PERTINENT FACTS ON SALVAGE OF NEW ENGLAND TIMBER

Distributed by

NORTHEASTERN TIMBER SALVAGE ADMINISTRATION

thru cooperation of

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
FOREST PRODUCTS LABORATORY
Madison, Wisconsin

For further information consult State Project Director or
N. E. Timber Salvage Administration.

Preliminary Issue
November 1, 1938

TABLE OF CONTENTS

PERTINENT FACTS ON SALVAGING NEW ENGLAND TIMBER

This mimeograph presents pertinent facts on the storage, conversion, and marketing of New England timber felled by the hurricane of September 21, 1938. Facts and deductions brought together on short notice in this mimeograph must be subject necessarily to revision and modification as more exact knowledge of the conditions and possibilities becomes available. Due weight must be given to subsequent recommendations from public and industrial salvage agencies which may or may not conform to the present contents of this mimeograph.

It is understood that a special committee of trade and technical agencies is being organized to issue advice from time to time on matters of milling, products, grades, and markets. Such advice can be presumed to be a reliable composite of various sets of facts and judgments. This mimeograph is intended as a contribution to conclusions thus jointly arrived at rather than to present by itself final answers to the many complicated problems involved.

More complete information on the subjects summarized here may be obtained from the various publications cited in the text.

Log Storage

The length of time that logs can safely be held after cutting depends upon the season and the method of storage. During a normal winter in New England there is no danger of attack by insects, stains, or decay but hardwood logs or high grade pine logs that are held into the late spring or early summer may deteriorate seriously unless preventive measures are taken.

Complete Submersion

Complete submersion in fresh water may not be the most practicable but is the surest way to avoid deterioration. Both hardwood and softwood logs and timbers can be kept in sound condition for many years in this manner. Submersion in tidal or brackish water is unsafe because the wood may be damaged by marine borers. For worthwhile results, the logs must be submerged before they begin to deteriorate. Submersion will soon halt the progress of insects, decay, or stains that may have started but it cannot undo any damage that has already taken place. Where submersion is to be used logs cut during the fall and winter should be submerged by late April or early May. Deep water submersion involves high cost of raising and recovery. Only shallow water submersion can be considered.

In ponds which are sufficiently small to "overfill" with floating logs the logs will sink as a sufficient quantity is piled in. It is roughly estimated that an acre of water area 4 feet deep will accommodate about 500,000 feet of logs and in so doing the bulk of them will be submerged. Covering the surface of a frozen pond with log piles about 4 feet deep for every 5 feet of water depth will be about right. In larger bodies of water than cannot be "overfilled" with logs one method of submersion of the floating softwoods is to construct cribs of suitable size by driving piles either through the ice or from barges and piling the logs within the cribs. As the height of the log pile increases, the bottom logs are forced under water.

The logs on top of submerged piles will necessarily remain above water and will thus be subject to deterioration in warm weather unless protected by the water spray method described later.

Where conditions permit, logs may be piled behind a dam and anchored down before the water is allowed to rise and cover them.

Floating

Floating is not as effective as submersion but, of course, is much easier. The degree of protection afforded floating logs varies with their buoyancy. Small white pine logs float low; medium to large logs high. Small pine logs absolutely green therefore can be given almost complete protection by storing in booms. The additional water absorbed by the exposed portions of logs provide conditions not favorable to staining or insect attacks. Large white pine logs are protected in proportion to the amount of submersion. Deterioration of logs afloat after three or four years will be confined chiefly to exposed sapwood. There will be some shrinkage, how much is not known, but estimates of 10-15 percent have been advanced.

Approximately 40 percent of woods-run hardwood logs will sink almost immediately. Those that float for awhile will be largely submerged with little resulting damage to the log as a whole.

It is roughly estimated that an acre of boom space will accommodate about 80M feet of 8-inch logs, 125 M feet of 11-inch logs, 218M feet of 15-inch logs, and 280 M feet of 18-inch logs.

Dry Decking

Dry decking of pine logs on skids in a protected location over one summer will result in some damage through end stain. Devaluation of products of small logs will be slight. Damage of lumber from larger higher grade logs may be considerable, since stain is a defect in the higher grades.

Hardwood logs decked as cut cannot stand dry storage over summer. The value of hardwood lies largely in the clear sapwood content, and sapwood will be badly stained during that period. End checking, which will also occur, and stain can be minimized by methods described elsewhere.

Water Sprays

Where the quality of the logs justifies the expense the logs may be decked and kept in green condition free from deterioration from stain, decay, and insects for an entire summer season and probably longer if the piles are kept wet by continuous water sprays. Experience with pulpwood storage as well as with log storage has shown that the logs should be piled in rows so that both ends of each log are exposed to the direct action of the sprays.

At one plant which used this method successfully for several years on birch logs, sprays of water were directed diagonally downward upon the ends of the piles from fixed spray heads located well beyond the pile ends. Spray nozzles, such as used in spraying trees, were found to be suitable. Enough water must be used to keep the pile enveloped in a light mist; otherwise drying will take place from surfaces not directly exposed to the action of the sprays.

End Coatings

To control end checking in logs, poles, and posts certain moistureproof coatings may be used. To be worthwhile coatings must be applied before the logs have begun to dry out and end check. After checking has started beyond the hair-check stage there is little value in end coating. End coatings may be applied after the chemical spray treatment in cases where the latter is used for the prevention of blue stain. (See "Chemical Log Sprays.") A good, cheap, end coating that is used cold consists of -

50 parts gloss oil
(8 parts by weight quick lime
100 " " " rosin
57.5 " " " solvent, such as naphtha or turpentine)
25 parts barytes, and
25 " asbestine.

See Forest Products Laboratory Tech. Note 186 (free) for further details on end coating, also Mimeograph R52 (free).

Other end coatings such as hot paraffin and heavy paint have merit though not as effective as the gloss oil treatment.

Chemical Log Sprays

In the absence of severe insect infestations, spraying the ends and barked or peeled areas of freshly cut logs with a 5 percent solution of Dowicide H, Santobrite, or Permatox, or a 2 percent solution of Lignasan should substantially retard the occurrence of blue stain in the sapwood during storage periods as long as 3 months. (Distributors of the products mentioned are given in the discussion of "Lumber Dipping") Insects are a major source of blue-stain infection and in the event that their attacks become prominent it is unlikely that a spray treatment would pay.

It is very important that the spraying be done within 48 hours after the logs are cut or peeled. Logs having splintered ends should be butted to fresh wood before spraying. Spraying over the bark is not worthwhile.

The chemical solution may be applied with an ordinary garden spray of medium capacity.

Poles and Piles

Poles and piles should be removed from the woods as soon as they are cut, particularly in warm weather. Unless arrangements can be made to deliver them to the purchaser with bark on, they should be peeled promptly and thoroughly and placed in sanitary, well-built seasoning

piles. The bottom layer in the seasoning pile should be at least 18 inches above the ground on posts or other durable supports that leave plenty of space on all sides for air circulation. Cross pieces, preferably of dry, durable wood, should be used to separate the layers of poles in the pile. Serious end checking is likely to occur in hardwood poles or piles but it can be greatly retarded by the use of end coatings.

Since the principal users of poles and piles have special requirements as to species, size, quality, peeling, and delivery, it is much safer to produce on contract, in accordance with these requirements, than to produce and store the material and then try to find purchasers.

Railway Ties

Railway ties should be produced, handled, and delivered strictly in accordance with the specifications of the purchaser. Railroads are usually unwilling to accept ties that have been kept in storage by the producer and generally require delivery of the ties to the railroad or to the tie-treating plant promptly after cutting. While awaiting rail shipment to the tie plant, the ties should be open piled at the loading switch, with the bottom ties in each pile at least a foot above the ground. Ties in good piles do not deteriorate in cold weather but in warm weather they may deteriorate rapidly unless properly cared for.

Posts

If posts are to be treated in the green condition by the tire-tube method, described later in this mimeograph, or any other method suitable for green wood, they may be stored safely (after treatment) for several years in "cordwood" piles or any other convenient form of pile, provided the posts are not in direct contact with the ground. If the treatment is made by a method that does not require the prior removal of the bark, peeling subsequent to treatment is unnecessary.

Posts that are to be used untreated or that are to be treated by methods that require prior seasoning, should be thoroughly peeled and placed in seasoning piles before warm weather begins. The bottom layer of posts should be at least 18 inches above the ground on suitable supports and each layer of posts in the pile should be at right angles to the adjacent layers. Piling the posts all in the same direction, cordwood fashion, retards the rate of seasoning and encourages deterioration. Deterioration by decay in any form of pile exposed to the weather is likely to begin if the posts are held through more than one summer, but will not deteriorate during cold weather.

End checking is likely to be severe in hardwood posts but, where the value of the posts permits, it can be greatly retarded by end coatings if they are applied soon after the posts are cut.

Firewood

Firewood to be stored should be cut presumably into 4-foot lengths, split, and piled in the open on high ground. If the cordwood is to be stored more than 6 months, compact piles resting on two bed pieces raising the piles off the ground can be used. The top of the piles should be so constructed as to shed much of the rain.

One cord of wood containing 80 cubic feet of solid wood at 20 percent moisture content of beech, birch, and maple will have the total heat equivalent of 1 ton of anthracite or bituminous coal; 1 cord of white pine will be the equivalent of about 3/5 of a ton of coal.

Pulpwood

The most economically effective method of storing pulpwood is with the bark off in open piles; in other words, under conditions which promote rapid air-drying. Under these conditions incipient decay is checked and new infection may be prevented for a number of months.

The hardwoods now on the ground may be difficult to peel at this time. However, immediate barking and piling is advised. After May infection will take place rapidly in the unbarked material.

All storage yards should be well-drained and cleaned of bark, leaves, and other debris in which infection may start. This material should be burned. Although a clean earthen surface will serve, gravel, cinder, or slag surfaces are better. The logs should be piled off of the ground on uninfected stringers. Creosoted (or other antiseptically treated) stringers are, of course, better than untreated stringers. Concrete piers are excellent. Relatively open cross-piled ricks with air circulation on all sides are recommended. If close piling is necessary, lanes between rows should run in the direction of prevailing winds.

A considerable amount of the blown down timber may already be infected with heart and butt rots. These infected parts should be removed as quickly as possible from the remaining wood. It may be possible to profitably market the less infected logs immediately at a lower price, of course, than good pulpwood. All rotten logs remaining in the woods should be removed from the vicinity of the pulpwood piles and preferably burned.

Peeling

Although wood cut in midwinter or late winter will peel more easily in spring after the cambium has started to grow under the bark, it is not known whether timber that has been blown down in September will remain alive all winter sufficiently to start cambial growth in spring and facilitate peeling. In general it probably is safer to peel in winter and not take a chance on easier peeling in the spring.

Lumber Conversion

Milling Season

Logging and milling can be conducted simultaneously at all seasons. Whether "sap" is up or down makes no difference. Warm spring and summer months require greater attention to proper methods of seasoning lumber to prevent stain on the one hand and checking on the other if the drying is too slow or too fast. Hardwood logs can normally be carried until May or June with practically no damage from excessive stain. Pine logs are more resistant than hardwoods, and can be carried through the summer with little effect on quality of product cut from small low-grade logs.

Sawing Thicknesses and Products

Rapid conversion and flexibility in marketing both call for sawing white pine into as much thick lumber as possible. With hardwoods it is different.

Although in recent years white pine in New England has not been used largely for house framing lumber, much of it can be used for that purpose, and such outlet should be definitely provided for. Neither have millwork or planing mill products provided much outlet for New England second-growth white pine heretofore, but some of the better second-growth pine is suitable for such purposes and the sawing thicknesses need to be such that the best material can be sorted out for this market. All factors point to the advantage of sawing the pine 2 inches thick (actual sawing thickness 2-1/8") on the headsaw instead of attempting to cut 1-inch boards for general marketing purposes. Two-inch pine planks will increase mill output, reduce yard drying costs, permit ripping after drying into house framing, dimension, and millwork, and resawing into sheathing, concrete form lumber, box boards, and the like.

The drawback to this practice for the lumber that is to find its outlet in the building field is that resawing facilities are required. However, with the facilities for ripping and resawing that are available at the 30-odd box factories in New England this difficulty can be fairly readily taken care of. There are some 7 box factories in Maine, 11 in New Hampshire, 2 in Vermont, 10 in Massachusetts, and several in New York and Pennsylvania that may be drawn on. The setting up of special remanufacturing facilities for ripping, resawing, and dressing may be necessary.

Some 3-inch lumber is used in New England for joist material. The amount that can be cut 3 inches is limited by the quality of the logs and the somewhat restricted marketing possibilities. Remanufacturing possibilities from 3-inch plank are limited.

Timbers, such as 6x6's, etc., are a distinct possibility, especially in connection with current public works programs in the

Eastern States, but definite uses and markets must be explored before a program of cutting white pine timbers is launched.

Hardwood lumber should be sawed 4/4 or 1 inch (actual sawing thickness 1-1/8") except where a definite and known demand exists for thicker material. Hard maple for shoe heel stock should be cut 9/4" unless definite orders specify otherwise. Basswood suitable for Venetian blind stock, etc., should be cut to thicknesses dictated by the purchasing factories, and white ash should be in accord with specifications secured from the most likely purchasers.

The cutting of round-edged material for box boards on an expanded scale and without a definite market is to be discouraged. The demand is limited and cannot readily be expanded. The brightest prospects lie in square-edged lumber for the building field.

For mills not equipped with edgers a good output of square-edged lumber can be realized by slabbing heavily two opposite sides of the log, turning down and sawing through and through. Most of the product will then be square edged. There will be some sacrifice in grade but not enough to jeopardize the advantage of getting away from round-edged boards which are difficult to pile compactly and subject to insect attack under the bark.

Roofers have been suggested as the product into which the bulk of the blown-down pine should be sawn. Roofers are defined as No. 2 common and better boards as produced in the Southeastern states. They are used for sheathing concrete forms and other rough coverage purposes. Much of the New England pine can be expected to go into the markets served by roofers but it is a somewhat limited and low-priced market, and to cut everything on the headsaw to 1-inch boards automatically limits the marketing possibilities. To salvage the New England pine to the fullest advantage consideration must be given to manufacturing not only 1-inch boards but 2-inch house framing and millwork material as well. It is for this reason that emphasis in this mimeograph is put on sawing 2-inch planks on the headsaw, and seasoning in this form so that ripping and resawing later on can yield 2x4's, 6's, 8's, 10's, planing mill items, roofers or box as the demand may be and as the quality of the stock permits.

Log Sizes

Logging and milling studies in New England on second-growth white pine timber have proved conclusively that many operators have been cutting smaller and more crooked logs than return anything over costs. Logs 6 inches in diameter at the small end appear to be the minimum that warrant any urgent consideration for lumber in salvage operations.

Yard Piling

Lumber cut for deferred use and long storage must be carefully and thoroughly seasoned if serious deterioration is to be avoided.

Adequate pile foundations, special stickers or crossers, and proper pile coverage are factors necessitating careful attention. Foundations and pile coverage are of obvious importance, and common sense largely dictates what needs to be done. The matter of stickers or crossers is not so obvious and for that reason requires special consideration. The practice of self-stickering, that is, using cross pieces of the same green material as is being piled, is to be strongly condemned because serious stain and decay are almost sure to set in at the point of contact. Dry 1x2-inch or 1x3-inch stickers should be used, no wider. Obtaining suitable supplies of such stickers presents some difficulties. A small mill without a rip saw is not in a good position to cut them readily. It may be necessary to have stickers cut at mills equipped to do the job and then distribute them to the nearby mills that are not equipped.

There are various methods of piling that are used: flat, crib, end-racking, etc. Flat piling has most to recommend itself for the job at hand in New England. Mimeograph R899-8 (free) from the Forest Products Laboratory, Madison, Wis., describes approved methods in some detail.

Amount of Yard Drying

Whereas it is possible to "get by" with partial seasoning when the lumber is to be used fairly promptly and for low quality purposes, it is courting serious trouble to put partially seasoned lumber into bulk storage. Bulk storage will probably be necessary on a large scale if the New England lumber is not to be dumped on the market all at once.

No lumber having a moisture content higher than 20 percent should be bulk piled, viz., in large closed piles without crossers. There is no way (other than testing) of telling just how long lumber should be yard piled to reach this moisture content. Much depends on the weather and the lumber.

One must figure on 4 to 8 months under favorable drying conditions for 2-inch pine and 1-inch hardwoods, and 1-1/2 to 2 months for 1-inch pine. Unfavorable drying conditions will double the above requirements.

Kiln Drying

As an emergency measure large-scale kiln drying of either pine or hardwood lumber does not appear to be very much in the picture in view especially of the relatively low grades involved. Some special provision for kiln drying the relatively small quantities of select pine lumber yielded may be justified in certain areas.

There are certain scattered points in New England where good kiln facilities are available and the shipment of high-grade lumber to these points might be feasible. The hurried construction of new kilns is of doubtful feasibility.

Hardwoods may be kiln dried green from the saw in kilns having accurate control of humidity and temperature combined with adequate and positive circulation. The more common types of ventilated kilns cannot, as a rule, be controlled close enough for such green hardwoods, but could be used for air-seasoned hardwoods. White pine can be dried green from the saw in good ventilated kilns.

Boilerless kilns or smoke kilns, such as can readily be built in connection with portable pine mill operations may prove useful in certain instances. They are especially adapted to 1-inch pine lumber, and cannot be used for hardwoods. They involve no purchased equipment or material except a section of a metal smoke stack, such as is frequently available in junk yards. Fairly uniform and rapid drying, at least to a

thoroughly air-dried condition, can be accomplished in such kilns. They should not be used where fire danger cannot be controlled either in the woods or mill yards because there is some fire hazard in their use. A Forest Products Laboratory Mimeograph R899-9 (free) describes the construction and operation of smoke kilns. The Kiln Drying Handbook gives details about dry kilns and their operation (Supt. of Documents, Washington, D. C., 30 cents).

Bulk Piling

To prevent the deterioration of thoroughly air-dry lumber during prolonged storage, protection against rain, snow, and ground moisture must be provided by means of well-constructed lumber-storage sheds in which the lumber may be solid piled. Stain or decay will not develop in the lumber in bulk piles so long as the moisture content is less than 20 percent, and it can be held indefinitely without deterioration except that the sapwood of hardwood lumber needs protection against powder-post beetles. (See p. 22).

Lumber Dipping

One of the most extensively used and generally effective methods of preventing blue stain during air seasoning is to dip the freshly sawed lumber in solutions of certain chemicals that are toxic to the fungi responsible for the stain. Stain fungi gain entrance into the wood rapidly; hence the stock should be dipped within 24 to 48 hours after sawing. Greater delays incur the risk of infection inside the surface layers of the wood reached by the chemical and commonly result in objectionable interior stain. For satisfactory results the dipping should be followed by good piling practices and the stock should be protected from rain washing insofar as is practicable.

Chemicals generally favored for dipping of both softwood and hardwood lumber are Lignasan (distributed by E. I. du Pont de Nemours & Co., Wilmington, Del.), Dowicide P and Permatox (distributed by A. D. Chapman & Co., Inc., Chicago, Ill.), and Santobrite (distributed by the Monsanto Chemical Co., St. Louis, Mo.). In addition to these, Dowicide H is commonly used for treating hardwoods. All are comparable in effectiveness if directions furnished by the distributors are followed carefully.

Dipping may be accomplished either mechanically or by hand, depending largely on the output of the mill. The equipment in either case is comparatively simple and suggestions for its construction may be procured from the distributors of the antistain preparations mentioned.

