I was admitted to the Bar of Wisconsin and practiced in Milwaukee, later going to Melbourne, Australia, where I entered business as the representative of various United States manufacturers. In 1919 I returned to Springfield, Mass., temporarily and returned to Melbourne as the Australasian representative of the Fiske Tire Co.

RICHARD THORNTON FISHER

Born *at Brooklyn, N. Y., Nov.* 9, 1876. Parents: *Edward Thornton, Ellen Bowditch (Thayer) Fisher.* School: *Harvard School, Chicago, Ill.* Years in College: 1894–1898. Degrees: *A.B.*, 1898; *M.F. (Yale)*, 1903.
Married: *Georgina Paine, Newton, Mass., July* 17, 1913. Children: *Richard Thornton, Jr.; Anne; Faith; Charles Paine.*
Business: *Forester; Director of the Harvard Forest and assistant professor of forestry.*
Address: *Petersham, Mass.*

IMMEDIATELY after leaving College I got a job with the U. S. Biological Survey as a member of the Shasta Epedition to northern California. Furs and feathers for the National Museum. The following autumn and winter I spent as assistant to Professors Wendell and Copeland at Harvard. This conflict between science and the humanities resulted in a compromise on forestry, and in June, 1899, I joined the Federal Forestry Department. With an intermission of a little over a year—October, 1902, to August, 1903,—which was devoted to getting an M.F. degree from Yale, and a few observations in Germany and Austria, I stayed with the Government, mostly in Washington, Oregon, and California. Since February, 1904, I have been promoting forestry at Harvard. At present, I manage The Harvard Forest, which is an experiment station and a research laboratory for advanced students, and conduct the instruction in lumbering at the Harvard Business School. The Forest, I may add, is at the head of its class in the country.

What little public service I have been able to do has been mainly professional. I have a hand in shaping some of the legislation relating to forestry in Massachusetts, and through the development of the Harvard Forest, in the establishment of practicable methods of timber land management in New England. The only public office I have not been able to avoid is that of Tree Warden of the town of Petersham.

My hobbies are staged where the rest of you (erroneously) suppose I practice my business, i. e., out-of-doors. When possible I

enjoy Nature, whether rough as in the tall timber, or curried as on a golf course. It keeps you from brooding too much on your game. From the rifle to the axe, from the axe to the niblic,—that is likely to be the story of my sporting life. From May until November we live in Petersham, the balance of the year in Weston, whence I commute to Cambridge and elsewhere.

During the War I was an inglorious member of the Food Administration, being chairman of the town (Petersham) Food Committee. I helped organize farms and farm production, acted as dispenser of advice from Washington, and factotum for the various "drives." It was not very dangerous.

PUBLICATIONS: *The Redwood*, "U. S. Forest Service Bulletin 38"; *The Woodlot* (with H. S. Graves) "U. S. Forest Service Bulletin 42"; *Silviculture for Country Roadsides*, "Bulletin of the Massachusetts Forestry Association"; *Utilization and Round-edged Lumber*, "Proceedings of the Society of American Foresters," vol. ix. 1914; *The Yield of Volunteer Second-Growth, as Affected by Improvement Cutting and Early Weeding*, "Journal of Forestry," May, 1920; *Management of Second Growth White Pine in Central New England* (with E. I. Terry), "Journal of Forestry," May, 1920; *The Management of the Harvard Forest* 1901–19, "Harvard Forest Bulletin, no. 1," 1921.

MEMBER: The number of associations that I belong to for promoting things is only equalled by the numbers I belong to for preventing other things,—most of them concern the welfare of forests, trees, birds, game, antiquities, the English Nation, National parks, and others; (chairman) New England Section of the Society of American Foresters, an organization of Simon-pure professional men; The Country Club, Brookline; Tatmuck Club, Worcester; Weston Golf Club, Weston; Oakley Country Club, Belmont; Seapuit Golf Club, Osterville; and Petersham Country Club, Petersham; The Pea Island Club of North Carolina and the Boston Harvard Club.

CHARLES NORMAN FISKE

Born *at East Jaffrey, N. H., April* 22, 1876. **Parents:** *Stephen Burlingame, Alice Norman (Stebbins) Fiske.* **School:** *Phillips Exeter Academy.*

Years in College: 1894–1895. **Degrees:** *M.D.*, 1899 (1900).

Married: *Helen Tucker Hawke, Mare Island, Cal., Sept.* 25, 1902. **Children:** *John Norman, Nov.* 15, 1903; *Stephen Burlingame, Oct.* 30, 1907; *Rebecca Wetherell, Feb.* 26, 1915.

Business: *Medical officer, United States Navy.*



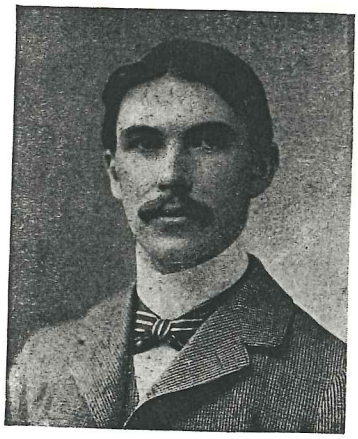


MILTON ERNEST FISH





RICHARD THORNTON FISHER





CHARLES NORMAN FISKE

College, Pennsylvania, and remained there up to the time of his death.

[Above taken from Second Report.—B. H. H.]

CHARLES CHAUNCEY STILLMAN

Born *at Irvington-on-Hudson, N. Y., Sept.* 29, 1877. **Parents:** *James, Sarah (Rumrill) Stillman.* **School:** *Hill School, Pottstown, Pa.*
Years in College: 1894–1898. **Degree:** *A.B.*, 1898.
Married: *Mary Estelle Wight, Augusta, Me., Oct.* 17, 1903. **Children:** *Elizabeth Goodrich, Oct.* 27, 1905; *Chauncey Devereux, Nov.* 9, 1907; *Eliot Wight, April* 26, 1909.
Business: *Financial trustee.*
Address: (*home*) 9 *East 67th St., New York, N. Y.*; (*business*) 3 *East 44St., New York, N. Y.*

AFTER graduation, it was my good fortune to get a job with the firm in New York City which was then known as N. W. Harris & Co. At that time, it was one of the best places to learn the bond business, and a just value of various investments.

In two years, the stage shifted to the West, and steam railroads formed the scenery. First, track construction and maintenance through the wheat fields of North Dakota to the mountains of Idaho. That was followed by a study of the passenger and freight traffic departments among the fogs and sunshine of San Francisco. Then came study and experience in the motive power department. The final act was laid in the purchasing and executives offices, again in New York City.

If it be a misfortune, in an age of gas-driven engines, to care for horses, then that has been my hard luck. For my desire has been to produce a horse of an American breed which bred true to type. The Morgan horse, which came originally from Vermont, has satisfied this desire. The point of interest has been, not the race-track, not the show ring, but the attempt to use the intelligence in the selection and mating of horses to produce the best. Man alone can make a metal engine, but a live horse cannot be modeled without the help of nature.

We have often sung—

"And we are proud to state that we came to Harvard College in the Class of '98." And haven't we a right to be proud, for didn't we listen to Professor Child in our freshman year, with Professors Shaller, Wendell, Royce, and Palmer, throughout our four years at Harvard, with Professor Norton speaking his last public official

utterances in a course counting for a degree in our senior year? Surely, the memory of such things has been the source of comfort and happiness during the past twenty-five years.

BENJAMIN HEYWOOD STONE

Born *at East Greenwich, R. I., April* 21, 1876. **Parents:** *Harry Leete, Mary Elizabeth (Heywood) Stone.* **School:** *Classical High School, Worcester, Mass.*
Years in College: 1894–1898. **Degree:** *A.B.*, 1898.
Married: *Rosamond Lee Mitchell, Webster, Mass., July* 19, 1911. **Children:** *Benjamin Heywood, Jr., Feb.* 2, 1914; *Mary Elizabeth, Sept.* 25, 1915.
Business: *Assistant to the director, Worcester Art Museum.*
Address: (*home*) 9 *Catharine St., Worcester, Mass.*; (*business*) *Worcester Art Museum, Worcester, Mass.*

THERE is really nothing to add to the notes in the report for 1913. I have continued in the same work, namely at the Worcester Art Museum, since leaving College. Beyond this there is only to add that I am now the father of two promising children.

My war work consisted of trying to buy Liberty Bonds, and acting as an associated legal advisor in Worcester during the period of the war.

Golf is my favorite sport. I am yet a "duffer" but have hopes that some day I can break a hundred consistently. Up to date I have followed the well known slogan "See America First." However, since the rise to fame of Mr. Volstead, I have made one business trip to Montreal.

MEMBER: Quinsigamond Boat Club, Worcester; Worcester Club; Harvard, University, and Tatnuck Country Clubs, Worcester; National Geographic Society; Unitarian Laymen's League, Worcester Chapter.

ROBERT BOWDITCH STONE

Born *at Boston, Mass., Jan.* 6, 1877. **Parents:** *Richard, