are properly spaced to leave.

Clear cutting is often practical in even-aged pine stands that are growing on heavy soils if there is a well-established desirable hardwood reproduction, with perhaps a mixture of white pine. Before clear cutting is started, it is advisable to cut back the young hardwood, allowing the softwood an even start and permitting the men to work to advantage in operating the stumpage. The slash which results from clear cutting should be lopped so that it will have direct contact with the soil. This hastens decay and lessens fire hazards. Slash handled in this manner will be fairly well decomposed within from three to five years. Such a precaution is especially important, if the cut area is near traveled highways, railroads, or areas where hunting is done. Another important reason for lopping brush and scattering it is to allow full opportunity for reproduction to become established evenly over the area. If the slash is unusually heavy, burning may be necessary, especially if it is located near a traveled road or railway.

Every few years there is a heavy seeding of white pine. For example, white pines were loaded with cones and dropped their seed during the falls of 1938 and 1947. The hurricane of September 21, 1938 destroyed many merchantable stands of white pine throughout southern and central New Hampshire. But a heavy seeding of white pine followed on hundreds of acres where the timber had blown over. There was a heavy reproduction of white pine seedlings in the spring of 1948 in areas where conditions were favorable for germination of white pine seed.

Hardwood Saw Timber. Clear cuttings are often justified in even-aged hardwood growth suitable for saw timber, especially if the timber is largely white and yellow birch. Excellent reproduction of pine, hemlock, spruce,

and fir, or an established crop of suitable hardwood will often be found under white birch timber and often northern hardwoods. If suitable reproduction is not established, or if the young seedlings are just getting established and will not withstand sudden exposure, it is wise to protect them with partial shade by leaving culls that are usually scattered through an even-aged stand of hardwood. If these culls do not die within the following few years, they may be girdled after suitable reproduction has become firmly established. But if a young growth is well established when the clear cut is made and can withstand sudden exposure, the scattered culls should be cut or girdled at the time of the clear cut.

Natural reproduction of spruce and fir resulting from clear cutting over small areas when spruce and fir are established beneath the merchantable trees.

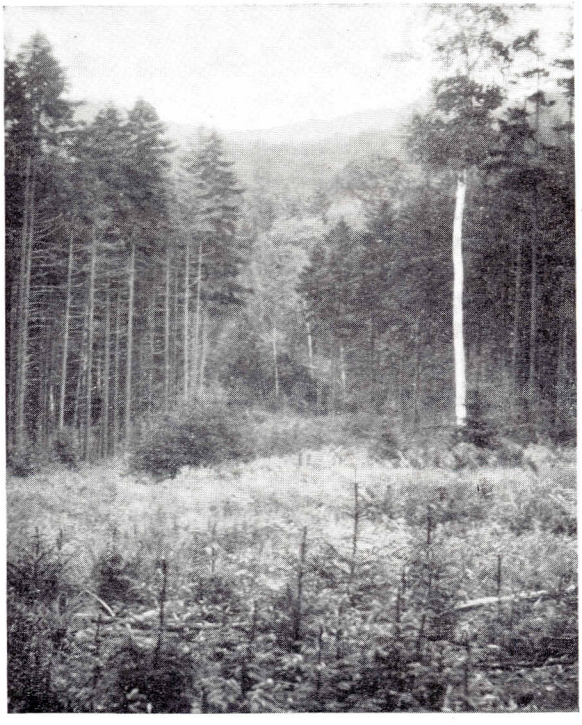
Spruce and Fir. In some stands of spruce and fir where the trees are tall and slender with small crowns, clear cutting is the only practical procedure to follow. However, when such a course is necessary, the area cleared should be small, unless suitable reproduction is established. Large-crowned and well-rooted spruce, often of little or no timber value, are occasionally scattered through tall, even-aged spruce and fir stands. These trees should be left standing as seed trees. If possible, areas selected for clear cutting should be where small spruce and fir seedlings are already established and have reached a height of two or three feet. Smaller spruce seedlings that have grown in the shade, where there is a heavy litter of needles, are not well-rooted; a large percentage of them will not survive a clear cutting.

Poor Quality Hardwood and Softwood. When farm woodlands are covered in part with a miscellaneous growth of hardwood such as gray birch, red maple, scrub pine, or a coppice (sprout) growth of hardwood of no value except for cordwood, often the only practical procedure is to cut clean and

start fresh with a new timber crop. If a crop of desirable timber trees has seeded in beneath this growth, the next crop of suitable timber is usually assured. But often it may be necessary to clear such areas of the poor-quality timber and establish the next crop by planting.

Partial Cutting

Under most conditions, farmers can apply partial cuttings when harvesting their merchantable timber. The distribution of trees of different sizes on



The red spruce reproduction in the foreground has come in on a strip cutting which was made five years before the photograph was taken.
(By Northeastern Forest Experiment Station.)

a timber tract allows the best opportunity to make annual or periodic cuttings. The danger lies in the tendency to cut the best trees and leave the poor. All too often the good-quality trees are cut when they are putting on a maximum growth. The term "selective logging or cutting", so often heard in the lumber industry and among foresters, is (or should be) synonymous with the term "partial cutting". The term applies to several kinds of cuttings, such as tree selection, group selection, and strip cuttings.

Group Selective Cuttings. In many woodland areas the variation in age, size, and quality is by groups of trees rather than by individual trees. In these stands, group selective cuttings are advisable. Care should be exercised to leave the fast-growing, well-formed trees for the final cut.

Strip Cuttings. Strip cuttings are sometimes made in even-aged softwood stands. The usual procedure is to make a clear-cutting strip about 100 feet wide on the side of the stand exposed to the prevailing winds. In a few years, when the cut-over area has seeded in and the reproduction is well established, the second strip should be cut and so on until the entire stand is gone over.

Tree Selection Cutting. Frequently, a form of tree selection cutting is combined with a strip cutting. At the time the first strip is cut, a portion of the trees are removed on an adjacent strip which is cleared in the next cutting. Usually some form of tree selective cuttings and group selective cuttings in various combinations can be applied advantageously on the average farm woodlands. But on the lot to be operated selectively for the first time, it is a good idea to establish a road system by clearing the timber to make roadways and then reach in from the cleared roadways for the trees that should be cut. These include rough trees, mature trees, and decadent trees that may be holding back the well-formed trees that are growing rapidly. Partial or selective cuttings are made with two important objectives in mind: (1) to establish the re-seeding of suitable timber trees; (2) to leave standing the immature trees, that usually will grow rapidly during the next ten-year period and thereby become more profitable to operate.

Cuttings in Pine Stands. Group or individual tree selection cuttings are desirable in pine stands that have seeded on abandoned fields or cut-over areas where small groups or individual pine that are coarser than the rest are often found. At the first cutting the groups or individual coarse tree should be removed. The openings should be kept small. (Usually they should not exceed one-fourth acre.) On medium to light soils group selection and individual tree selection is likely to result in suitable pine reproduction. Experience has shown that on medium to better soils, pine does not often follow pine even though the reproduction is satisfactory. Hardwood sprouts and seedlings will overcome and suppress pine in spite of periodic weedings to keep the pine ahead of the hardwood. Hemlock which is growing with pine should not be discouraged, for its presence tends to improve the quality of pine. Often, on light soils, the size of individual pine trees is apt to vary, and correct cutting practices become a problem of selecting individual trees. In all cases, the rapid-growing, well-formed trees should be left to put on the maximum amount of quality wood. Interfering poorer-quality trees should be cut.

If the pine growth is of fairly uniform quality and size, an individual tree selection cutting is often advisable in order to obtain natural reproduction. In such a stand one or more tree selection cuttings should be made approximately 10 to 15 years apart, prior to the final cut. At the time of the final cut, the newly seeded young pine should be well established, but not sufficiently advanced (under 10 feet in height) to be seriously damaged by the final cut. When opening up a stand where the trees are tall and of uniform size for the purpose of getting reproduction, care needs to be exercised by making light cuttings so as to avoid windthrow and sunscald.

In most even-aged pine stands, it is difficult to make a tree selection cutting the first time. Usually in the first strip cutting, cuttings which will serve as convenient roadways through it must extend into the stand. (A se-

lection of individual trees is desirable in the areas between the strips.) The road system should reach into all parts of the merchantable growth. Another practical way to make strip cuttings is to make approximately a hundred-foot cut on the leeward side of the lot. At the same time a tree selection cut can be made in the adjacent strip. Within a few years after reproduction is established, the second strip may be cleared and a tree selection cutting made on the adjoining strip. As already indicated, selective cutting in pine stands for the purpose of securing natural reproduction on the better soils is seldom possible because hardwood will usually take over regardless of the effort made to establish pine as the next crop. Generally speaking, well-formed, fast-growing pine should not be cut until it is at least 14 to 16 inches in diameter.

In some pine stands nearly all the trees are a poor quality. When such a condition exists, it is sometimes advisable to cut clean, especially if natural re-seeding can be established by cutting during a seed year or by leaving a few scattered seed trees on each acre.

Mixed Hardwood Saw Timber. Selective cuttings in even-aged, mixed hardwood stands are much more difficult to manage than in softwood stands, especially in the northern hardwood type of forests. All too often these mixed hardwood stands are cluttered with wide-spreading cull trees left from previous cuttings. When the time arrives to cut the merchantable saw timber, the operator is usually confronted with the problem of disposing of these low-grade trees. Often, when the culls are removed, the stand is so opened up that it is not safe to remove any of the good merchantable timber for fear of sunscald, windthrow, and the general decadence of the merchantable trees left standing. Therefore, in many of our merchantable mixed hardwood stands, the first cutting, instead of being a partial cutting, actually becomes an improvement cutting. Many of our hardwoods are so sensitive to change that not much more than 20 per cent of the volume should be removed at one time, and, all too often, this percentage is in the form of culls.

Cuttings in Yellow and White Birch. Yellow birch is the most difficult to manage in making selective cuttings. If too large openings are made as a result of selective cuttings, side suckers start and the trees commence to go to pieces at the top. White birch is not as sensitive to change as yellow birch, but it, too, will soon begin to die if large openings are made. Generally the woodland owner will find it advisable to clear cut even-aged northern hardwood, especially if advance reproduction is established. Where there is not suitable reproduction the clear cut areas should be limited to openings of about one-half acre. Maples are not nearly as sensitive as birches. Beginning in 1945, the Bronze Birch Borer *(see page 38)* has done much damage to white and yellow birch, especially in mature stands. In many areas this pest has killed all merchantable birch. When there is evidence that the birch is being damaged by the borer or from other causes, it should be salvaged at once before the damage becomes serious.

High-grading Timber Stands. In most of the so-called selective loggings, as carried on in our mixed hardwood stands, the operator takes the best and leaves the culls. The term applied to this kind of cutting is "high-grading a timber stand." In making a sale of merchantable hardwood, the farmer should go through his woodlot and mark the merchantable trees that

appear to have passed the period when they are putting on rapid growth. (Often these trees show signs of decay.) The well-formed, rapid-growing, desirable hardwood should be left standing. At the same time that the timber cutting is being made, culls that are interfering with the growth of the desirable hardwood should be removed. In making a selective cutting, care needs to be exercised to avoid injury to the standing timber and unnecessary damage to young growth that may be already established.

Small Group Selective Cuttings. In order to get away from some of the difficulties of selective cutting of individual trees in northern mixed hardwood stands, it is sometimes advisable to make small group cuttings. They should not be over one-half acre each. The following suggestions are given for this group selective cutting. If possible, select spots where seedlings of desirable species are already established. (It would be well to cut back all the hardwood seedlings before cutting the timber.) Insofar as possible, avoid leaving yellow birch standing on the edge of such a cutting. Cut the opening clean so that there will be no trees standing. The culls and tops should be utilized if possible. The brush can be scattered. The openings should not be too close together, but they should, of course, be connected by a logging road. Standing timber, adjacent to the cuttings, should not be cut until reproduction is well established in the openings. A farmer who adopts this method of cutting in northern hardwood should carefully watch how well reproduction becomes established in the openings and what the effect is on the standing adjacent timber. He should make every effort to utilize the poor-quality wood and timber along with the higher grade material.

In the so-called transition hardwoods, (oaks, birch, maple, ash, basswood and other hardwoods) found growing on the better soils of southern New Hampshire, an individual tree selective cutting can be made with

Group selection cutting in a spruce-fir stand to get reproduction.

less difficulty than in the northern hardwood type (beech, birch, and maple). Generally speaking, hardwood for sawtimber should not be cut until it is at least 16 to 18 inches in diameter.

Cuttings in Spruce-Fir Stands. In spruce-fir stands every effort should be made to favor spruce. Fir is a short-lived tree and the wood is not as valuable for lumber as spruce. Most of the stands in northern New Hampshire have a high proportion of fir, usually over 60 per cent, a condition that occurs because fir becomes established much more readily than spruce on abandoned fields and areas where cuttings have been made. In making selective cuttings, care must be exercised not to open up the stand too much. Where the distribution of spruce and fir over an area is rather evenly divided, the stand will be left in a good growing condition by removing the poorly formed spruce, the mature fir, and the fir that are interfering with the spruce. Where the stand is almost entirely fir, the mature fir and the trees with small crowns which are crowding the more vigorous trees should be removed. It is important to leave the scattered spruce that may be mixed with the fir. A safe rule is not to remove more than 30 per cent of the volume in a selective cutting. In many instances, the percentage of removal should be much less. At the time a selective cutting is made in a spruce-fir stand, or within two years following, scattered cull hardwood that may be overtopping the spruce and fir should be cut or girdled. Spruce-fir stands which grow on flat, moist areas and on many moist hillsides that are exposed to high winds are especially subject to windthrow as the trees are very shallow-rooted on such sites.

Some woodland owners have been successful in maintaining a suitable reproduction of spruce and fir by making group selection cuttings of about a half-acre or less. Suitable reproduction is often established in this manner, but when it is done the owner sometimes sacrifices thrifty spruce and fir that should be left to grow for several years. In other cases, satisfactory reproduction of spruce and fir has been obtained by strips on the leeward side of the lot, or by running strips through the lot to make the wood and timber accessible when it is cut for the first time. Like pine stands, most spruce and fir stands lend themselves to a combination of individual tree selection and group selection cuttings. Generally speaking, well-formed, fast-growing spruce should not be cut until it is at least 16 inches in diameter; fir should be at least 10 inches in diameter.

Woodland owners are generally encouraged to convert all spruce and fir into pulpwood. But the farmer who owns standing spruce and fir should reserve some of his better spruce for lumber, especially where it is needed for the repair or construction of his farm buildings.

Marking Trees for Selective Cutting. The best way to start a selective cut, especially where individual trees are to be selected, is to go through the area to be cut, and mark the trees that are to be felled with cheap red or yellow paint. Then, after the marking is complete, cutting can begin. Choosing the trees and cutting them at the same time causes too many mistakes. Trees can be blazed with an ax or hatchet if they are to be cut immediately. The painting method is quicker, and the marks are easier to see and to erase in case of error. It also does not injure the tree.

In this illustration of strip cutting, the owner, in getting out pulpwood, cleared a strip along the leeward side of his woodlot. As it was a seed year, a good reproduction of fir and spruce may have occurred. However, there is danger of getting a dense cover of bushes and other vegetation that tends to retard the growth of suitable reproduction. Another disadvantage is that many fast-growing spruce that should be left to develop into timber trees are cut for pulp when a strip cutting is made.

Paint that is used in a spray gun or paint gun should be diluted with kerosene. Mark the tree twice — once at about breast height, and once below the stump height. Both marks should be on the side of the tree where buyers and cutters are most likely to see them.

Artificial Reproduction by Planting

Suitable Areas

Planting should be resorted to when it is not possible to establish a new timber crop from natural se-seeding. The problem always arises as to where, when, what, and how to plant so a suitable timber crop eventually can be harvested. Abandoned pastures which are starting to graw up to junipers, gray birch,, and hardhack, abandoned fields, cut-over areas not restocked by natural re-seeding, and sometmes openings in the woods that do not seed in are usually suitable areas for planting. On areas where vigorous hardwood sprouts, weed trees, or brush predominate, numerous weedings will be necessary for several years following planting. Where softwood, such as pine, is cleared from the land, planting should generally be delayed until the third growing season following the clearing, in order to avoid damage to the plantation by the Pales weevil. *(See page 38.)*

Stock for Planting

Forest trees should be planted in the dormant stage in moist soil in the spring or fall. (Spring is preferable.) Forest trees which are grown in a forest nursery make the best stock to use. Some success has been achieved, too, by digging up small pines in places where they are too thick and transplanting them. But, for the most part, transplanting small seedlings is not practical and is a very time-consuming job.

Kinds of Trees to Plant

White pine has been used for planting more than any other species. In southern New Hampshire, however, it is liable to be seriously damaged by the white pine weevil, and it is always subject to damage from white pine blister rust unless all currant and gooseberry bushes are eradicated within a radius of 1,000 feet of the trees. The weevil is not as serious a problem in the northern part of the state; but the currant and gooseberry bushes are generally more abundant and the cost of keeping them eradicated from around the plantings may be prohibitive. Consequently, landowners have turned more and more from white pine to other species for planting, or are planting white pine and other species by groups. Mixed plantings in groups are to be encouraged, but planting mixtures in alternate rows is not practical because of the difference in the rate of growth between species. (Some farmers in northern New Hampshire are planting balsam fir for the purpose of growing Christmas trees*.)

Pine suffers the least of all species when it is transplanted from the forest nursery. But considerable care must be used in planting spruce. If planted too deep, the young trees do not make growth because the roots are smothered. The establishment of hardwood by planting has only been tried to a limited extent under New Hampshire conditions; consequently, it is not advisable to make definite recommendations about it. A few maple sugar producers have successfully transplanted young sugar maple trees. The following species may be used on well drained loams throughout the state: *Softwoods*—white pine, red pine, white spruce, red spruce, northern white cedar, balsam fir, and hemlock; *Hardwoods*—red oak, white oak, white ash, sugar maple, †poplar, basswood, and ‡black locust. Plant-

*See *Extension Circular 278, Christmas Trees a Cash Crop.*

†Poplar should be cultivated for two years if planted in grass sod or old fields or pasture.

‡Black locust plantings should be cut back to the ground in the second and third years to get vigorous sprout growth capable of resisting the locust borer.

Cutover land.

Field planted with red pine, planted 3 years.

Field planting with red pine, planted 15 years.

ings of spruce, northern white cedar, and balsam fir should be largely *confined* to northern New Hampshire. Plantings of oak and locust should be *confined* largely to southern New Hampshire.

White pine and red pine may also be planted on very light, sterile, sandy, or gravelly soils.

Size of Stock

For all softwood (coniferous) stock, 2-2 transplants (grown in the nursery four years, transplanted the second year) are recommended for general use; but stocky 2-1 transplants (grown in the nursery three years, transplanted the second year,) or 3-0 root-pruned seedlings (grown in the nursery three years without transplanting but root pruned) are sometimes satisfactory when not less than six inches high. For hardwood, 1-0 seedling stock not less than six inches in height may be used. The four-year softwood stock should be used when transplanting in heavy sod or where there is an abundance of hardwood stump sprouts.

Planting

Heeling-In. As soon as trees are received from a nursery, they should be heeled in (if they are not to be planted immediately) on shady wet ground, along the edge of a brook, for instance, near the place where the planting is to be made. Dig a shallow trench and lay the trees in it. If possible the tops should point toward the south. To prevent heating, the strings on the bundles need to be cut when heeled in.

General Method. When the trees are planted, 50 to 100 trees at a time should be taken from the place they are heeled in or from the crate in which they were shipped and placed in a pail or some convenient container, and arranged so that the roots are covered with wet moss or a small quantity of water. It is of the utmost importance to keep the roots of a tree from exposure to the air and sun before planting. Trees should be carefully and firmly set upright in the ground at approximately the same depth as in the nursery. The roots should be spread as nearly as possible in a natural position but the ends should not protrude from the ground. Several kinds of tools (mattock, shovel, crow-bar, and special planting tools) are used in planting trees. When the mattock is used, the sod is torn out and the soil loosened up so the tree is easily planted.

Slit planting. Slit planting, with a specially designed shovel or tool, is used quite extensively. The tree should be carefully placed in the slit and then both sides of the slit should be firmly pushed together with the heel. Roots should be carefully spread out in the hole made by the planting tool, and precaution must be taken not to leave them dangling in an air pocket. There are some advantages in slit planting. It is faster, works better in a rocky soil, and lessens the danger of frost heave. When a mattock is used, the trees are usually planted with greater care. Two men can easily plant carefully 1,000 trees a day.

Spacing. It is advisable not to space trees more than 8 x 8 feet. In open pastures and fields a closer spacing is often desirable, especially for white pine except on sprout lands where a 8 x 8 foot spacing is feasible.

The following table shows the number of trees per acre, according to different spacings:

Table VII.—Number of Trees Per Acre According to the Spacing

Spacing FEET	Number of trees per acre
3 x 3	4840
4 x 4	2722
5 x 5	1742
6 r 6	1210
7 x 7	881
8 x 8	680

Checking. A new plantation should be checked during the next few seasons after planting, with the purpose of filling in the places where trees have died.

Home Nursery

Some farmers may find it practical to grow trees in a home nursery, but most of them purchase forest trees from commercial or state forest nurseries at cost. Starting a home nursery is simply a matter of care in preparing the seedbed, weeding, and watering.

Special Precautions. The only special precautions different from those for ordinary garden crops are that the seeds need to be protected from birds and mice and the seedlings require shade in their first year. For these reasons tree seeds are usually sown in a bed 12 x 4 feet. A frame two feet high and covered with small-mesh poultry wire is made around this. Over the top goes a lath screen which keeps out 50 per cent of the direct sunlight. Better drainage can be secured by raising the seedbed six inches above the general level.

Prevention of Damping-Off. Every precaution should be taken to prevent damping-off, a disease that often attacks newly germinated seedlings in the nursery bed. The following treatment for its prevention is suggested: After the seedbed is sown, excavate a deep hole near the seedbed, and use the subsoil from a depth of two or more feet beneath the surface for covering the seed. If this method is not used, the soil should be sterilized by an acid treatment, solution of one per cent commercial formalin and 100 to 200 parts water at the rate of 1½ gallons per square foot of seed bed. As formalin will often kill the seed if used at the time of seeding, it should be applied about 10 days prior to seeding.

Care of Seedbed. When the seedbed is ready for sowing, 10 ounces (for white pine) of seed should be sown broadcast and covered by sifting the sterilized soil over it. Only fall-plowed land should be used. Weeding is very important and must be done several times during the summer. Watering during dry weather is also required, especially for the seed beds in their first year.

Transplanting Seedlings. If the seedlings grow well the first year, they may be transplanted into rows wide enough apart for cultivation by

a horse or hand cultivator. The small trees should be about 4 inches apart in the row. If very hardy trees are desired, they should be transplanted at the beginning of the third year; but usually 3-year-old trees, once transplanted, are vigorous enough.

Expenses. Raising young trees is essentially a gardening job, and is expensive because of the unusual care required in weeding and transplanting. It is also difficult to get seeds. Tree seeds are more expensive than garden seeds because trees do not seed abundantly every year. The seeds are borne high upon the tree where it is difficult to get at them; and they must be removed from the cones, and cleaned of wings. Then poor seeds must be sorted out and the good ones stored for future use.

Table VIII.—Amount of Tree Seed by Species Necessary for a Nursery Bed 4′ x 12′

Species	Amount of True Seed	Species	Amount of True Seed
White Pine	10 oz.	White Spruce	8 oz.
Red Pine	6 oz.	Hemlock	8 oz.
Red Spruce	6 oz.	Balsam Fir	12 oz.

Transplanting Wild Trees

A few farmers have been successful in transplanting wild trees. But if the time and labor involved in harvesting them is figured, it will be much cheaper to get the trees from a nursery. The survival is also liable to be low even when the greatest care is used in digging and transplanting the trees. It is not advisable to move trees over a foot and a half in height, when transplanting them. Transplanted wild trees will have little chance to survive if they are moved to areas where the soil and light conditions vary radically. Broadcasting seed in order to secure a suitable catch of desirable tree species is ineffective and costly.

Seed-Spot Method

Suitable softwood and hardwood reproductions have been obtained by planting tree seed on an area in need of restocking. Pine plantations have been established in this manner. While it is difficult and usually impractical to establish hardwood plantations by planting, suitable hardwood plantations, such as maple, oak, and hickory, have been established by the seed-spot method. Seed spots should be spaced about three feet apart. The depth of planting should be about twice the thickness of the seed. When planting small seed such as pine, about six seeds should be placed in each seed spot. When planting oak or hickory seed one or two seeds to a spot should be sufficient. There are always the dangers that the seeds may be destroyed by rodents or that the young seedlings, if they germinate, will be smothered by overtopping brush and weeds.

Selling Tree Seeds

Collecting tree seed for the purpose of selling it to dealers of forest tree seed or direct to commercial or federal and state forest nurseries often will add to the farm income. Before seeds are collected, the op-

portunities of marketing them should first be determined. The demand and price paid for different species of tree seed change from season to season. The collector should obtain definite instructions for collecting and cleaning the seeds so that they can be placed on the market in satisfactory condition.

The seed yield varies with individual trees, the quality of the fruit and the completeness of the seed extraction. The cost of collection is equally variable, and there is a great variation in the yield of seed per bushel of fruit. The average yield in pounds per bushel of the fruits for a few of different species in New Hampshire is given here.

Table IX.—Pound Per Bushel of Fruits

Species	Pound per Bushel	Species	Pound per Bushel
White Pine	1.1 lbs.	Shagbark hickory	30 lbs.
Red Pine	1. lb.	Red oak acorns (clean)	50 lbs.
Butternut (husked	40 lbs.	White oak acorns	70 lbs.

Table X.—Number of Tree Seed in a Pound by Species

Species	No. of Seed per Pound	Species	No. of Seed per Pound
White Pine	26,800	Balsam Fir	43,800
Red Pine	61,420	Arborvitae	284,300
Norway Spruce	59,400	Yellow Birch	424,600
Red Spruce	131,400	Paper Birch	711,680
Eastern Hemlock	194,200	Sugar Maple	7,160
		White Ash	6,240

Weedings and Improvement Cuttings

The term "weedings" applies to young stands approximately 15 years of age and under. The term "improvement cuttings" refers to older stands that have never been weeded and where there remains an opportunity to bring through a timber crop by the cutting of the inferior trees that are interfering with and overtopping desirable crop trees.

On farm woodlands over the state, there are both large and small areas where young and desirable crop trees (such as well-formed white and red pine, spruce, fir, hemlock, white and yellow birch, white ash, red oak, basswood, hickory, black cherry, and sugar maple) are being crowded and smothered by overtopping weed trees (such as gray birch, pin cherry, red maple, rank-growing stump sprouts, and ill-shaped hardwood and softwood). When weed trees are allowed to dominate an area, the potential crop trees are severely reduced or eliminated. Weeding with the purpose of bringing through young timber growth is often a necessary operation in the care of a growing timber crop. Excellent plantations of pine are often destroyed by overtopping weeds after an investment of more than 15 dollars per acre has been made in planting the trees. Weedings are necessary where natural seedings of softwood or desirable hardwood, or both in mixtures, or softwood plantations have been overtopped and suppressed by

weed trees such as gray birch and rank-growing stump sprouts of oak and maple.

The valuable hardwoods will be found on the better soils. In young stands on the best soils it is not uncommon to find as many as 10 different hardwood species in mixtures and densities of stocking in excess of 5000 trees per acre. And, in many cases, stands on the moderately fertile soils also contain a sufficiently good stocking of hardwood trees to permit the development of a satisfactory saw-timber crop. With a lowering of soil fertility the opportunity for hardwood saw-timber production becomes progressively less favorable until finally on the light sandy soils the only possible hardwood crop is cordwood or some other product of low quality. It should be strongly emphasized that growing high-quality hardwood crops demands good soil.

Weed trees overtopping planted white pine.

The most effective examples of weedings and improvement cuttings in New England are in the Yale Demonstration Forest at West Swanzey, N. H., and the Harvard Forest at Petersham, Mass.

How to Weed

The tops of the crop trees should be freed by cutting the overtopping weeds. There is always a tendency to do too much work when weeding a young forest. Cut only those weed trees that are overtopping or interfering with the tops of the growing crop trees. All other growth in between the crop trees which does not overtop nor interfere with their tops should be left for trainers which will help to improve the form and reduce the size of the knots on the crop trees. If the weed trees to be cut are

not large enough for fuel, they should be cut and left on the ground to decay. When cutting back soft maple or oak sprouts, it is best to sever the stem completely from the stump. If the stems are not completely severed, they are likely to live and make the area very difficult to get through, especially in case of fire. When the growth is not too large, averaging four inches and under in diameter, one man should be able to weed an acre a day.

A red pine plantation that was soon overtopped by weed trees after planting. Later, part of the plantation was weeded. The suppressed pine are the same age as those which were free to grow. (By Harvard Forest.)

When to Weed

Early or late winter, when the snow is not too deep and when other farm work is slack, is the best time to weed. It is also easier to see the softwoods when the hardwoods are without leaves. However, some species, such as birches, are often difficult to distinguish when the leaves are off, and there is danger of cutting back thrifty white birch that might be mistaken for gray birch. Under such circumstances the weeding should be done in the fall before the leaves fall or in the early spring after the leaves are out. When working with stump sprouts, the growth of the sprouts may be retarded if they are cut back in late summer. When the sprouts are cut back at this time of year, fresh sprouts usually start and they, in turn, are often killed back by the first heavy frosts. If the stumps from which the sprouts are growing are badly bruised, decay will be more rapid, thus weakening the sprout growth. Many farmers have been successful in retarding the growth of sprouts by bruising the stumps.

Delayed weeding in a young stand may result in serious damage to the young crop trees. The weeding should be done as soon as the weed trees are overtopping or crowding the tops of the crop trees. The number of weedings needed on an area depends upon the rapidity of growth of the sprouts from the stumps of the weed trees following the first weeding. Weeding is very effective in stands of white pine overtopped by gray birch. In this type of growth it is often desirable to let the gray birch trees

reach fuelwood size, if they are not doing noticeable damage to the pine. They should be cut regardless of their size when the pines show evidence of suppression or abrasion caused by the rubbing of two branches back and forth. Under average conditions, if the pines are 12 feet or more high at the time of the first weeding, a second weeding of the gray birch will not be necessary. If the weed trees are dense and the softwood is weak and spindling, a partial weeding is desirable at the start to prevent sudden exposure. In areas where the white pine weevil damage is serious, a partial releasing is desirable because the weevil damage to the pine will not be as serious when a partial shade exists. On cutover hardwood areas, when the crop trees are desirable hardwood or softwood or both, it is necessary to do the weeding when the young timber crop is less than 12 years old.

How to Make Improvement Cuttings

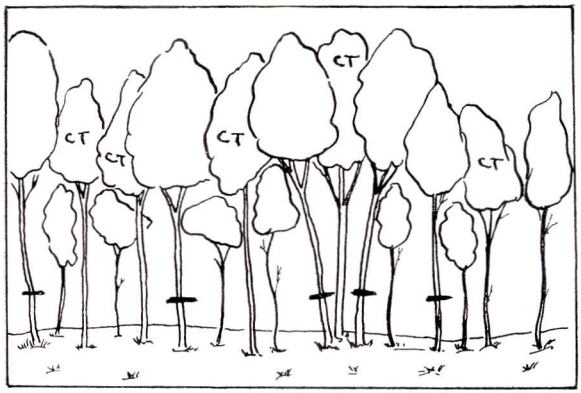
Many young, even-aged mixed hardwood stands (under 40 years of age) have never been weeded. The white ash, red oak, maple, white birch, and other desirable species are badly suppressed by weed and inferior trees that should have been eliminated when the timber crop was getting established. These desirable trees may have their growth retarded and often may be damaged by the overtopping weed trees, but a desirable timber crop usually can be brought through by making an improvement cutting.

A managed young hardwood stand in the Harvard Forest. Excellent hardwood (28 years old) has come in as a result of volunteer growth on cutover pine land. The desirable hardwood has been kept free to grow by keeping the overtopping weed trees cut back.

Light Cuttings. Improvement cuttings should be as light as possible and still accomplish their purpose. In stands which tend to be understocked, or which run strongly to weeds, care should be taken not to make large openings in the crown canopy. High density of stocking is necessary in order to keep the branches small. Few of the natural stands of mixed hardwood or mixed hardwood and softwood have ever been weeded.

In Second-Growth Stands. Improvement cuttings are necessary if many of the second-growth stands are to be saved

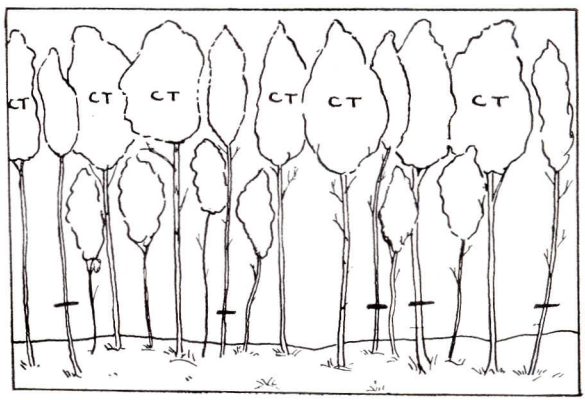
for timber. All too often the farmer, in getting out fuelwood, will clear-cut a second-growth hardwood stand that could be saved for timber production. He should remove for fuel the inferior and weed trees that are interfering with the desirable crop trees.



CT represents the crop trees, the best formed and thrifty growing trees. Trees marked with a dash are to be cut. They are poorly formed and are interfering with the selected crop trees. Note that trees not up into the crowns of the crop trees and trees not interfering with the crown development of the selected crop trees should not be cut. The smaller trees often act as trainers for the crop trees.

Girdling. On many areas old culls have been left from previous cuttings. Often these spreading hardwoods or rough softwoods are growing when a new timber crop becomes established. When this condition exists young desirable growth may be badly damaged or destroyed if these are cut, and it is often impractical to work such trees up into wood. Under these circumstances, such trees should be girdled and allowed to go to pieces gradually. In some pine stands a large number of the trees are rough, because they started in fields and pastures in advance of the full stocking of the area. With the removal of the rough trees for cheap lumber, the better-quality pine are given an opportunity to develop. In many white pine plantations that have been severely damaged by the white pine weevil, dominant, ill-shaped trees can sometimes be girdled to advantage. This practice gradually lets light down into the plantation and gives the surpressed, better-formed pine an opportunity to come through. But the practice should be used only when there is not a suitable market for the rough pine that needs to be removed from the stand.

CT represents selected crop trees. Trees marked with a dash are to be cut. After some form of improvement cutting has been made, the crowns of the trees that are left develop so that crowding results as the stand gets older. This makes a thinning necessary. Save the best formed crop trees with well developed crowns, but mark for removal those trees with small, poorly formed crowns that are interferring. Care should be taken to leave all smaller growth.



Tools. Most farmers use a sharp, light axe for weeding and improvement cuttings. When working on small trees, however, other tools, such as trench knives, machetes, bush scythes, meat cleavers, bill hooks, double action clippers, and special bush hooks, have proved effective.

Thinnings

Rule for First Thinnings. As the young timber crop grows older, the crop trees begin to crowd each other. The yearly growth rate becomes less when root and crown competition start. In young growth the greater the density the better, because the crop trees will develop straighter stems and smaller side branches. In well-stocked, even-aged pine stands, the first thinnings should be made when the stands are around 25 to 30 years of age. No definite time can be set as to when first thinnings in uneven and even-aged mixed stands of hardwood, and mixed hardwood and softwood stands are desirable. It depends upon the density of the growth, the species, and many other factors, including soil conditions.

First thinning of white pine about 30 years old. Product is converted into pulpwood.

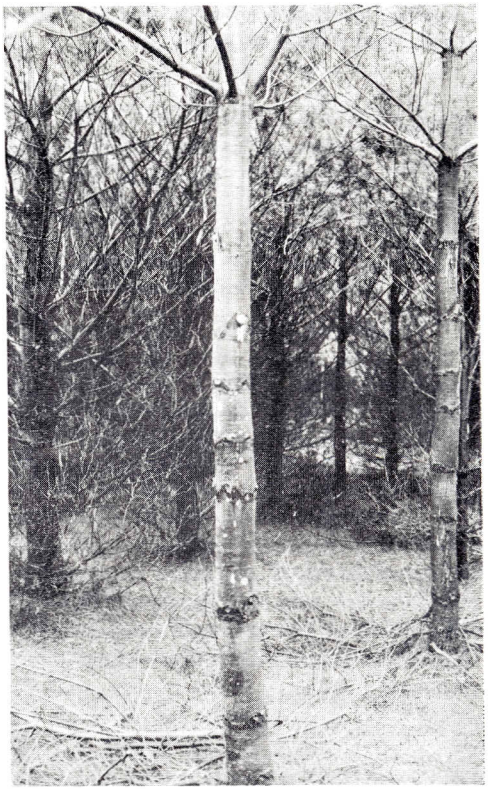
The objective of thinning is to allow sufficient room for crown development of crop trees, but care must be used not to open up a stand too much. In making a thinning it is important to look up into the crowns. It is usually desirable to leave a tree with a good crown and a good stem for the crop tree. The near-by tree that is hindering its crown development may be the tree that should be removed in a thinning.

General Rule. The following rule can be applied in most stands. First, go over the area to be thinned and select the desirable timber trees that are to benefit by the thinning. Then cut the trees that are interfering with the selected crop trees even. Thinnings should be light and made often, in order to keep a good crown cover and yet maintain maximum growth of the crop trees. If these thinnings are made frequently, so that the crowns of the selected crop trees will close in within less than a 10-year period, it will not be necessary to exercise so much care when making the final thinning. If this is done, many of the dangers of windthrow and other difficulties that result from a sudden opening of a stand are avoided. By means of early thinnings, the crop trees develop better crowns and substantial root systems, thus making it possible for them to withstand the pressure of the wind and maintain maximum growth.

Pruning

The owner of a woodlot will sometimes find it practical to do selective pruning in young white pine stands. Only well-formed, dominant

white pine between two and eight inches in diameter should be pruned; and only trees that will make up the final crop should be selected for pruning — not over 300 trees to the acre. The branches should be cut flush to the trunk of the tree with a saw or clippers for the purpose of developing a 12- to 16-foot clear butt log. When cutting green limbs, never prune over one-half the height of the tree. If it is necessary to make more than one pruning to reach the required height, space the prunings not more than two or three years apart.



Selective pruning in a young stand of white pine. Prune only well formed trees between two and eight inches in diameter so as to develop clear butt logs, 14 or 16 feet.

Protection of Growing Timber

There can be no enthusiasm for growing quality timber if farm woodlands are not properly protected from forest fires, injury from livestock, and the attack of insects and diseases. Any one or all of these can severely or completely destroy growing timber.

Forest Fires

Fire is one of the destructive enemies of growing timber. In New Hampshire, a well-organized forest fire protection system keeps forest fires at a minimum. Records, during a five-year period, show that forest fires result from the causes shown on the following table.

Table XI.—Causes of Forest Fires and Percentage of Damage

Causes	Per Cent Total Number of Fires	Per Cent Total Areas Burned	Per Cent Total Damage
Smokers	31.3	53.4	56.3
Burning Brush	24.6	13.1	2.3
Railroads	16.4	7.2	1.8
Miscellaneous	13.8	16.9	35.3
Lightning	4.9	.9	.3
Lumbering	2.3	1.7	2.7
Camp Fires	2.8	.7	.1
Incendirary	1.2	1.2	.2
Unknown	2.7	4.9	1.

The summary of averages of the New Hampshire Forest Fire Record for 37 years is as follows.

Table XII.—Summary of Averages

Average	1945	1946	37 years
No. Fires per year	319	402	400
Areas per year (acres)	1,116	2,989	7,790
Damage per year	$4,799.00	$106,517.00	$58,375.56
Area per Fire (acres)	3.5	7.4	19.5
Damage per Fire	$10.59	$264.97	$143.78

Dangerous Season. The serious forest fire season in New Hampshire comes in the spring after the melting of the snow, prior to the time new vegetation starts. But a forest fire may occur at any time of the year during a period of drought. One of the most destructive fire periods in years, when there were serious fires in southern New Hampshire and Maine, occurred in October, 1947, as the result of a prolonged drought.

Hazardous Areas. Some of the most hazardous fire areas in New Hampshire are in the southern half of the state on areas where the soil is light and dries out quickly. The hazards are very great in spring when the dry leaves, brush, and grass will ignite from the least spark. These areas are densely populated, and many people from states to the south drive into them in spring, thus greatly adding to danger of fire caused by carelessness.

State and Town Fire Wardens. The State Forestry and Recreation Commission has fire wardens and deputies in all towns. The Forest Fire Warden is responsible for the suppression of forest fires in a town. The District Forest Fire Chief, who is responsible to the State Forester, works with the Forest Fire wardens in bringing about a co-ordinated forest fire protection program for a district. Many towns have excellent equipment and, in some instances, well-trained crews for fighting fires. But in other towns more adequate fire fighting equipment is needed, and fire fighters need to be organized and trained to fight forest fires.

Educational Programs. The public should be constantly urged to prevent forest fires. Records show that smokers cause the greatest number of fires and this fact must forcibly be brought to general attention. Another menace (and one that should be repeated over and over again) is the danger from householders in rural areas and the outskirts and suburbs of villages and cities when they burn rubbish in their backyards and try to burn grass in spring. Occasionally, it is necessary to close the woods under the provisions of a state law, when the fire hazard is extremely serious. When this law is invoked, all outdoor burning is prohibited.

Wide educational community programs for pointing out the dangers of forest fires are very important. Local organizations should take the responsibility of co-operating with forest fire wardens in this work. This may be done by the use of posters, educational motion pictures on fire prevention and protection, discussions of forest fire hazards at local meetings, and full observance of forest fire laws at all times. Boy Scouts and Girl Scouts and members of 4-H Clubs and other youth organizations can assist in putting

up fire posters and can patrol the roads near woodlands at times of unusual fire hazard. Valuable work along these lines is being carried on in some towns at the present time.

Local Aids in Fighting Fires. In many rural towns water holes have been located at strategic points; with adequate fire-fighting equipment, the water stored in this manner is a real asset in quickly suppressing a fire. Property owners should co-operate with forest fire wardens in preventing and suppressing forest fires. It is desirable for every farmer to have fire-fighting tools, such as shovels and rakes, that he can easily locate for use in case a forest fire starts on his property or in the immediate vicinity.

Live-Stock Grazing

Woodland Pastures. The pasturing of approximately one-half million acres of New Hampshire farm woodlands presents serious problems in good forest management. At one time, much of this area was fairly good pasture and supported many head of livestock. Changing economic conditions and the gradual depletion of the soil fertility has resulted in pastures growing up to brush and trees. Today, many of the so-called woodland pastures are in such a state of depletion that they support neither suitable grass nor trees. Large acreages have reverted to juniper, hardhack, and similar vegetation that grows on exhausted soils. The problem cannot be solved by a blanket recommendation that the farmer fence his livestock out of the woodland. It is necessary that he work out the farm plan mentioned before, wherein he decides which parts of his farm should be in woodland, pasture, and tillage. After he arrives at such a decision, his efforts should go toward improving the pastures and growing good timber in the woodlands.

Many farmers fail to realize that they do not obtain the greatest efficiency from their dairy herds when the animals are forced to browse among trees and brush. However, the pastures are so badly depleted on many New Hampshire farms that the farmer does not know what to do, and it is difficult to advise him. Many of these farms may be in low-producing areas. It is possible that the only practical course is to allow nature to continue the march back to the forest.

Woodland Damage from Grazing. Some of the woodland damage which results from grazing includes browsing and breakage of young trees, compaction of the soil, and root injury by trampling. Grazing also causes increased erosion, formation of bushy trees rather than timber trees, changes in the composition of the growth, and formation of stands of worthless brush and weed trees. Insects and fungi are increased because of wounds and the weakening of the trees, pulling up seedlings by the roots, and breaking of the forest cover by concentrated grazing on small areas or paths.

Browsing (which includes chewing off of small twigs as well as leaves by farm animals) weakens, deforms, or kills young timber growth. Most of the damage is done to trees three feet and under in height. Valuable hardwoods, such as maple, ash, and oak, are browsed by light to moderate grazing, while the undesirable hardwood, such as ironwood and gray birch, are browsed to a much lesser degree. As for softwood, spruce is rarely damaged, and hemlock, white pine, and fir only under heavy grazing.

Breakage is another important form of damage. The major damage is to softwood, especially pine and fir, often in and adjacent to open areas where the cattle congregate. One serious result of grazing in so-called woodland pastures is the infestation of these areas with juniper, brush, sweet fern, hardhack, gray birch, and shrub pine. This growth is worthless and may be so dense that suitable timber trees seed in very slowly, if at all. Burning often induces thicker stands of sweet fern, juniper, and brush. It rarely brings in grass for any period of time and will kill desirable tree reproduction that may have been established.

Efforts at Pasture Control. Grazing, as it relates to woodland pastures, is one of the most serious agricultural problems in New Hampshire. Every effort should be made to develop good pastures that will produce adequate forage for grazing animals and, as rapidly as possible, to separate lands best suited for timber growing from the pasture lands.

Under some circumstances, controlled grazing by beef cattle, dry cows, and sheep in woodland pastures with the purpose of favoring softwoods that are being suppressed by rank-growing hardwoods, may be advantageous to the owner. A limited number of animals will browse the hardwood without damaging the softwood.

Injuries by Diseases, Insects, Rodents, and Weather

Approximately 215,000 cords of wood and timber are destroyed each year in New Hampshire by insects, disease, and wind.

Kinds of Disease. Fungus diseases which reduce the final yields and the quality of the forest products are always at work. They destroy many thousand feet of timber annually. Root diseases reduce a tree's capacity for absorbing water and mineral nutrients from the soil and may completely destroy the tree. Bark diseases produce wounds and in time may kill infected trees. Wood-rotting diseases reduce or destroy the merchantability of timber. Leaf and needle diseases reduce the leaf area and often defoliate trees. This condition weakens and reduces a tree's growth rate and sometimes causes its death. The cone rust of conifers may greatly reduce the seed crop.

Some of the common tree diseases that attack timber trees which grow on farm woodlands are these: white pine blister rust, Dutch elm disease, chestnut blight, cedar apple rust, nectris canker of hardwood, root rots of conifers, European larch canker, shoestring rot of conifers and hardwoods.

Introduced Diseases. Most of our forest tree diseases are native and are seldom epidemic. But diseases which have been introduced into the country often find host plants that are highly susceptible, and serious epidemic result. Notable examples are the chestnut blight disease and white pine blister rust. At the present time, there is much concern over the Dutch elm disease which was imported into the United States a few years ago.

Disease Control. The control of tree diseases involves removing from farm woodlands trees that have cankers, fruiting bodies, or exposed decayed wood, or which, for any reason, are a source of infection to growing timber. The trees chosen to compose the final crop must themselves be free from disease. But the extent to which sanitation can be applied varies according to

the disease, the available markets for the wood which is removed, and the degree of care that can be given the woodlands. The removal of diseased trees from woodlands not only reduces the source of infection but also gives the young growing timber an opportunity to use space formerly occupied by the diseased trees.

A fungus disease like white pine blister rust can be easily controlled because it requires two host plants to complete its life cycle. In the case of the blister rust, if the alternate host plants (currant and gooseberry bushes) are eradicated within approximately 1000 feet of a pine stand, the disease can be prevented from spreading to healthy pine.

Damage by Insects. Forest insects do thousands of dollars worth of damage each year. The control, for the most part, is difficult and expensive. Except in a few instances, direct control of forest insects is impractical, and prevention of insect attacks must be based largely upon good forest management. Forest sanitation and forest management to maintain a mixture of species are advisable preventive measures. Direct control of insects in the forest must take the form of destroying infested trees or destroying the insects.

Natural Checks. When an insect increases to great numbers and becomes destructive to vegetation, its increase is usually retarded by attacks from increasing numbers of parasitic insects. Nature tends to hold in balance insects native to a region. The tent caterpillar, for example, appears in cycles. It will build up to a point where it does a great deal of damage, then the damage lessens for several years when the natural insect enemies of the caterpillar have increased. Unfortunately, insects which are not native of the region often do not have natural enemies. Therefore, they increase in great numbers without being checked. The gypsy and brown-tail moths are both exotic insects that have spread without natural checks. Sometimes entomologists import insects that will attack and gradually check the increase of the exotic insect that is causing damage to vegetation.

General Insect Control Measures. If logs are to lie out over summer, it is advisable to peel the bark so as to avoid damage from bark beetle and wood borers. Pine and spruce logs are protected from insect and disease attack for several years if stored in a body of water.

It is quite practical to apply direct control measures in protecting shade trees from insects. Contact sprays, such as lime sulphur, miscible oil, kerosene emulsion, or 40 per cent nicotine sulphate are used to kill sucking insects (scale bugs, aphids, or plant lice). Stomach poison sprays, such as arsenate of lead and arsenate of lime, are used to kill chewing insects. In recent years DDT has been used in the form of dust or spray and has proved very effective on most kinds of insects.

Common Insects. Some of the common insects that damage forest trees in New Hampshire are beech scale, eastern spruce bark beetle, elm leaf beetle, European spruce sawfly, larch case bearer, pine sawflies, tent caterpillars, gypsy moth, canker worms, pine spittle bug, birch leaf skeltonizer, eastern spruce gall aphid, European pine shoot moth, fir bark louse, pales weevil, spruce bud worm, sugar maple borer, bronze birch borer, and white pine weevil.

Descriptions of direct controls for the most prevalent of these destructive insects follow.

GYPSY MOTH

Direct control of the gypsy moth has been attempted by painting the egg clusters with a creosote preparation. Individual trees may be protected, but there are continued outbreaks of the gypsy moth on woodlands where there is an abundance of poplar, gray birch, and oak, which are favorite foods of the insects. Therefore, if the desirable food can be reduced in an infested area in favor of less favorable food species such as the maples, ash, and pine, the damage from the gypsy moth will be greatly reduced.

An effective control of gypsy moth is DDT. In large areas of woodlands that have been dusted with DDT from airplanes, gypsy moths have been exterminated. Another effective method is the use of powerful roadside dusters that throw the DDT dust back into the woods.

BRONZE BIRCH BORER

In 1945, a serious outbreak of bronze birch borer occured in white and yellow birch stands of northern New Hampshire. The infestation spread from the state of Maine and has caused serious damage to the birch. It is not known whether the bronze birch borer is the primary cause of the dieback of birch. The only recommendation that can be made is to salvage birch in advance of destruction by the bronze birch borer.

THE SPRUCE BUD WORM

In northern New Hampshire, a careful watch is being kept on the limited infestation of spruce bud worm, for there is great concern that it may possibly spread to serious proportions. During 1948, only occasional bud worms were observed. This insect has done serious damage to spruce and fir stands in the Maritime Provinces.

PALES WEEVIL

The pales weevil appears in freshly cut stumps and tops, especially in pine after it has been logged. If young trees are planted on a freshly cutover pine lot, the insect sometimes seriously damages the new trees. Such areas should not usually be planted until the third growing season after the logging.

WHITE PINE WEEVIL

The spread of the white pine weevil can often be retarded in a white pine plantation by breaking off and destroying the infested leaders in which the larvae work during the late spring, providing there are no other nearby stands of pine where the insect can thrive and spread to the plantation.

ANTS

In young pine stands damage from ants can be reduced by destroying the anthills. It can be done by encircling the hills with a narrow band of DDT dust.

Damage from Animals. Rabbits and rodents often injure young hardwood by girdling the trunks. Porcupines do serious damage to trees in some

areas, especially in maple orchards. Deer often nip tender ash shoots. Birds and squirrels will sometimes destroy the terminal buds in young pine plantations.

Winter Injury. Usually after a severe winter there are many reports of trees dying as a result of winter injury. Sometimes, when there are high winds on clear dry days, water will evaporate so rapidly from pine needles that the root system of the tree cannot replace the moisture quickly enough. The needles turn brown. This condition sometimes occurs when the ground is still frozen or for some reason injury has resulted to the live wood in the roots or trunk of the trees, thus retarding the flow of water from the roots to the needles. When trees are injured by unusual weather conditions, they are more susceptible to fungus and insect attacks.

Sunscald. This injury shows up as loosened bark on the sunny side of a tree after sudden exposure. Sunscald often occurs in stands where partial cuttings have been made and the trunks of the remaining trees are suddenly exposed to the direct rays of the sun.

Root Competition. In dense stands many trees and much of the reproduction die from the lack of nourishment. The competition among the roots for food is so great that only the most vigorous trees survive.

Lack of Sunlight. Trees that cannot thrive in shade when overtopped by other trees may succumb. This is particularly true of red pine which requires considerable sunlight. The dying out of the lower branches of conifers is due to shade.

Drying Out. Following heavy cuttings in the forest, many of the remaining trees die as the result of the drying out of the soil.

Change of Water Level. The flooding or draining of ponds and bogs often destroys the trees on the borders by the drowning out of the roots.

Dust and Chemicals. Trees frequently die from smothering brought about by the coating and plugging up of the breathing pores of the leaves by dust, smoke, or poisonous gases. The roots of trees are often killed by chemicals or oils which either prevent moisture from reaching them or killing them directly. Gas escaping from a main will kill trees.

Marketing Forest Products

The forest products from New Hampshire woodlands are logs (used for lumber, veneer, ties, boxes, cooperage), pulpwood, excelsior wood, poles, piling, posts, fuelwood, Christmas trees and greens, and maple products, are of inestimable value in regulating run-off of water so necessary to the economy of the state, providing cover for fish and game, and enhancing the beauty of New Hampshire mountains, hills, lakes, and streams, which is so essential to the state's recreational industry.

Most forest products go to local sawmills, pulpmills, or other wood-using industries in New Hampshire or to near-by wood-using plants in neighboring states.

Table XIII, page 40, shows the annual forest depletion by uses in New Hampshire 1941-1945:

Table XIII.—Annual Forest Depletion in New Hampshire 1941-1945*

1	2 Lumber Cut (1) M. Bd. Ft.	3 Equivalent (8) Cords	4 Pulpwood Cut (2) Cords	5 Fuelwood Cut (3) Cords	6 Miscellaneous M. Bd. Ft.	7 Non-Lumber Uses (4) Equivalent Cords (8)	8 Fire Loss (6) Cords	9 Loss from Insects Disease & Wind (7) Cords	10 Total Annual Depletion Cords (Total of columns 3, 4, 5, 7, 8, 9)
1941	342,407	684,814	332,000	350,000	5,000 (Est)	10,000	74,252	214,900	1,665,966
1942	361,440	772,880	325,000	350,000	5,000 (Est)	10,000	12,206	214,900	1,634,986
1943	392,332	784,664	295,000	315,000	5,075	10,150	4,314	214,900	1,624,028
1944	356,509	713,018	370,000	442,000	97,241 (5)	194,482	9,260	214,900	1,943,660
1945	304,915	609,830	250,000	310,000	17,424	34,848	2,250	214,900	1,421,828
Totals	1,757,603	3,515,206	1,572,000	1,767,000	129,740	259,480	102,282	1,074,500	8,290,468
5-Year Average	351,520	703,041	314,400	353,400	25,948	51,896	20,456	214,900	1,658,093
Annual depletion per acre of forest land - Cords (9)		0.150	0.067	0.076		0.011	0.004	0.046	0.355

(1) U. S. Bureau of Census and U. S. Forest Service official figures 1946.

(2) U. Forest Service estimates 1946.

(3) U. S. Forest Service estimates for Northeastern States May 1, 1945.

(4) N. H. Forestry and Recreation Commission Annual Census of cut of poles, posts, piling, veneer, excelsior wood, etc., except where otherwise indicated.

(5) U. S. Forest Service Data, 1946.

(6) N. H. Forestry and Recreation Commission Fire record data. (Assumed loss 2 cords per acre; area burned x 2.)

(7) N. E. Forest Experiment Station data April 30, 1946. Loss from insects and diseases 105,500 cords. Wind and other 109,400 cords.

(8) Conversion factor: 2 cords - 1,000 bd. ft.

(9) Total area Forest Land 4,671,693 acres.

**New Hampshire Forestry and Recreation Report 1945-46.*

Measuring and Grading

Information as to the volume of standing timber or the board foot or cord content of logs, bolts, or cordwood is essential to a good sale. Before a fair bargain can be made, the owner must know how much and the quality of the product he has to sell. The following recommendations for measuring sawtimber and other forest products should be helpful to woodland owners. General information giving specifications of the different timber products should enable the owner to size up his growing timber to see what he can make from it.

Integrated Utilization. Each merchantable tree that is to be cut should be made up into the products or product that will bring the most profit. Location of markets for various kinds of forest products, location of the timber, kind, quantity, quality of the timber, method of operation, equipment, available labor, prices paid for various kinds of forest products, and other factors must be considered by the owner when he is deciding whether or not to make up his trees into one or more forest products. For example, one hardwood tree might yield a high-grade sawlog from the butt, perhaps a couple of sticks of pulpwood from the top part of the trunk, and some firewood from the top. Foresters call this "integrated utilization". When the woodland owner does his own logging instead of selling stumpage, he often finds it profitable to convert his trees into two or more forest products such as logs, pulpwood, and fuelwood.

Integrated utilization of trees must be done with care if each tree is to be cut up properly. Furthermore, the man who supervises the job (often the owner himself) must learn to look at a standing tree and be able to tell what products it will make. Before a woodland owner starts to convert a tree into more than one product, he should make sure that his profits will be greater than if he marketed the tree as only one product, such as sawlogs or pulpwood.

Measuring and Grading Sawlogs. Posts, ties, and poles are usually sold by the piece, although a few buyers purchase poles on a board foot measure. Poles are often sold by the linear foot, with certain minimum specifications such as minimum top diameter, freedom from knots, form, etc. Pulpwood and firewood are sold by the cord. In Coos County, firewood is often sold by the face cord. Bolt-wood is usually sold by the cord, although some buyers purchase bolt-wood on the board foot measure. The required length of a cord wood stick varies greatly depending upon its use. Usually the required length of a bolt-wood stick ranges from 40 inches to 54 inches. Most buyers accept a 48-inch stick for bolt-wood, pulpwood, or fuelwood.

Measuring Logs. The board foot content of a log is determined by measuring the diameter of the log at the small end, inside the bark, or measuring the diameter at the middle of the log with a pair of calipers, depending upon the log rule used. If the diameter and the length of a log are known, it is then a simple matter to check the measurements with the lengths and diameters given in a log table which states the board-foot content of a log of different sizes.

Most woodland owners who deal in forest products have scale sticks or calipers from which they can read the board foot contents of a log. But it

is quite feasible to determine the board foot contents of a log with only a yardstick, or a ruler, provided the owner has a suitable table which gives the board foot contents of logs by different sizes. There are three steps in this process:

1. Measure the average diameter of the log in inches, inside the bark at the small end. If the log is fairly round, measure across it only once. If it is uneven, take the average of the short and long diameters.
2. Measure the length of the log to the nearest foot, dropping all fractions, and allowing 4 inches for trimming.
3. Find its contents by a table giving board foot contents by log sizes. For example, suppose a log is 13 inches in diameter at the small end and 16 feet long. Run your finger down the left-hand column (diameter) to the figure 13. Move across to the 16-foot column. The figure there is the estimated number of board feet that can be sawed from the log, in this case, 81, using the Doyle Log Rule. The board-foot content for a log of the same size, based on the International Log Rule, would be 115, bases on the Scribner Decimal C, 100, and the New Hampshire Blodgett Log Rule, 106.

   Each log should be marked with chalk after being scaled, so that it will not be scaled twice.

   Unless otherwise agreed to by both parties in writing, the log rule generally used is the New Hampshire Blodgett Rule, the legal rule for the state. The International Log Rule is used by a number of buyers. It gives higher values for large straight logs of little taper than does the Blodgett Rule. The Blodgett Rule is favored by people who sell small "pasture pine" logs that have excessive taper. The Keene Cord Rule is used in the Keene area. Roughly, 1½ cords is equivalent to 1000 board feet, depending upon the quality and size of the logs. Along the Vermont border, the Vermont Rule is used in a few communities, and the Holland or Maine River Log Rule is occasionally used along the Maine border.

Although scaling logs is a fairly simple process, making deductions for defects can only be learned through practice and by watching experienced scalers work. Much can be learned by carefully watching how a good sawyer saws defective logs. Common defects in logs are rot, shake, check, pitch ring, cat faces, ingrown bark, worm holes, crooks or bends, and crotches or forks. Hardwoods may suffer from black heart and mineral streak. Spiral grain may be a defect in softwood intended for high-quality lumber. Some defects are usually allowed in each grade, but first-grade logs will have no defects or only a few small ones. The scaler estimates how much wood the defect will waste and subtracts it from what the log would saw out if it were sound.

Tables which give the contents of logs based on the New Hampshire Blodgett, International, Scribner Decimal C, Maine or Holland, and the Humphrey Decimal Cord Measure Log Scale will be found on page 65.

Grading Logs. The grade of a log depends upon its diameter and length and on the number and kind of its defects. Within each grade, the larger logs are the most valuable. Sometimes the amount of heartwood also counts.

Not every defect lowers a log grade. Generally speaking, however, grade one logs must be free of all serious defects, must meet certain length and diameter specifications, and must saw out a specified amount of clear lumber. Lower-grade logs may have one or more serious defects, may perhaps be short, and, in general, produce less salable lumber. Logs so full of flaws that it does not pay to saw are called culls. Grades vary with the kinds of trees and the products to be made from them, but also with individual mills. Prices, of course, depend upon grades, a Grade 1 sawlog being worth several times as much as a lower-grade log of the same size.

In some instances, if the woodland owner can tell logs by grades, the owner may make more money than if sold ungraded.

Following the hurricane of 1938, the United States Forest Service purchased white pine and hardwood logs in accordance with the following specifications:

Table XIV.—White Pine Log Grading Rules

Top Diameter inside bark	Length	Rot Permitted	Sweep Permitted	Surface Requirements
				Grade I
13-16"	12-16'	10%	1" per 8'	Must be ⅔ surface clear in lengths 8' long or longer, or 50% surface clear full length.
17" & up	10-16'	15%	1" per 8'	Must be 50% surface clear in lengths 8' long or longer, or 25% surface clear full length.
Note: 8' length logs with a top diameter of 13" or more will be accepted if straight and surface clear. Shake and splits not permitted.				
				Grade II
19-16"	10-16'	10%	1" per 4'	Sound tight knots not larger than 2½" in diam. Larger knots permitted only if 50% full length surface with sound tight knots not larger than 2" in diameter.
17" & up	8-16'	20%	1" per 4'	Sound tight knots not over 3" in diameter. Larger knots permitted only if 50% full length surface with sound tight knots not larger than 2½" in diameter.
Shake and spits not permitted.				
				Grade III
6-8"	10-16'	None	1" per 8'	Sound knots not over 1" in diameter or live knots not over 2" in diameter.
9-13"	10-16'	10%	1" per 4'	No surface requirements except logs with knots 4" or more in diam. in whorls less than 2' apart will not be accepted unless 25% or more full length surface with sound knots not over 2" in diameter.
14" & up	10-16'	20%	1" per 4'	Sound knots permitted.

Hardwood Log Grading Rules for Yellow Birch, Sugar Maple, Red and White Oak, Basswood, Black Cherry, Beech, Paper Birch, and White Ash.

Grade	Length	Diameter small end Butt logs	Allowable cull	Sweep per 8 feet	Allowable mineral stain	Surface Requirements
1	10′ & up	12-15″	25%	1½″	Not over ½ of diameter	75% in one clear cutting
1	10′ & up	16″ & up	40%	1½″		75% in not more than 2 clear cuttings not less than 5′ long
2	8′-10′	12″ & up	40%	2″	Not over ½ of diameter	60% in not more than 2 cuttings not less than 3′ long
2	12′ & up	10″ & up	40%	2″		60% in not more than 3 clear cuttings not less than 3′ long
3	8½′ or ° multiples	9″ & up	0%	3″	100%	Sound and suitable for ties
3	8′ & up	11″ & up	50%	3″	½ of diameter	40% in clear cuttings not less than 3′ long

°Tie logs

Unmerchantable Logs

1. Less than 8′ long.
2. Less than 9″ in diameter except white ash and paper birch.
3. Has more than 50% cull.
4. Has more than 3″ sweep in 8′.

Variations for Species

All soft maple and elm logs will be graded as No. 3 regardless of length of per cent surface clear. Beech—Add 2″ to minimum diameter. White ash and paper birch—Deduct 2″ from minimum diameter. Poplar and brown ash not accepted.

Estimating Standing Timber

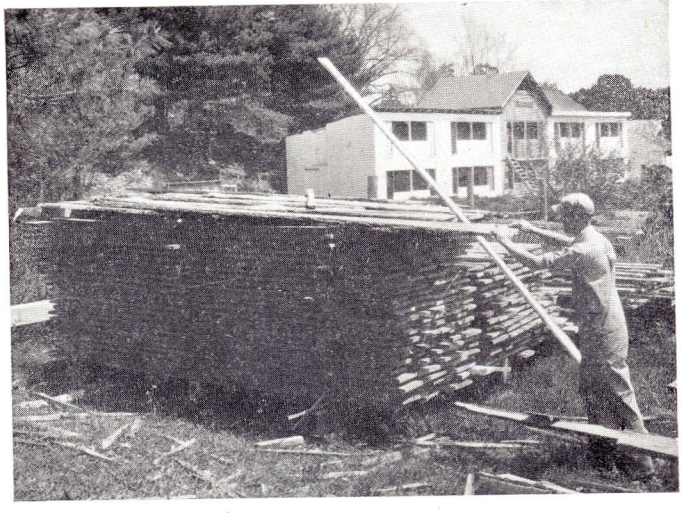
When woodland owners decide to sell standing timber, they should determine the volume of the standing timber before the sale is made. If the standing timber is sold at a price per thousand feet, the owner can often arrange to measure the logs after they are cut and then check his scale with the scale determined by the buyer. When the owner does not have a practical means of scaling the logs after they are cut or if the timber is sold in lump sum, it is important to make an estimate of the timber to be sold. Buyers, of course, will want to pay according to their own estimate of the volume of the standing timber. The owner needs to make an independent estimate in order to make a fair deal. Volume tables given on pages 62-64 which show approximately the number of board feet in a tree, greatly simplify the job of estimating.

To use the tables the following steps are necessary:

1. With a scale stick, a ruler, or calipers, find the diameter of a tree in inches, outside the bark, breast high (4½ feet above the ground). The Springfield Land Bank has scale sticks that can be used in determining the diameter and height of trees. They also have a scale stick that can be used in estimating the board feet of logs. The

Federal Land Bank scale sticks are made up so that the volume of trees and logs may be read direct from the sticks. The volumes are based upon the International Log Rule. Scale sticks may be secured at the County Extension Offices, or direct from the Federal Land Bank at Springfield. Instructions for the use of the Springfield Land Bank Scale sticks are included.

2. Look at the tree and decide how many 16-foot logs it contains. This takes practice. The Land Bank stciks can be used as an aid in determining the number of 16-foot logs in a tree.
3. The Volume Table for softwood should be used for softwoods and the hardwood table should be used for hardwoods when the board foot contents are not read direct from a scale stick. Many woodland owners do not have scale sticks which give board contents of trees, and they may find it difficult to get such scale sticks when needed. When using the Volume Tables, find the diameter of the tree in the left-hand column and look across to the column headed by the number of logs in the tree. For example, a 20-inch pine tree with a merchantable length of 40 feet (2½ logs) would contain 300 board feet.



Many farmers haul a few thousand feet of logs to a nearby mill every few years and have them sawed into lumber for use on the farm.

Making a Cruise

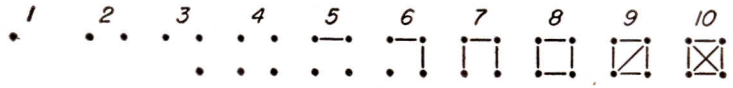
A timber cruise is an estimate of the timber to see what kind of trees are growing, how many are marketable, etc. Where a selective cutting is made, it is practical to estimate the volume of the trees at the time they are marked for cutting.

The person who makes the estimate should have with him a tally sheet. When a tree is measured, he can put the tally in the proper square. A good way is to tally by tens, using a dot apiece for the first four trees and connect-

ing lines for the next six. When the cruise is finished, the number of trees by diameters and logs are easily determined.

A sample tally sheet for tallying trees when volume tables are available, and the dot and line method of tallying by tens are shown below.

Diameter of tree breast (inches) high	Softwood Species: White Pine log 2½	log 2	log 2½	log 3	log 4	Softwood Species: log 1	log 1½	log 2	log 3	Hardwood Species: log 1	log 1½	log 2	log 3	log 1	log 1½	Hardwood Species: log 2	log 3
8																	
10																	
12																	
14																	
16																	
18																	
20																	
22																	



Making an Estimate from a Sample

When the woodland owner's time is limited or his forest is large, he may need to judge the volume of the entire stand by the part that is measured. The important thing is to get a fair sampling, neither better nor poorer than the rest of the forest. In small woodlands, it is best to measure every tree.

On a woodlot of average size (50 to 100 acres), where the trees are being marked for cutting, a feasible way of sampling is to tally every tenth tree marked; multiply the total volume of the tallied trees by 10, and the result gives the estimated volume of the entire stand.

Another way of sampling is to lay out plots at regular distances and measure the volume of the merchantable trees to be cut on the plots. If a 10 per cent estimate is to be made on a 100-acre tract, 40 quarter-acre plots would need to be laid out and the salable timber measured.

Samples (a quarter or a fifth of an acre in size) are easier to measure than larger plots. One acre is 208 feet square. A quarter of an acre is 104 feet square or, if round, 118 feet in diameter. Round plots are easier to estimate than square areas. Pacing the distance of 50 feet from the central point of the round plot in four directions to the outside boundary is a simple way of laying out a plot for estimating.

Experienced estimators can walk through stands and judge the volume fairly accurately. Their estimates are based on volumes sawed from stands of similar size and quality. Another method often used by an estimator is to count the trees in a lot and multiply the board foot volume of an average tree by the total number of trees.

Veneer Logs

Veneer logs are available only in limited numbers. They are scaled in about the same way as sawlogs. Surface defects are very serious, while small center flaws often are of little consequence. Mills take logs of various lengths. As specifications are constantly changing, the owners should find out the species, sizes, and specifications required. Fancy veneer logs or bolts for fine furniture veneer should most of all have a clear surface and be straight and sound. Grades depend largely on size and amount of sap wood,

and freedom from defect. Each veneer plant has its own specifications. Prices paid for top-grade veneer logs are excellent. Yellow birch and sugar maple are the principal veneer woods purchased in New Hampshire.

Poles and Piling

A given tree may be worth more if it can be made into a pole or piling, than if cut into shorter products. Norway or red pine treated against decay makes excellent telephone poles. Spruce and oak are used for poles and pilings where great strength is needed.

Trees converted into poles or piling must be of good quality, and the poles must be square at both ends, with the knots trimmed close. Defects are crookedness, sweep split tops and butts, rot, checks, and shakes.

Poles and piling specifications vary so much that before cutting the owner should know exactly what sizes the buyer will take. Most piling must be at least six inches in diameter at the top. They are classified by size, three feet from the butt, and by top measurement.

Trees to Cut for Logs

Timber operators know from actual experience that cutting small trees and handling and sawing small logs are not profitable. Except where it is desirable to cut small trees for lumber or other uses in order to make growing space for trees of better quality, only those that are profitable to handle should be cut. Actual time studies made in the handling of logs of different sizes clearly support the fact that it does not pay to convert small trees into logs. Tables showing average labor required for log making are shown on page 66.

Pulpwood

Many woodland owners sell pulpwood stumpage directly to company agents. Others sell pulpwood beside a truck road, loaded on a railroad car, or delivered at the mill. Pulpwood is measured as a standard cord, 4 feet high, 8 feet long, and 4 feet wide (length of a pulpwood stick) which is 128 cubic feet by measure or 90 cubic feet of solid wood. It is a common practice to stack green wood 3 or 4 inches higher than the required 4 feet, to allow for shrinkage.

A forest owner who wishes to cut pulpwood should get specifications from the buyer. The New Hampshire pulp industry demands better quality and preparation of wood pulp than was required during World War II. General specifications require that knots be cut even with the surface of the stick, 4-inch minimum diameter inside the bark at the small end, 4-foot lengths, and ends sawed square. Nothing is allowed for over-length or scarfs. Rotten and burned wood, forks and large burls are not acceptable. The wood must be well stacked when purchased beside the truck road. All pulp companies which buy wood in New Hampshire take spruce and fir. A few mills buy hardwood pulp, some only in limited quantities. One mill buys all kinds of hardwoods and softwoods.

The New Hampshire pulp industry is concerned over future supplies of quality wood. Consequently, the cutting recommendations on page 48 are agreed upon.

Fitting pulpwood for market.

1. Woodland owners are urged to make selective or partial cutting when cutting pulpwood for market.
2. Limit the cutting of spruce, pine, and hardwood to 10 inches or more stump diameter; balsam fir, 7 inches or more, stump diameter unless these limits are not consistent with good forest practices.
3. Improve immature stands by weedings and improvement cuttings.
4. Control fire, insects, disease, and grazing. The pulp industry points out to woodland owners who plan to cut pulpwood that the selective cutting of only the larger trees will: (a) produce better quality pulpwood; (b) reduce labor in cutting, skidding, and hauling; (c) increase the workers' daily earnings

Experience based on actual time studies proves that cutting trees below 10 inches in diameter, stump height, for pulpwood is costly from the time the tree is cut from the stump until it is delivered at the mill. However, cutting tops, down to 4 inches inside the bark is important because it gives closer utilization of the trees. Records show that the cutting and skidding of 12-inch trees required two man hours less per cord of pulpwood than cutting 6-inch trees.

The woodland owner can estimate the pulpwood in his standing trees in about the same manner as an estimate is made for saw timber. He measures and counts the pulpwood trees, tallying them by usable pulpwood length in feet and by diameter. Then, from figures given in the table on pulpwood volumes it is possible to determine the number of cubic feet of solid wood each tree will yield. The total volume in cubic feet of the trees to be cut can be changed to cords. For example, if the owner finds that his trees to be cut for pulpwood total 1260 cubic feet of solid wood, he has 14 cords for sale. Ninety cubic feet of solid wood is equivalent to one cord of pulpwood.

Table XV.—Number of Sticks of Peeled Spruce and Fir Contained in Standard Cord of Pulpwood*

Average Center Diameter of Pulp Stick in inches	Number of Sticks Per Cord
4	274
5	176
6	122
7	90
8	69
9	54
10	44
11	36
12	30
13	26

*Occasional paper No. 9. Cost of producing pulpwood on farm woodlands of Upper Connecticut River Valley. Northeastern Forest Experiment State, United States Forest Service.

Fence Posts

Posts for fence construction are always needed on the farm, along highways, and other rights-of-way. Often, too little attention is given to the selection of wood that is durable in contact with the soil. When the labor used in getting out posts and putting them into the ground is taken into consideration, it is important to know whether or not a post will last three years or 15 years. The following classification of native woodland species, based on their durability in contact with the soil, is presented as a guide in the selection of the proper species for post material:

Table XVI.—Estimated Durability of Native Species Used as Fence Posts in New Hampshire*

Class A 20 years and over	Class B 10 to 20 years	Class C 5 to 10 years	Class D Not over 5 years
Black locust	White oak	Black cherry	White ash
Red cedar	Honey locust	Butternut	Basswood
	Chestnut	Hemlock	Red oak
	Northern white cedar	Tamarack	Red maple
			Sugar maple
			Hickory
			White elm
			White birch
			Yellow birch
			Beech
			Willow

*Table adapted, with some changes to suit New Hampshire conditions, from lists published in the *Preservation of Structural Timber*, page 275, by Howard Wiers, McGraw-Hill Book Company, Incorporated, New York City, 1916.

Preservative Treatment. Non-durable woods, as listed in Classes C and D, can be made durable by giving the posts a preservative treatment. The posts may be taken to a treating plant and treated for a few cents each. They are treated in such a way that the preservatives penetrate into the wood to the fullest extent. However, few farmers, when they add the cost of transportation to the cost of treating can afford to send their posts to a commercial plant.

Creosote Treatment. A simple treating process is needed if it is used by the farmer. The life of a post may be slightly increased by merely painting with creosote the portion to be placed in the ground. Setting a post in an open tank of creosote for a few days also adds somewhat to its life. However, if the life of a post is to be increased for an appreciable length of time, a method must be used that will force the creosote into the wood. Some farmers have constructed a simple apparatus which permits treating 20 to 25 posts at one time. The posts are placed in a 100-gallon drum which is filled with creosote and a fire is built under the drum. The creosote is kept nearly to the boiling point from five to eight hours. Then the fire is drawn, the tank is completely filled with creosote, and the posts are left in for 10 to 12 hours. This causes the creosote to penetrate into the wood with uniformly satisfactory results.

Tire Tube Method of Treatment. The simple tire tube method can be used with the assurance of good durability of the posts treated.

A non-durable post treated by the tire-tube method, using copper sulfate or zinc chloride, the former at a dosage of ¾ pound of the salt and ½ gallon of water per cubic foot of wood, and the latter at a dosage of one pound of the salt to ½ gallon of water per cubic foot of wood, can reasonably be expected to last 10 to 15 years under ordinary conditions.

In making the treatment, the bark is peeled for a distance of from four to six inches from the large end of the post to provide a smooth, clean surface. A section of inner tube about 2 or 2½ feet long is cut from a used tire and then slipped over the peeled surface where it is mound in place with cord, wire, rubber band, or any other convenient and suitable material. The post is then laid on a rack with the large end about 1½ feet or more higher than the small end. The loose end of the tire section is next fastened to a frame so that the preservative cannot spill out but will be kept in close contact with the end of the post, and then a measured amount of the preservative solution is poured in. In a short time the preservative will begin to flow into the sapwood of the post, forcing the natural sap out at the small end. When all the preservative has flowed from the tire tube into the wood, the tube is removed and the post is taken from the rack.

The length of time required for the preservative to flow into the wood will vary with the quantity used, the kind and condition of the wood, season of the year, thickness of sapwood, and other factors. With aspen posts seven feet long, eight to 24 hours are usually sufficient.

The tire tube method is suitable only for wood that is thoroughly green. The sooner posts are treated after cutting, the better. If possible, they should be treated within 24 hours, especially in hot, dry weather.

Only preservatives dissolved in water can be used, for oils will not penetrate when applied to green wood in this manner. Zinc chloride seems most promising because of its cheapness, availability, safety and convenience, combined with moderate effectiveness. It is available in three forms — granulated, fused, and concentrated solution. (The most convenient form for small users is the concentrated solution.) Various manufacturers ship the solution in different strengths, usually about 48 to 72 per cent. For information on names of dealers write to the University of New Hampshire Agricultural Extension Service, Durham, N. H.

Bolts, Billets, and Excelsior Wood

Bolts are short logs. Much of the white birch goes into bolt wood for square stock and other uses. Billets are bolts split lengthwise. Red oak billets are bought for manufacture into ladder rounds. Elm bolts are cut up for trawl rollers. Poplar, basswood, and pine are used for excelsior. Hickory goes into axe and hammer handles. Each wood-using industry has its own specifications for the stock it will buy.

Bolts are measured and sold by the cord, the running foot, and especially if over 12 inches in diameter, by the board measure. Billets are often sold by the piece.

Fuelwood

In spite of the wide use of coal and oil for heating, wood will continue to remain one of the principal methods of heating homes in the rural areas of the state. The estimated annual cut of fuelwood in New Hampshire over a five-year period 1941-45 was 353,400 cords. Farmers who own woodlands are obtaining a cheap heat by burning wood for fuel, and at the same time can improve the quality of their standing timber by removing the inferior growth. With heating plants designed to burn wood, which are easily operated, economical on fuel and which properly heat the home, the farm woodland owner cannot really afford to burn other forms of fuel.

Table XVII.—Heat Value of Cordwood†

Species	Weight		Available heat units per cord of 90 solid cubic feet (in millions B. t. u.)		Per cent of short ton coal value	
	Air-dry	Green	Air-dry	Green	Air-dry Per Cent	Green Per Cent
Hickory	4600	5700	24.8	23.1	95	89
White Oak	4300	5600	23.9	22.4	92	86
Sugar maple	3900	5000	21.8	20.4	84	78
Red oak	3900	5800	21.7	19.6	83	75
Beech	3900	5000	20.9	19.7	80	76
*Yellow birch	4000	5100	20.9	19.4	80	75
*Paper birch	3800	.....	18.2	16.7	70	64
White ash	3800	4300	20.5	19.9	79	77
Red maple	3200	4700	19.1	17.6	73	68
*Gray birch	3500	.....	17.5	16.1	68	62
Elm	3100	4400	17.7	15.8	68	61
*Pitch pine	3200	4900	18.5	16.4	71	63
*Norway pine	2800	3500	17.8	16.8	68	65
*Red spruce	2600	3000	15.0	14.2	58	55
*Aspen	2400	4200	14.1	12.2	54	47
*White pine	2700	3500	14.2	12.9	55	50
*Hemlock	2600	4400	15.0	12.8	58	49
*Balsam	2200	3700	13.5	11.5	52	46

†Based on data of Forest Products Laboratory, Madison, Wisconsin, weights for air-dry, and green wood and assuming 7,350 B. t.u. available per pound of dry wood with flue gases at 300 degrees F. From Bulletin 753, U.S.D.A.

*Weights from Farmers' Bulletin 1210, U.S.D.A., 1921.

Research on Wood-Burning Stove. There has been considerable research in the development of more efficient wood-burning stoves that burn

less wood, require less firing, and give off more heat. A few homeowners in New England have tried out a foreign wood-burning stove that requires a minimum amount of fuel and needs firing only once or tiwce a day. It has been found fairly satisfactory.

Brooder House Stoves. Many poultrymen who own woodlands are using a new type wood-burning stove in their brooder houses. It is easy to operate, throws off the necessary heat, and saves on the annual fuel bill.

Wood-Burning Furnace. Large farm homes are well heated by a new type of hot-air, wood-burning furnace. The temperature of the rooms is regulated by an automatic thermostat and the furnace is fired twice daily with three-foot wood.

Comparative Fuel Value of Wood and Coal. Weight for weight, coal is superior to wood as fuel. Generally speaking, the heavier the wood, the greater its value as firewood. In other woods, one can afford to pay more for a cord of hickory, which is equivalent to approximately a ton of coal, than he can afford to pay for a cord of aspen, which is equivalent to only about one-half ton of coal. Table XVII shows the comparative fuel value of various kinds of wood.

Well-seasoned wood contains approximately 25 per cent of water by weight. Using this standard, a comparison by percentage of woods in various stages of seasoning can be made. This comparison cannot be exact because the rate of seasoning varies greatly under different conditions. However, as a general rule, it takes 12 months of seasoning to reduce the moisture content to 25 per cent of the weight, while in three months the moisture content will be reduced to 35 per cent of the weight and in six months to 30 per cent. In other woods, seasoning takes place very rapidly for the first six months of process. These data, considered with the fact that each 10 per cent of moisture detracts 12 per cent from the fuel value, make it possible to construct the following table:

Table XVIII.—Fuel Value of Wood in Relation to Period of Seasoning

	Per cent fuel value
Wood seasoned 12 months	100
Wood seasoned 9 months	95
Wood seasoned 6 months	90
Wood seasoned 3 months	85
Green wood	63

Fuelwood in New Hampshire is sold by the standard cord, 128 cubic feet. In the northern part of the state, wood is sometimes sold by the running cord — a stack of wood 4 feet high and 8 feet long, ranging from 12 to 18 inches in width, depending on the size of the stove in which the wood is burned. Sixteen inches is often considered as an average width and thus, roughly, three running cords equal one standard cord. Woodland owners often sell cordwood on the stump. When cordwood is sold on the stump, it is often necessary to estimate the number of cords available in standing trees to be cut. Table XIX shows roughly the number of trees of different diameters required to make a cord.

Table XIX.—Number of Trees of Different Diameters Required to Make a Cord*

Diameter of tree (breast high, outside bark) in inches	Northern hardwood beech, birch, maple	Softwood
5	35	....
6	20	....
7	15	20
8	11	13
9	8	10
10	6	8
11	5	7
12	4	6
13	3.5	4.5
14	3.0	3.7
15	2.5	3.0
16	2.0	2.5
17	1.7	2.1
18	1.5	1.9
19	1.3	1.6
20	1.2	1.5
21	1.0	1.4
22	.9	1.2
23	.8	1.1
24	.7	1.0

*Bulletin 763, U.S.D., 1919.

What to Use for Fuelwood. Most farm woodlands can be improved rather than depleted by the cutting of fuelwood. When cutting wood, the following points should be kept in mind:

Cut	Save
Crooked trees	Straight trees
Short, bushy-crowned trees	All thrifty-crowned trees
Unsound or rotted trees	Sound trees
Poor timber trees	Good timber trees
Some trees where the stand is too thick	Enough trees to form a complete stand

Other Woodland Resources

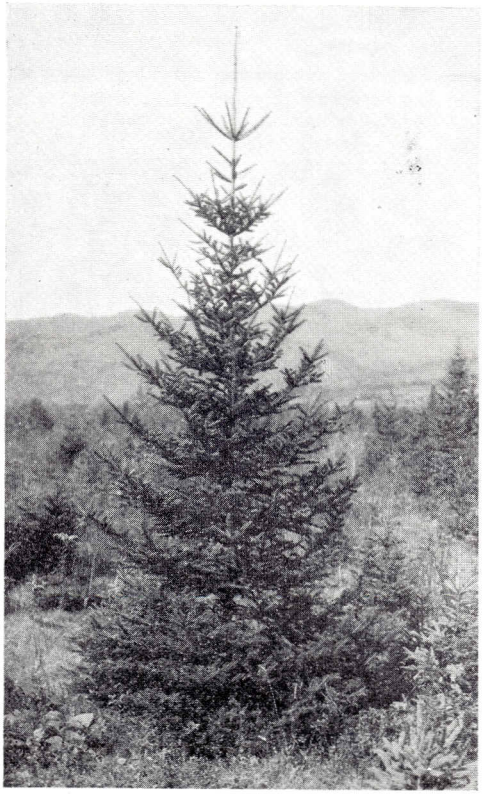
Maple Syrup Products

The production and sale of maple products on some New Hampshire farms represent an important part of the farm income, and every effort should be made to develop this business, especially with the tourists that come to the state each year in increasing numbers.†

Christmas Trees and Greens

Buyers come into the state every fall and purchase Christmas trees from farmers. In northern New Hampshire the sale of Christmas trees represents a real source of income to farmers in a slack season of the year. Christmas greens are gathered from woodlands in many sections of the state and marketed advantageously.

†For information on the production and marketing of maple products, refer to Extension Bulletin 79, "Maple Syrup Production in New Hampshire", 1947.



Christmas trees growing naturally in a northern New Hampshire pasture

A few New Hampshire farmers have planted balsam, fir, and spruce to insure a continuous supply of Christmas trees.† Some farmers sell spruce and balsam boughs for distillation of oils which are bought by wholesale drug dealers.

Fish and Game

Farm woodland owners should make every effort to develop fish and game resources. Farm incomes may be supplemented by boarding hunters and fishermen. Woodland owners may also trap fur-bearing animals under state regulations. If greater advantage is to be gained from the game resources on farm woodlands, it is necesary to determine the kinds and amounts of game any one area should carry and then work toward this balance. Often by carrying out certain cutting practices and perhaps introducing certain food plants the carrying capacity for game birds or animals may be increased.

Cutting the Timber Crop

Use of Owner's Labor and Equipment

The farm woodland owner who has the logging equipment can often increase the income from the sale of his timber products by cutting, preparing, and hauling them with his own labor and his hired help, just as is done with field crops. In this way he sells his own labor and that of his team or machinery, along with his timber.

The farmer who does his own logging is naturally more careful than a contractor to cut only the right trees, to avoid damage to young trees, and in general to make the best use of his trees. Furthermore, with few exceptions, the work can be done whenever there is time for it.

While it is desirable for the woodland owner to get out logs and other forest products for market, he should keep out of the sawmill business unless he knows something about it. In general, it will not pay him to buy expen-

†For information on the production and marketing of Christmas trees refer to Extension Circular 278, "Christmas Trees: A Cash Crop."

sive lumbering equipment unless he can also use it in his farm work or other business. If he has a large amount of timber to harvest in a short time, he may consider buying a logging truck; but usually it will be cheaper to hire a trucker to do the hauling.

Most farmers skid and haul wood with their teams. Many have tractors or trucks that are useful in the woods. When new equipment is bought, it should be heavy enough to stand up to woods work.

Season for Work

Farmers generally harvest forest products during the winter months, when they have the spare time and help. Some dairy farmers plan work in the woods during the winter in order to keep their hired help profitably employed 12 months of the year. There are many advantages in cutting forest products during the winter. There are no troubles from insects, decay, and stain during cold weather. Snow often aids skidding and hauling. Then, too, buyers may take certain products only during specified seasons. For example, the pulp mills cannot use as much hardwood pulp during the hot summer months as is possible during the cooler months. On the other hand, pulpwood that is sold peeled, must have the bark removed during the late spring and early summer.

Tools

An axe, a saw or two, a sledge hammer, wedges, measuring stick, and a bottle of kerosene for oiling the saw are the tools necessary for felling trees and marking logs. A peavy is an important tool for loading logs. Power chain saws and tractors are generally used. But the farmer must plan to do sufficient logging to justify the purchase of power euipment.

Axes. Double-bitted axes, which are dangerous to handle and carry, are often preferred, since one blade can be used for materials that dull the edge quickly, and the other saved for normal chopping. The double-bitted axe is common in northern New Hampshire. For trees less than 1½ feet in diameter, a 3-pound axe is satisfactory, but for larger timber a 3½- or 4-pound axe is better.

Saws. Saws which are 5½ or 6 feet long are about right for ordinary timber. A narrow saw with a concave back to make wedging easy works well for small timber, but a straight-back saw is recommended for larger stock. A saw needs to be filed for sawing softwood or hardwood. Saws have different type teeth. Figures A and B show the types best suited for hardwood and softwood.

For small trees, especially spruce and fir pulpwood, the frame or bow saw is a much stronger and faster form of the old buck saw. It will save a good deal of sawing labor. One man can use the bow saw to fell and buck trees for pulpwood and fuelwood.

The power buzz saw or some other kind of power saw saves much time when the tree-length stick can be hauled to a central point to be sawed into pulpwood or fuelwood.

Wedges. Tough, shock-resisting woods like hickory, ash, beech, yellow birch, or oak make good wedges, as does steel or iron. Wedges are about 4 inches wide by 7 inches long, and have an axe-blade taper. Only wooden wedges should be used when using a power saw.

Handling Sawlogs

Felling. In getting ready to cut down a tree, the workman needs to clear away brush, overhanging branches, and some small hardwood growth to allow him to work freely at the tree he wants to fell. Care should be used not to cut young softwood reproduction that will not interfere with the use of axe in felling a tree if ordinary precautions are taken. The chopper should plan to drop the tree in natural openings, if possible. An experienced chopper can fell trees into small openings and avoid damaging the standing trees.

Stumps should be low (6 to 8 inches on trees up to 20 inches in diameter). Larger trees should be taken a foot or less above the ground. Higher stumps waste lumber, and get in the way during skidding and other woods operations.

The undercut should be made on the side toward which a tree should fall. On a straight tree, the undercut should be chopped out to about one-third of the diameter and should have a level bottom. The saw cut starts on the opposite side of the tree, slightly above the level of the bottom of the undercut. When the saw blade binds, drive in a wedge to free it. When the cut is almost through, saw fast in order to cut as many wood fibres as possible. Withdraw the saw and get out of the way when the tree starts to drop. Falling limbs are very dangerous. Also, the trunk of the tree may kick back or bounces sidewise.

When a tree lodges in a standing tree, the ground end of the hung tree can sometimes be pulled clear with a tractor or horse. The final but dangerous way is to fell the supporting tree.

If a leaning or crooked tree has to be dropped in some other direction than it would naturally fall, undercut it on the side to which it is to go. Carry the undercut to the center, if possible. Then saw on the side of the natural fall up to the center, if possible. Remove the saw and strongly wedge the cut. Next, saw opposite the undercut until the tree weakens. Remove the saw, and wedge the tree in the direction it should go.

Bucking. It is important when sawing a tree trunk into the proper lengths, to separate the high-value sections from the poorer parts. Often good logs can be cut between major defects like knots and crooks, but cutting many short logs should be avoided. A very general rule for sawlogs is to cut as many 16-foot lengths as possible if the buyer wants 16-foot saw logs. Many of the small portable mills in southern and central New Hampshire take only 12- or 14-foot saw logs. Log lengths should be measured accurately, allowing four inches extra for trim. Branches should be cut off even with the surface of the log. Brush should be lopped and scattered as much as possible and should be placed so that it will not need to be rehandled when getting out the logs.

Skidding. Horses or tractor will skid logs to a loading point. A single horse is enough for light work, and can handle softwood logs up to 20 inches for a short distance. A chain is necessary. Grapple hooks or tongs to be hooked to the clevis are useful. Wise lay-out of skid trails, running across instead of down steep slopes, will eliminate much trouble and danger. Skid-

ding logs on snow is feasible, but difficulties occur when it is done on the bare ground. Dirt is ground into the bark and dirty logs cause trouble at the saw. Many loggers use a small two-runner scoot to haul the logs to the skidway, and in this way keep them fairly free from dirt. The skidways should be built so that logs are loaded onto a truck with the minimum of effort.

Loading and Hauling. Logs are either rolled onto a truck by manpower, or cross-hauled by a team or tractor. In either case, two or three men are needed. The volume of logs that can be hauled by a truck depends upon the size and condition of the truck, loading facilities, and the condition of the road. Trucks will haul anywhere from 2000 to 5000 board feet of logs, depending upon the size of the truck, condition of the roads, and kind of logs being hauled.

Cutting Other Timber Products

Pulpwood is handled somewhat differently from logs. Pulpwood is not as heavy to handle as logs, especially softwood. The wood is either cut in 4-foot lengths and piled at the stump (the term used for piling where it is cut, or twitched out in pole lengths to a central yard where it is sawed into 4-foot lengths and piled). The twitching of pole lengths to a central yard is advocated. When a twitching job is done, there is not the temptation to cut the small trees that should be left standing. If the wood is cut and piled at a central point, it is more convenient to get at with a truck. Furthermore, a power saw can be used in sawing the poles into 4-foot sticks. Large hardwood that is sawed into pulpwood can not be twitched as easily as softwood. In such instances, it may be more practical to cut and pile the hardwood pulp near the point of cutting.

Pulpwood buyers like to buy peeled wood, but because of labor difficulties, not much wood is peeled by the woodland owners. Spruce and fir are pelled by a few farmers. To do the job efficiently, the trees should be cut in the late spring or early summer and peeled when felled. A peeling tool or spud is necessary when peeling wood. The bark is easily removed with a little practice. Another pulp tool commonly used is a strong hook with a handle. The hook is used by the handler to grab into a pulpwood stick, thus enabling him to handle the pulpwood more efficiently.

Attention is being given to the development of mechanical peeling machines that can be moved from woodlot to woodlot. Along with the mechanical peeler, there should be a power saw of some sort and a mechanical loader. Such portable equipment could be moved to a yard where a quantity of tree-length sticks have been twitched. The mechanical equipment could be used to saw the poles into four-foot sticks, to peel them, and to load them onto waiting trucks.

Care of Timber Products

Once timber has been felled, it must be protected from weather, rapid drying, and disease and insect infestation. The farmer should sell and deliver forest products as soon as possible after cutting in order to avoid some of the difficulties resulting from weather, disease, and insects. Blue stain may develop in six to seven days during hot sticky weather. Insects will get into

logs very quickly during the summer months. Timber cut in the late fall can be held until late in the following spring without damage.

Seasoning

As soon as a tree is cut down, it begins to lose its moisture. Because more air can get to it, lumber seasons faster than logs, posts, and poles. If green lumber is dried too slowly it is liable to be attacked by stain, rot, or insects. If it dries too fast it will check, split, crack, and warp. Sap or blue stain greatly affects the appearance, though not the strength of lumber. If logs are sawed within a reasonable time after cutting, they will not stain, unless there happens to be an unusual period of hot damp weather. Insects will get into logs if left on the skids too long during the early summer. In order to reduce insect damage, logs may be sprayed with an insecticide such as a DDT preparation. The ends of logs may also be painted to retard stain and checking. Such treatments are costly and may be impractical. Logs can be successfully stored under water. Pine logs stored in ponds, following the 1938 hurricane, are still being found in the bottom of ponds and sawed into lumber.

Green, fresh-sawn lumber which is kept for home use should be stacked for seasoning as soon as possible in an open, level, well-drained field. The stack should be well off the ground, and piled so that the air can circulate freely through it. Good seasoning of lumber is very important.

Suggestions for Marketing Forest Products

A profitable sale is the final step in good forest management. Woodland owners may find the following suggestions helpful. Find out from a number of buyers what prices are being offered. Compare the local prices with those quoted from other sections.

Send for the latest New Hampshire Forest Market Report, prepared by the University of New Hampshire Agricultural Extension Service each fall. In this annual bulletin current prices for various kinds of forest products, on the stump, roadside, or mill, are quoted. Also the prices being paid for operating from stump to stick, custom sawing, trucking logs and pulpwood are quoted. Names and addresses of companies and buyers by counties are also listed.

The following suggestions should be considered before selling stumpage or forest products:

1. Inquire from neighbors who have recently disposed of their timber and use their experience as a guide. *Ask your County Forester.* Failure to do this has resulted in many instances of not getting full value of the product.

2. Thoroughly investigate all local timber requirements and prices, since in many cases local markets pay better prices than outside markets, because of the saving of transportation charges.

3. Advertise, and secure competition among outside purchasers. The expense will be small and outside buyers will thus learn of chances to bid on timber in competition with local buyers.

4. Secure bids whenever practical, both by the lump and by log-scale measure. A choice is thus offered, and a more profitable form of bid can be accepted.

5. Consider the responsibility of the prospective purchaser before making the sale in order to avoid slow payment, costly collections, and losses.

6. Prior to making sales, secure at least a fairly good estimate of the amount and value of the material for sale. Persons acquainted with the business of estimating or measuring timber can usually be found in every region.

7. Market the higher grades of timber. The poorer grades can often be used on the farm to advantage. When there is quality timber to market, sell by grade. For example, selected pine logs must be practically clear surfaced and must be reasonably straight and smooth.

8. Remember that standing timber does not deteriorate rapidly. The owner, therefore, is not always forced to place his product on the market regardless of market conditions.

9. Use a written timber sale agreement, particularly where the cutting is done by the purchaser.

As an aid to people who are unfamiliar with such agreements, a sample contract is given. It shows the more important provisions that should be included in a contract for the sale of marked trees to be scaled in the log. Substitute clauses are given for use in other kinds of sales. No single form of contract will suit all classes of sales, but owners of woodland timber should have no difficulty in adopting this contract to their use.

SAMPLE TIMBER SALE CONTRACT

Agreement entered into on this ..... day of .....
between ..... of ..... New Hampshire,
hereinafter called the seller, and ..... of
....., hereinafter called the purchaser.

Witnesseth:

ARTICLE I. The seller agrees to sell to the purchaser, upon the terms and conditions hereinafter stated, all the living timber marked or designated by the seller and all the merchantable dead timber,
standing or down, estimated to be ..... board feet, more or less, on a certain tract of land situated in the town of ....., state of .....
..... and located on a farm owned by the seller and about ..... miles from .....

ARTICLE II. The purchaser agrees to pay the seller the sum of .....
more or less, as may be determined by the actual scale, at the rate of .....
per thousand board feet for .....
.....
.....
payable prior to the date of removal of material, in installments of ..... each.

ARTICLE III. The purchaser further agrees to cut and remove said timber in strict accordance with the following conditions:

1. Unless an extension of time is granted, all timber shall be cut, paid for, and removed on or before .....

2. Saw timber shall be scaled by the ..... log rule, and measured at the .....

3. The maximum scaling lengths of logs shall be 16 feet; greater lengths shall be scaled as two or more logs. Upon all logs an additional length of 4 inches shall be allowed for trimming. Logs overrunning this allowance shall be scaled not to exceed the next foot in length.

4. No unmarked timber of any kind shall be cut, except .....
.....

5. Stumps shall be cut so as to cause the least possible waste-stumps of trees up to 16 inches in diameter, not higher than 12 inches above the ground, and those of trees above this size at a distance above the ground not greater than three-fourths of their diameter.

6. All trees shall be utilized in their tops to the lowest possible diameter, for commercially salable material.

7. Young trees shall be protected against unnecessary injury; only dead trees and less valuable kinds may be used for construction purposed in connection with lumbering operations.

8. Care shall be exercised at all times by the purchaser and his employees against starting and spreading of fire.

ARTICLE IV. It is mutually understiod and agreed by and between the parties heretofore mentioned as follows:

1. All timber included in this agreement shall remain the property of the seller until paid for in full.

2. In case of dispute over the terms of this contract, final decision shall rest with a reputable person to be mutually agreed upon by parties to this contract, and in case of further disagreement, with an arbitration board of three persons, one to be selected by each party to this contract and a third to be the State Forester or his chosen representative.

In witness whereof the parties hereto have hereunto set their hands and seal this ..... day of ..... 19 .....

Witnesses:

....

....

The following are sample clauses that should be substituted in the contract when other methods of sale are used. In lump sum sales, substitute in Article I a descriptive clause, modeled on this one:

All merchantable living trees, except ..... which measure 12 inches or less in diameter at breast height (a height of 4½ feet above the ground).

Such a provision will reserve the basis of a second crop consisting of the more valuable and rapid-growing kinds of trees and remove all of the inferior and slower-growing trees.

The payment clause in lump sum sales should be varied to read somewhat like this:

The sum of ..... dollars ..... for said timber, payable prior to the cutting of the material, in installments of ..... dollars ..... each, payable on or before ..... respectively.

Other clauses which might be included are those requiring that the timber be sealed in the presence of the seller or his authorized agent; that the log lengths shall be varied so as to best utilize the timber; that unmarked trees, if cut, shall be paid for at double the regular price; that tops left in logging shall be left on the tract for the use of the seller (or, if desired, shall be utilized by the purchaser).

In selling by the lump, the other essential change is to omit the provisions, or part of them referring to scaling, measuring, and unit prices. The total amount to be paid is very important, while the total estimated quantity of timber is optional.

Many operators hesitate to buy marked lots for fear the owner may sell the remaining growth to another buyer. The following contract clause is suggested as a means of affording a buyer some assurance that he may have an opportunity to purchase stumpage from the tract in the future.

In sales in which the purchaser wishes the option to buy a second cut of timber, insert in Article IV a clause similar to the following:

"In the event a second cut of sawlog stumpage from the above-mentioned property is offered for sale, and if the land and remaining timber specified herein are at that time under the control of the seller, the purchaser, provided purchaser is doing business under the present firm name and has complied with all the terms of this contract, shall have the option of buying said stumpage at the highest price offered at the time; provided, however, that the provisons of this section shall not be construed to prevent the seller from cutting stumpage or fuel wood for his own use, and shall not prohibit or restrict the sale or other transfer of title to the land and timber, and the title of any purchaser or transferee thereof shall in no way be encumbered by the provisions of this section."

APPENDIX

Volume Tables for Common New Hampshire Trees

Table XIX.—Northern White Pine

Diam. Breast Ht. (inches)	Number of 16″ Logs ½	1	1½	2	2½	3	3½	4	4½	5
8	1	2	3	5						
10	2	3	5	6	8	9				
12	3	5	7	9	10	12				
14	5	7	9	11	13	15	18	22	24	
16	6	9	13	15	18	20	24	29	32	
18	8	12	16	20	24	26	30	36	45	
20	10	17	21	26	30	32	38	44	55	60
22	12	20	26	32	36	39	46	53	65	78
24		25	31	38	42	47	55	63	78	90
26		28	36	46	51	55	66	74	92	108
28				54	60	65	71	86	110	125
30				63	70	75	88	98	120	145
32					80	85	101	110	130	168
34						97	108	122	140	190
36										215

Table XX.—White and Red Oak (Board Feet)

Diam. Breast Ht. (inches)	Number of 16″ Logs ½	1	1½	2	2½	3	3½
10	21	34	46	57	67	77	
11	26	43	58	71	84	96	
12	32	52	70	87	102	117	
13	38	63	85	104	123	140	
14	45	75	100	124	146	167	
15	53	88	118	145	171	195	
16	61	102	137	169	199	226	
17	70	117	157	194	228	261	
18	81	133	180	221	261	297	
20	103	170	229	282	332	397	
22	128	212	285	352	413	472	
24	156	259	348	430	506	577	
26	188	311	419	516	608	695	
28	223	370	497	612	721	824	
30	434	582	718	845	966	1081	
32	502	676	834	982	1119	1253	

Table XXI.—Northern Hardwoods

D.B.H. (Inches)	Total Height of Tree (In feet) 20	30	40	50	60	(In cords) 70	80
5	.021	.031	.034	.043	.051		
6	.025	.040	.048	.060	.070		
7	.031	.047	.063	.079	.095	.113	
8	.036	.055	.078	.101	.122	.149	
9	.042	.065	.095	.125	.149	.168	.184
10	.049	.077	.114	.151	.179	.199	.217
11	.067	.113	.146	.179	.212	.235	.252
12	.087	.120	.169	.210	.251	.276	.294
13	.108	.154	.200	.246	.292	.324	.343
14		.182	.242	.286	.338	.374	.392
15			.304	.332	.390	.430	.450
16			.315	.383	.451	.491	.565
17				.433	.511	.550	.607

Table XXII.—Spruce

D.B.H. (Inches)	Total Height of Tree (In feet) 40	45	50	55	60	(In cords) 65	70
6	.04	.05	.05	.06			
7	.06	.06	.07	.08	.09		
8	.07	.08	.09	.10	.12	.13	
9	.09	.10	.12	.13	.14	.16	
10	.11	.12	.14	.16	.17	.19	.20
11		.15	.17	.19	.20	.22	.24
12		.18	.20	.22	.24	.26	.28
13		.21	.23	.25	.27	.30	.32
14			.26	.29	.31	.34	.36
15				.32	.35	.38	.40
16				.36	.39	.42	.45
17				.40	.43	.46	.50
18				.45	.48	.50	.55
19				.49	.52	.56	.60
20				.52	.57	.62	.66

Table XXIII.—Spruce

D.B.H. (Inches)	Number of Trees to Yield 1 Cord Total Height of Tree 30	40	50	60	70 Feet
5	44	32			
6	30	24			
7	24	17	14	11	
8		14	11	8.5	
9		11	8.5	7	
10		9	7	6	5
11			5	5	4
12			5	4	3.5
13			4.3	3.5	3.1
14			4.0	3.2	2.8
15			4.0	2.9	2.5
16				2.8	2.2
17				2.3	2.0
18				2.0	1.8
19				1.9	1.7
20				1.7	1.5

Table XXIV.—Fir

D.B.H. (Inches)	Number of Trees to Yield 1 Cord Total Height of Tree 30	40	50	60	70 Feet
5	42	30	24		
6	29	22	18	15	
7	22	17	13	11	9.5
8		13	10	9	7.3
9		10	8.5	7	5.8
10		8	7	5.8	4.9
11		7	5.7	4.8	4.1
12			4.7	4.1	3.5
13				3.5	3.1
14				2.7	2.4

Table XXV.—Hardwood

D.B.H. (Inches)	Number of Trees to Yield a Cord Northern Hardwoods Beech, Birch, Maple	Southern Hardwoods Oaks, Basswood, Ash, etc.
3		90
4		50
5	35	25
6	20	17
7	15	13
8	11	9
9	8	7
10	6	6

Comparison of Log Rules

Table XXVI.—Comparison of Log Rules for 16-Foot Logs

Top diam. of log inside bark (inches)	Contents of log in board feet by rule stated												
	International	Scribner		Doyle	Doyle and Scribner	Holland or Maine	Blodgett or N. H.	Humphrey or Vermont	Bangor	Cumberland River	Square or three-fourths	Herring	Champlain
		Scribner	Decimal C.										
4	5	(10)	(10)	.....	.....	(3)	13	11	(6)	8	12	(6)	8
5	10	(13)	(10)	1	1	(11)	19	16	(12)	12	19	(12)	14
6	20	18	20	4	4	20	26	24	23	17	27	(19)	22
7	30	24	30	9	9	31	35	32	27	23	37	(26)	32
8	40	32	30	16	16	44	43	43	41	31	48	34	43
9	50	42	40	25	25	52	54	53	54	39	61	43	56
10	65	54	60	36	36	68	66	67	69	47	75	53	70
11	80	64	70	49	49	83	78	80	84	57	91	65	87
12	95	79	80	64	64	105	92	96	100	68	108	77	105
13	115	97	100	81	81	120	106	112	118	80	127	91	124
14	135	114	110	100	100	142	123	131	137	93	147	107	146
15	160	142	140	121	121	161	139	149	158	107	169	124	168
16	180	159	160	144	144	179	157	171	182	121	192	142	193
17	205	185	180	169	169	205	176	192	209	137	217	162	219
18	230	213	210	196	196	232	197	216	238	153	243	183	247
19	260	240	240	225	225	271	217	240	268	171	271	206	277
20	290	280	280	256	256	302	240	267	300	190	300	230	308
21	320	304	300	289	289	336	262	293	334	209	331	256	341
22	355	334	330	324	324	363	287	323	369	229	365	284	376
23	390	377	380	361	361	401	313	352	406	250	397	313	412
24	425	404	400	400	400	439	339	384	444	273	432	344	450
25	460	459	460	441	441	477	367	416	484	296	469	377	490
26	500	500	500	484	484	507	397	451	526	320	507	411	532
27	540	548	550	529	529	546	426	485	566	345	547	447	575
28	585	582	580	576	582	614	457	523	609	372	588	485	620
29	630	609	610	625	609	657	489	560	652	399	631	525	666
30	675	657	660	676	657	706	514	600	697	427	675	567	714
31	720	710	710	729	710	755	557	640	743	456	721	616	764
32	770	736	740	784	736	795	592	683	792	485	768	655	814
33	820	784	780	841	784	848	628	725	842	516	817	703	868
34	870	800	800	900	800	900	666	771	892	548	867	752	923
35	925	876	880	961	876	949	704	816	(950)	581	919	(800)	980
36	980	923	920	1024	923	1026	744	864	(1000)	614	972	(850)	1038
37	1040	1029	1030	1089	1029	1089	785	912	(1050)	649	1027	(910)	1097
38	1095	1068	1070	1156	1068	1135	827	963	(1110)	685	1083	(960)	1159
39	1155	1120	1120	1225	1120	1209	870	1013	(1170)	721	1141	(1020)	1222
40	1220	1204	1200	1296	1204	1261	914	1067	(1220)	759	1200	(1080)	1287

Average Labor Required

Table XXVII.—Average-Labor Required for Log Making in White Pine, and Skidding White Pine Logs. Labor per Thousand Board Feet Based on Lumber Tally

Diameter at Breast Height (inches	Tree Size Man-Hours	Top Diameter Inside Bark (inches)	Log Size Man-Hours	Diameter at Breast Height (inches)	Tree Size Man-Hours	Top Diameter Inside Bark (inches)	Log Size Man-Hours
	Log Making				Skidding - 400 feet		
4	8.39	4	8.24	6	3.68	4	4.06
6	6.59	6	5.52	8	2.79	6	2.78
8	5.09	8	4.06	10	2.31	8	2.06
10	4.08	10	3.22	12	2.01	10	1.74
12	3.52	12	2.76	14	1.82	14	1.57
14	3.22	14	2.56	16	1.69	12	1.46
16	3.12	16	2.45	18	1.59	16	1.37
18	3.10	18	2.41	20	1.50	18	1.30
20	3.12	20	2.44	22	1.43	20	1.26
22	3.19	22	2.54	24	1.38	22	1.25
24	3.29	24	2.66	26	1.37	24	1.27
26	3.42	26	2.81	28	1.39	26	1.32
28	3.59	28	.....				

Cost of producing white pine lumber in New Hampshire. Circular No. 557, Table 9.

Table XXVIII.—Average Labor Required for Hauling White Pine Logs 10 Miles by Motor Truck and for Milling, Based on Lumber Tally

Diameter at Breast Height (inches)	Tree Size Man-Hours	Top Diameter Inside Bark (inches)	Log Size Man-Hours	Diameter at Breast Height (inches)	Tree Size Man-Hours	Top Diameter Inside Bark (inches)	Log Size Man-Hours
	Hauling				Milling		
6	2.67	4	2.71	4	14.2	4	9.3
8	2.40	6	2.40	6	8.9	6	4.9
10	2.25	8	2.21	8	5.6	8	3.1
12	2.14	10	2.08	10	4.0	10	2.5
14	2.06	12	1.98	12	3.1	12	2.2
16	2.00	14	1.90	14	2.7	14	2.0
18	1.94	16	1.84	16	2.5	16	1.9
20	1.90	18	1.79	18	2.3	18	1.9
22	1.87	20	1.77	20	2.2	20	1.9
24	1.89	22	1.79	22	2.2		
26	1.93	24	1.82	24	2.2		

Cost of producing white pine lumber in New Hampshire. Circular No. 557, Table 10.

References

N. H. EXTENSION AND AGRICULTURAL EXPERIMENT STATION PUBLICATIONS

Ex. Cir. 278 Christmas Trees, A Cash Crop
Ex. Bul. 79 Maple Syrup and Sugar Production
Ex. Bul. 82 New Hampshire Forest Market Report
Sta. Bul. 337 The Place of Woodland in the Farm Organization in Coos County, N. H.

OTHER EXTENSION PUBLICATIONS

Vermont Ex. Cir. 94 Harvesting Timber on Vermont Farms
Ohio Ex. Bul. 213 Woodland Management

REPORTS

New Hampshire Forestry and Recreation Report, 1945-46

YALE UNIVERSITY SCHOOL OF FORESTRY BULLETINS

No. 48 Growing of White Pine on the Yale Forest near Keene, N. H.

HARVARD FOREST BULLETINS

No. 2 Growth Study and Normal Yield Tables for Second Growth Hardwood Stand in Central New England
No. 4 Red Oak and White Ash. A Study of Growth and Yield
No. 8 Mixed White Pine and Hardwood
No. 9 Red Pine in Central New England
No. 11 Growth of Hemlock Before and After Release from Suppression

NORTHEASTERN FOREST EXPERIMENT STATION OCCASIONAL PAPERS

No. 3 Suggestions for Weeding Northern Hardwoods
No. 8 Cost of Producing Pulpwood on Farm Woodlands of Upper Connecticut Valley

U.S.D.A. PUBLICATIONS

Cir. 134 Suggestions for Management of Spruce Stands in the Northeast
Cir. 163 Paper Birch in the Northeast
Cir. 431 Increasing Growth and Yield of Young Spruce Pulpwood Stands by Girdling Hardwoods
Cir. 557 Cost of Producing White Pine Lumber in New England
Cir. 717 Chemical Impregnation of Trees and Poles for Wood Preservation
Bul. 13 White Pine Under Forest Management
Tech. Bul. 166 Timber Growing and Logging Practice in the Northeast
Farmers' Bul. 1210 Measuring and Marketing Farm Timber
Farmers' Bul. 1989 Managing the Small Forest