More detailed information regarding chemical control of blue stain can be found in Forest Products Laboratory Technical Note 225 (free). Dipping practices for small sawmills are more extensively discussed in the December 15, 1934 issue of the Southern Lumberman.

Hardwood Dimension-Square Grades

Dimension-squares in New England are generally sold on a "90 percent clear" specification. This applies also to shoe heel squares.

The intent of the specification is to admit stock that is 90 percent or more usable where clear stock is required. The 10 percent may be knot or check areas or other defects that detract from the serviceability of the piece.

Specific rules for grading New England turning squares are given in the official rule book of the National Hardwood Lumber Association, 2408 Buckingham Bldg., Chicago, Ill.

Dimension Grades and Sizes (Framing)

White pine has not been used extensively for dimension in recent years. Nevertheless house framing can furnish a substantial market for much salvaged white pine provided suitable grades are produced.

Best results will be obtained if all forms of dimension are cut to width after seasoning so that they will be straight and free of twist. White pine dimension so manufactured will be in favorable competitive status with other woods.

White pine grade for grade is not quite the equal of eastern spruce or eastern hemlock in strength or stiffness. The use of white pine in rough thickness of 2-inch dimension instead of dressed to 1-5/8 inches will fully compensate for the difference in breaking strength and stiffness regardless of whether the material is used flat or on edge or for studs, rafters, or joists. Dressing dimension on one edge is all that is absolutely necessary for good construction, although consumer preference may dictate further surfacing.

The grading rules of the Northeastern Lumber Manufacturers' Association for northern white pine and Norway pine are primarily board rather than dimension grades. However, the No. 1 Common grade for pine can be used for any item of house framing, provided a medium cross-grain limitation, as defined in the Association rules for eastern spruce and balsam fir, is applied.

It appears probable that only a relatively small amount of No. 1 Common lumber can be obtained from the down timber. It is therefore suggested that consideration be given to the following rule for use in the grading of joist and rafter stock in order to make higher percentage available for use as dimension.

Stock free of pieces containing parts of burls and decay. Will admit medium cross grain, sound and encased knots, and knot holes whose average diameter does not exceed one-fourth of the width of the wide face when located at or near the edge and in the center half of the length, and one-half of the width when located at or near the center line of the wide face or near the ends of the piece.

The rule suggested can be applied to any species, softwoods or hardwoods. Dimension so graded will have 50 percent of the basic clear material strength shown on page 105, Table 20, of U. S. Department of Agriculture Wood Handbook (Superintendent of Documents, Washington, D. C., 35¢).

Material for studs for use in the ordinary small dwelling can well be of a lower grade than that suggested for joists and rafters, provided the stock is thoroughly seasoned before being cut to width. All material that is straight after being cut to size can be safely used for studding, provided pieces obviously seriously weakened by decay, parts of burls, and large knots are culled.

The No. 1 (merchantable) grade of the Northeastern Lumber Manufacturers' Association for eastern spruce and balsam fir is suitable for any item of house framing. The grade may also be applied to eastern hemlock, northern white pine, or any of the species and the lumber will be suitable for any item of house framing.

Sawmill Equipment

The salvaging of relatively small-sized logs from relatively small holdings dictates comparatively light, inexpensive, portable equipment. The following table gives some guiding data for mills of this type. Usually a relationship exists between cost, capacity, durability, and weight of mills, the greater the weight the higher the other three. The lightest mill given in the table -- Belsaw -- is ordinarily equipped with a 30-inch saw and its field of utility is limited to logs under 20 inches (diameter inside bark). The others carry saws about 50 inches in diameter and can cut logs of 36 inches or more in diameter.

Saws for work of this kind are the insert-point type because solid-tooth saws call for extra skill in servicing. Such saws are listed at about $150 each. Some saw manufacturers and suppliers are the E. C. Atkins Co., Indianapolis, Ind., Henry Disston & Sons, Inc., Philadelphia, Pa., R. Hoe & Co., Inc., 138 St. and E. River, New York City, Simonds Saw Manufacturing Co., Fitchburg, Mass. The size of saw and type of tooth depend, of course, upon the size and species of timber to be cut. In general the saw diameter should be 1-2/3 times the largest logs. Specific recommendations are given by the saw manufacturers.

Edgers are frequently dispensed with in the smallest operations, and the work is done on the headsaw instead. Production beyond 3 to 5 M per day usually justifies an edger if the operation is to be self-contained. In coordinated salvage operations, edging can probably best be done at central plants rather than at individual sawmills unless the lumber is for local use. The concerns listed in the following table of mill manufacturers also sell edgers. The list prices range from $300 to $400. J. H. Miner, Meridian, Miss., features a light edger listed at about $165.

Power for small mills of the foregoing type can be supplied by standard gasoline-powered tractors of the McCormick, Fordson, and similar types usually found in farming communities, or by steam tractors such as used for threshing. If new equipment is purchased the gasoline-powered units of about 40 hp. rating are usually cheaper than are the steam. The cost is approximately $800 per unit.

PORTABLE MILLS

Make	Address	Catalogue number	Rated capacity per 10 hr. day	Weight	Movement per rev. of saw: Feed	Movement per rev. of saw: Gig	Type of feed	Approx. list price
			M.	Pounds	Inches	Inches		Dollars
American	Amer. Sawmill Mchy. Co. Hackettstown, N.J.	#1	2-6	(3,000-3,400)	4-1/4	11-1/4	Either belt or disc.	450
Do.	do.	#2	5-10	(3,900-4,160)	4-3/4	11-1/2	do.	550
Amidon	C. S. Amidon&Sons, E. Willington, Conn.						Belt	
Belsaw	Belsaw Mchy. Co., Kansas City, Mo.	10S18	2-3	500			do.	180
Chase	Chase Turbine Mfg. Co., Orange, Mass.	"300" series	8-10				do.	
Corley	Corley Mfg. Co., Chattanooga, Tenn.	395	5-8	3,576	5	10	do.	460
Do.	do.	440	5-8	3,950	5	10	do.	530
Cunningham	Cunningham Mach. Corp. Shreveport, La.	A-#1		4,500			do.	700
Enterprise	Enterprise Co., Columbiana, Ohio	18			5-1/2	16	do.	
Do.	do.	21			4-3/4	12-1/2	do.	
Do.	do.	1 & 10			5	9	do.	
Do.	do.	1-1/2-2-2-1/2			5	9	Disc.	
Farquahr	York, Pa.	8	4-10	3,000	4	10-1/4	Belt	
Do.	do.	9	5-12	3,000	4	10-1/4	do.	
Fisher&Davis	Fisher & Davis Mfg. Co., 934-940	0			3-1/2	10-1/2	do.	650
Do.	N. First St., St. Louis, Mo.	1			2-3/4	8	do.	730
Frick	Frick Co., Waynesboro, Pa.	00	4-10	3,000	4	8	do.	
Do.	do.	0	5-12	4,000	5	10	do.	
Ireland	Ireland Mch. & Foundry Co.,	1	2-5	2,100	4-1/2	12		
Do.	Norwich, N. Y.	2	3-8	3,200	4-1/2	12		
Lane	Lane Mfg. Co., Montpelier, Vt.	Tractor Mill	5-10	3,250	4-1/2		Belt	630
Do.	do.	Dixie		4,100			do.	900
Meadows	Meadows Mill Co., N. Wilkesboro,	#1 headblock		3,000			do.	425
Do.	N. C.	#2 headblock		4,000			do.	515
Sinker Davis	Sinker Davis Co. Indianapolis, Ind.	#0			3	9	do.	

Belt size will depend upon the power-unit pulley, but where possible a 10-inch, 5-ply belt costing about $85 is to be preferred to an 8-inch costing about $55.

Lumber rolls costing about $40 are obtainable from the manufacturers of sawmills.

Lumber dollies cost about $20 each. Two are the usual number required.

Further information along these and related lines is contained in Forest Products Laboratory Mimeograph R1083 (free).

Labor Requirements

The crew of the small, portable mill powered with a gasoline engine will usually consist of six men as follows: one deckman, one sawyer, one slab off-bearer, and one lumber off-bearer in the mill, and two men hauling and piling lumber in the yard. If the mill is edging the lumber five men are generally used in the mill. By having another man as dogger and setter, the number of men in the mill would be increased to six, but the output would also be increased.

The capacity of a mill will depend largely on the power available, equipment, size of logs, and type of product. A mill cutting largely 8/4-inch round edge lumber from logs running from 4 to 19 inches in diameter, averaging about 8 inches, with sufficient power can cut 10 M feet of lumber per 10 hours. In this case the man-hour requirement per M board feet of lumber would be six man-hours including piling. The man-hour requirement will vary from 5 to 10 man-hours per M feet of lumber for portable mills.

Log Grades, Scales, and Cutting Specifications

Grading Rules for White Pine Logs

Subject to later modification the New England Timber Salvage Administration has adopted the following grades for white pine logs as of November 1, 1938. The price to be paid for each grade and cutting instructions may be obtained from the office of the Administration.

Top diameter inside bark	Length	Rot Permitted	Sweep Permitted	SURFACE REQUIREMENTS
				GRADE 1
13-16"	12-16'	10%	1" per 8'	Must be 2/3 surface clear in lengths 8' long or longer, or 50% surface clear full length.
17" & up	10-16'	15%	"	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 2
9-16"	10-16'	10%	1" per 4'	Sound tight knots not larger than 2-1/2" in diameter, or 50% full length surface with sound tight knots not larger than 2" in diameter.
17" & up	8-16'	20%	"	Sound tight knots not over 3" in diameter, or 50% full length surface with sound tight knots not larger than 2-1/2" in diameter.
Shake and splits not permitted.				
				GRADE 3
6-8"	10-16'	None	1" per 8'	Sound knots not over 1" in diameter or live knots not over 2" in diameter.
8-13"	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" and up	10-16'	20%	"	Sound knots permitted.

Pulpwood Specification

In the absence of specific instructions from known mill buyers a general guide for cutting is as follows.

All wood should be sound, seasoned, straight, free of burned portions, and be not less than 5 inches in diameter at the small end. Outside and inside bark should be entirely removed, and knots and limbs trimmed close. Bolts of spruce and balsam fir should be sawed 48 inches long, poplar and basswood 48 to 60 inches. Spruce and balsam may be loaded in the same car but in separate ranks. Beech, birch, maple and elm may be mixed in ranks, but must be kept separate from poplar and basswood which may also be mixed. All wood must be round except beech, birch, and maple which, if 12 inches in diameter, may be halved, or if larger, quartered.

Pole Specifications

Pole using companies generally have their own detailed pole specifications that may or may not conform to the national standard of the American Standards Association. Specifications should be obtained

direct from the company to whom the poles are to be sold. Some of them may be willing to accept red (Norway) pine or some other species for poles in addition to northern white cedar. Probably white pine or hardwood poles will not be accepted by any public utility, but the Rural Electrification Administration may accept types of poles not acceptable by other utilities.

The sizes and quality required in cedar poles are about as follows: 16 feet or longer, 5 inches or more in top diameter and 7 inches or more in diameter measured 6 feet from the butt. Poles must be practically straight and free from serious defects, such as decay, splits, shake, or excessive knots.

Pole specifications have been adopted by the American Standards Association covering only northern white cedar of the species that now grow in New England. This specification (No. 05b1-1931 and 05b2-1931) may be obtained from the American Standards Association, 29 W. 39th St., New York City, for 20¢.

Pile Specifications

Pile specifications have been adopted by the American Railway Engineering Association, 59 E. Van Buren St., Chicago, Ill., which cover the general requirements of the railroads as to acceptable species, sizes, and quality. Individual railroads, however, usually have their own pile specifications, naming the acceptable species and other details, which do not necessarily conform exactly with the general specifications of the Association. The highway departments of the several states have their own pile specifications, as do some of the large public utilities, government organizations, and harbor authorities. Since the various specifications differ more or less in detail, it is important, where possible, to secure the specification of the organization to whom the piles are to be sold before starting production. Pile specifications are also available from the American Society for Testing Materials, Philadelphia, Pa., and the American Association of State Highway Officials, 1220 National Press Bldg., Washington, D. C.

One specification lists oak, red (Norway) pine, tamarack, and spruce among the acceptable woods. Lengths are 16 feet and longer. Diameters, measured 3 feet above the butt, may be not less than 12 inches nor more than 18 inches and the minimum top diameter is 8 inches. Piles must be practically straight and free from such serious defects as decay, splits, large knots, or knot clusters.

Tie Specifications

The specifications of the individual railroad companies vary somewhat from the general standards adopted by the American Railway

Engineering Association and Federal Government, particularly as to the species and sizes that will be accepted. It is necessary, therefore, to make certain that the ties conform to the specific requirements of the company for whom they are produced.

In general the common New England woods acceptable for ties are ash, beech, birch, maple, hemlock, red (Norway) pine, and oak. The principal sizes are 6 x 8 inches, 7 x 8 inches, and 7 x 9 inches in cross section by 8-1/2 feet long. Ties must be free from serious defects, such as decay, large splits, large shakes, and large or numerous knots.

The general standards adopted by the American Engineering Association and by the Federal Government, are almost identical in their requirements. Federal Specification MM-T-371 for "Ties, Wood; Cross and Switch", can be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., for 5 cents per copy.

Marketing

Lumber

Special surveys will undoubtedly be advisable to determine outlets that have not been reached by New England lumber in the past. Public works projects and small house construction seem to afford the best opportunities. In addition to construction lumber some attention may well be devoted to minor products, such as slack cooperage, excelsior, woodenware, shade and map rollers, Venetian blind stock, snow fencing, and log cabin siding.

If emergency shipping rates are granted they will increase the possibility of reaching Atlantic Coast markets otherwise unavailable both for lumber and round wood products including pulpwood. Movement of lumber and timber products in the rough (with bark on) from certain heavily moth infested areas in New England is prohibited and from lightly infested areas such shipments may be made only upon inspection and the issuance of a permit. Shipments from the infested districts are regulated by Federal quarantine.

Pulpwood

Marketing and use of the salvaged species for pulp and paper will be, of course, limited to existing mills in the area or in adjacent territory. No temporary pulping units appear practicable. The distribution of mills in the affected States are as follows:

(1) Maine -- 17 groundwood mills, 12 sulphite mills, 3 soda mills, 1 sulphate mill.

(2) New Hampshire -- 2 groundwood mills, 4 sulphite mills.

(3) Massachusetts -- 1 sulphite mill, 1 soda mill.

(4) Vermont -- 3 groundwood mills.

(5) New York -- 38 groundwood mills, 11 sulphite mills, 4 soda mills.

The groundwood process utilizes principally spruce and balsam. A small quantity of aspen might be consumed by this method. In the sulphite process spruce, balsam, hemlock and hardwoods, such as birch, maple, and aspen, are customarily used. In the soda pulping, hardwoods, principally aspen, are employed. The sulphate process is applicable to all long-fibered softwoods and in this area probably spruce, balsam, and hemlock constitute the bulk of the utilization although white pine could be readily employed.

In general, the utilization for pulp will probably be limited to wind-thrown trees of the smaller diameters or to the upper portions of large trees. If shipped a long distance or even if used locally, the wood

will have to be laid down as cheaply, if not cheaper, than wood which the mills normally buy, because the mills may not care to stop purchases from their regular contractors and also because of the possibility that the material furnished may be of unknown quality.

Current prices in New England are as follows, based on mill reports to the American Pulp and Paper Association for second quarter, 1938:

	Per 128-foot cord
Spruce	$9.91-$11.18
Balsam fir	9.67 and 11.60
Hardwoods	8.83-9.73
Other species	(for Maine only)... $10.39.

These figures indicate maximums which can be expected and are on an f.o.b. mill basis, thus including freight costs if any.

If properly priced, there should be no difficulty in disposing to the pulp mills of any spruce, balsam, or hemlock which might be available. Hardwoods will present a more difficult problem because the quantity consumed is still somewhat limited by the nature of the products for which they may be used and the fact that there is an oversupply of hardwood species at the present time. It may also be complicated by the fact that mills in the area will have salvage wood on their own lands for which they need to provide an outlet. Another complicating factor is that the bulk of the New England pulp tonnage (New York not included) is produced in Maine or by one large mill in New Hampshire. Hardwoods which have the best chance of utilization on the basis of past experience are birch, beech, maple, elm, aspen, and basswood. Miscellaneous hardwoods, such as pin cherry, the oaks, etc., are practically unknown quantities in pulping, and mills may be hesitant to attempt their conversion. White pine is also largely an unknown quantity, although as above stated, its use for sulphate is undoubtedly practicable. Second-growth pine, if largely sapwood, might be utilized to a certain extent for both groundwood and sulphite pulps and possibly also in soda pulping, but here again it may be difficult to induce mills to try out a species of relatively unknown pulping quality.

Ties, Poles, Piling

See paragraphs on specifications for these items.

Stains

Stains in spots, streaks, or patches which vary in intensity and shade, frequently occur in sapwood. Most important of these stains, because of its prevalence and objectionable appearance, is the dark type widely referred to as blue stain. Predominant shades of stain are bluish black and steel gray, although brown hues are also common. They are caused by minute fungi which grow in the sapwood but rarely in the heartwood. These fungi are disseminated either by spores, that are produced in great abundance, or by spreading directly from infected wood.

Blue stain is not a stage of decay, although the conditions that favor staining are also favorable for decay-producing fungi. Blue stain has little effect on the strength of wood.

To prevent blue stain it is necessary to produce unfavorable conditions for the development of the causal fungi. Their growth is dependent largely upon moisture and favorable temperatures. If the wood is dried promptly after cutting or treated with effective stain preventives, stain can usually be avoided.

Blue stain does not occur when the moisture content of the wood is less than 20 percent or when the wood cells are absolutely full of water. Growth of fungi practically stops below 34° F. and above 100° F.

Insect Damage

During warm weather, wood-boring insects and bark beetles are likely to become established in logs or rustic construction of any kind with the bark on or in down or weakened trees. Their presence encourages the rapid staining of the sapwood of down trees and logs and loosens the bark and permits it to fall off in large patches which are unsightly in rustic structures.

If any special control methods are practical, they lie along the following lines: Cutting the logs in October or November and piling at once in such a manner as to encourage the rapid drying of the soft inner bark before the beetles begin to fly in the spring. This will in almost every case prevent damage by insects that prefer freshly cut wood. When the logs cannot be cut or handled as above, it is often helpful (though not always effective) to immerse or spray them very thoroughly, while they are fresh and before infection has started, with a mixture containing 1 part of coal-tar creosote and 3 parts of kerosene, which has been allowed to settle thoroughly after mixing. Peeling, of course, will aid greatly in avoiding insect attack.

Round timber can also become infested with powder-post beetles, and other insects that bore into and destroy the wood. Cutting and drying the logs, as previously mentioned, will avoid most of such damage and some protection may also be obtained by using the creosote-kerosene mixture. Detailed information is given in U. S. Dept. Agr. Bull. 1490 (15 cents) and in Farmers' Bulletin 1582 (5 cents) obtainable from the Supt. of Documents, Washington, D. C.

Hardwood lumber and sawed timbers, when stored for several years, are very likely to be seriously damaged by Lyctus powder-post beetles. The best way to avoid such damage is to keep the premises in a clean, sanitary condition, allowing no accumulation of waste wood that may harbor the insects. The structure in which the lumber piles are housed should also be inspected to see that its timbers are not infested. The stored material should be inspected from time to time and the storage period should be no longer than is necessary. Farmers' Bulletin 1477 gives a more complete discussion of these insects and their control. (Supt. of Documents, Washington, D. C., 5 cents.)

Decay

Decay is caused by fungi, minute threadlike plants, which derive their nourishment from the wood that they destroy. To prevent decay it is necessary to produce unfavorable conditions for the development of the causal fungi. Decay cannot take place in wood that has a moisture content of less than 20 percent. Consequently any measures that can be taken to promote the seasoning of green wood or to protect wood in storage or service from becoming wet, aid in decreasing the decay hazard. See U. S. Dept. Agr. Bull. 510 (25 cents) and Tech. Bull. 174 (35 cents, Supt. of Documents, Washington, D. C.). Wood lying in the forest, wood in contact with the ground, and green wood stored in close piles are especially subject to decay in warm weather.

On the other hand, wood that is continuously saturated with water, as in the case of submerged logs, will not decay because it contains insufficient air for the development of the decay fungi.

Fungi must also have favorable temperatures for their development. Throughout the winter in most parts of the northern United States the progress of decay or its occurrence is inhibited. Maximum precautions against decay should be taken in months when general vegetative growth is active.

Control of decay can be made independent of natural conditions of the environment by introducing chemicals into the wood that are toxic to fungi, as, for example, creosote.

Additional information on the protection against wood-destroying fungi may be obtained from the U.S. Dept. Agr., Wood Handbook (Supt. of Documents, Washington, D. C., 35 cents).

Wood Preservatives and Preservative Treatments

For general outdoor use where dark color, strong odor, unsatisfactory paintability, and oiliness are not objectionable, coal-tar creosote is the most commonly used and most effective preservative against insects and decay. It is less expensive than most other preservatives that are suitable for outdoor use and can be still further cheapened by diluting it up to the extent of 50 percent with waste automobile crank case oil, domestic fuel oil, clean tar, or similar cheap materials. A list of producers and dealers in coal-tar creosote can be obtained upon request from the Forest Products Laboratory.

Preservatives dissolved in water, of which zinc chloride is the principal representative, are generally free from odor, and do not seriously discolor woods or interfere with painting. They are less suitable than creosote and its mixtures for outdoor use, yet they will give very substantial protection under such conditions. For indoor use, where the wood is not in direct contact with the soil or exposed to the leaching effect of water, zinc chloride and similar preservatives are entirely satisfactory.

Some proprietary preservatives are as good as creosote and zinc chloride in their respective classes and, where their composition is not concealed, they can often be used to advantage. There seldom is any economic justification for using a proprietary preservative of secret composition.

The method of treatment employed is as important as the character of the preservative used and often more so. Brushing, spraying, or brief immersion treatments, even with the best of preservatives, result in shallow penetration and usually give only slight protection. For best results, it is necessary for the wood to absorb very substantial quantities of preservative. The sapwood should be entirely penetrated, if possible, and the penetration in the heartwood should be at least 1/4 inch and preferably deeper. Absorptions of 6 to 8 pounds of creosote or creosote mixtures per cubic foot of wood are about the minimum that should be used on land or in fresh water structures while much higher absorptions of creosote are required for protection against marine borers. Absorptions of 3/4 to 1 pound of zinc chloride (dry basis) per cubic foot of wood are most commonly specified.

Pressure treatment by an empty-cell process is best for creosote and similar oils, but water-borne preservatives are customarily injected by the full-cell pressure process. Since pressure treating equipment is expensive it is seldom practicable to build a pressure plant for home use or small scale treatments, but there are a number of commercial pressure treating plants in New England and nearby States that are equipped to do such work. A list can be obtained from the Forest Products Laboratory.

Hot-and-cold bath treatments are often a very good substitute for pressure treatment and can be made in simpler and less expensive

apparatus. They consist in heating the wood for several hours in a tank of preservative and then removing the wood to a tank of cold preservative, or allowing the wood and the hot preservative to cool together. This method of treatment is more suitable for oils than for preservatives in water solution but, with sufficient care, it can be used with zinc chloride or any other preservative solution that can be heated safely to high temperatures. Hot-and-cold bath and other nonpressure treatments are discussed in Farmers' Bulletin 744 (Supt. of Documents, Washington, D. C., 5 cents). A description of pressure treatments and some of the principal preservatives is given in a reprint entitled "Wood Preservation" that may be obtained from the Forest Products Laboratory, on request.

Fence posts, when freshly cut and in the thoroughly green condition, can be treated with zinc chloride solution by the "tire-tube" process, which consists in fastening a section of a tire inner tube over one end of the post, pouring in a measured amount of zinc chloride solution, and allowing the solution to run into the sapwood of the post. This inexpensive treatment can be expected to make posts of nondurable species last about as long as good cedar or chestnut posts without treatment. Details of the method are given in Forest Products Laboratory mimeograph R1158 (free).

Moderate protection can be obtained by the steeping method, which consists in soaking green or dry, peeled or sawed, material for a week or more in a solution of zinc chloride or similar preservative. Steeping will usually be less effective than hot-and-cold bath or tire-tube treatment. The method is described in Forest Products Laboratory mimeograph R621 (free)

Standing or freshly felled green trees can be satisfactorily treated for rustic structures or similar purposes by methods developed by the U. S. Bureau of Entomology and Plant Quarantine. For standing trees, a specially formed groove is cut around the tree and covered with a tight gasket, after which preservative in water solution is siphoned into the groove from a container attached to the tree. The preservative is drawn up into the sapwood of the tree by the evaporation of moisture from the foliage. Freshly felled trees with their branches on, if not too large, can be stood in a container of preservative or a section of tire-tube can be fastened over the butt end and filled with preservative solution as the tree lies on the ground. The preservative is then drawn into the sapwood, as in the standing tree. These three methods are described in a mimeograph entitled "A method for preventing insect injury, to material used for posts, poles, and rustic construction," available on request from the Bureau of Entomology and Plant Quarantine, Washington, D. C.

Comparative Value of Timber Cut from Live and Dead Trees

Timber cut from dead trees is just as strong and durable as timber of similar quality cut from live trees, provided that the trees have

not been dead so long that the wood has begun to deteriorate through decay, stain, or insect attack. The important question is whether the wood is of good quality and perfectly sound, not whether the tree was alive or dead when cut. Timber of high quality from a sound dead tree is better than timber of poor quality from a live tree.

The prejudice against dead timber is probably based to a very large degree on the fact that much dead timber offered for sale has been dead so long that it has begun to decay and it is often difficult to detect the presence of decay in its early stages. For example, most of the chestnut in New England died so long ago that it is now not nearly so valuable or durable as was the chestnut timber formerly obtained in that region from live trees.

Recommended Moisture Content

The percentages of moisture content here recommended for wood are selected primarily for the purpose of reducing changes in moisture content to a minimum, thereby minimizing dimensional changes after the wood is put into service.

Timbers.--Ordinarily a timber should be seasoned to as low a moisture content as it will ultimately come to in service, or as near this condition as practical. While this optimum may be possible in small and medium-sized timbers, it is seldom possible to obtain large timbers fully seasoned. In the construction of unheated buildings, such as barns and warehouses, large green timbers often dry with fewer seasoning defects after being put in place than would result under poor air-seasoning conditions. Therefore, if there is no decay hazard and shrinkage is not a serious factor, it generally proves entirely satisfactory to use unseasoned timbers in such construction.

Lumber for exterior or interior service.--The moisture-content requirements for finish lumber or wood products to be used in the interior of heated buildings are more exacting than those for lumber or wood products used out of doors because of the higher character of the service and because wood used out of doors does not reach so low a moisture content. In general, lumber for exterior and interior use should be dried to approximately the value to which it will come in service. The recommended moisture-content values for various items and for use in New England are as follows:

	Moisture content (percentage of weight of oven-dry wood) for the New England States	
	Average[1]	Individual pieces
	Percent	Percent
Interior finish woodwork and softwood flooring	8	5-10
Hardwood flooring	7	6-9
Siding, exterior trim, sheathing, and framing[2]	12	9-14

[1] In general, the moisture-content averages have less significance than the range in moisture content permitted in individual pieces. If the moisture-content values of all the pieces in a lot fall within the prescribed range, the entire lot will be satisfactory as to moisture content no matter what its average moisture content may be.

[2] Framing lumber of higher moisture content is commonly used in ordinary construction because material of the moisture content specified may not be available except on special order.

It is the general commercial practice to dry some wood products, such as flooring and furniture wood to a lower moisture content than service conditions demand, counting on a moderate increase in moisture content during the storage and manufacturing period. This practice is intended to assure a uniform distribution of moisture among the individual pieces. Other wood products, such as finish and millwork lumber, are not seasoned to so low a moisture content. Common grades and rough construction lumber are not ordinarily seasoned to the moisture-content values just given.

Determination of Moisture Content

Oven-drying method.--In the oven-drying method of determining the moisture content of wood, samples about 1 inch long in the direction of the grain are cut from representative boards of a lot of lumber. These samples should be at least 1 foot from the end of the boards to avoid the effect of end drying and should also be free from knots and other defects.

Each sample is immediately weighed, before any drying has taken place, and is then placed in an oven heated to 212° F., and kept there until

of constant weight. The difference between the original and the oven-dry weight divided by the oven-dry weight, multiplied by 100, is the percentage of moisture based on the dry weight.

For weighing ordinary moisture-determination sections, balances having a capacity of about 200 grams and sensitive to 0.1 gram are recommended.

Both steam and electric ovens are in common use for drying moisture-determination sections. The sections, with either type of oven, should be open piled in order to permit good circulation of air, especially around the end grain of each piece, to hasten drying.

Electrical-resistance method.--Where the rapid indication of the moisture content of wood is desired, as for inspection purposes, the electrical-resistance method is the most suitable. This method is based upon the well-known fact that the electrical resistance of wood changes with moisture content. Several types of portable electrical moisture instruments are now on the market. The range of the present instruments is about 7 to 24 percent moisture content.

The electrical-resistance method has an advantage over the oven-drying method principally on account of its speed and convenience, the time required to determine the amount of moisture in any piece of wood being only a few seconds. It is therefore very adaptable for sorting lumber on the basis of its moisture content. See Forest Products Laboratory Mimeo. R1146 (free) for list of manufacturers of electric moisture meters.

Chief Properties and Uses for New England Woods

White ash ranks high in weight, strength, hardness, and shock resistance, retains its shape, and wears well. It is especially desirable for such uses as handles, vehicle parts, and agricultural implements.

Black ash is used extensively for interior finish, refrigerators, furniture, and boxes and crates.

Beech is heavy, hard, strong, uniform in texture, does not impart odor or taste to food, and resists abrasion. It is low in resistance to decay. Beech is used considerably for flooring, chairs, and other furniture, handles, woodenware, and laundry appliances. It is also highly suitable for food containers, and when treated is used for railway ties.

Yellow birch is heavy, hard, stiff, and strong, and has good shock-resisting ability. It is low in natural resistance to decay. Interior finish and furniture take a large part of the birch cut. Other uses are flooring, musical instruments, treated railway ties, woodenware, and veneer.

Paper birch is also fine and uniform in texture. It is largely white sapwood without figure, moderately heavy, and considerably below yellow

birch in strength and stiffness. It is used largely for turned products principally spools, novelties, and toys, and also for toothpicks and shoe-pegs.

Eastern hemlock is moderately light in weight and moderately low in strength. It has a tendency to splinter, is subject to ring shake, and is not decay resistant. The lumber is nonresinous, holds nails well, and is used largely for framing, sheathing, roofing, and subflooring.

Hard maple is heavy, hard, strong, stiff, has good resistance to shock, moderate shrinkage, uniform texture, and wears well under abrasion. Maple is used for flooring and other planing mill products, interior trim, and furniture. Large quantities also go into agricultural implements, handles, vehicle parts, and veneer. It is also used for shoe heels.

Red maple is lighter in weight and weaker than sugar maple. It is suitable for boxing and crating and other relatively low-value products.

Oak is heavy, hard, stiff, and strong. Flooring, interior trim, furniture, motor vehicle parts, and implements consume a large part of the oak cut, and in addition oak is used for cooperage, piling, crossties, and timbers.

White pine is moderately light, moderately low in strength, and usually straight grained. Changing dimension little with changes in moisture content and easily worked, the species makes a desirable wood for patterns. Second-growth and the lower grades of virgin growth are largely used for boxes and crates. The soft, uniform texture of virgin growth has won for it extensive use in building and millwork.

Red (Norway) pine is somewhat coarser in grain and texture than white pine, has more strongly marked annual rings, is heavier and stronger, and is somewhat more resinous. For structural purposes it ranks higher than white pine.

Spruce dries easily, stays in place well, is moderately light in weight and easily worked, has a moderate shrinkage and a moderate degree of strength, stiffness, toughness, and hardness. It is not resistant to decay. It is used principally for pulpwood and house framing material and general millwork. Large quantities are also used in boxes and crates.

Basswood is light in weight, low in strength, soft in texture, easily workable, and straight grained. The sapwood is particularly desirable for Venetian blind slats, veneer, boxes, fruit baskets, and woodenware. Other significant uses are for furniture and millwork.

With the exception of the heartwood of white oak and white pine, the woods named above are not significantly decay resistant.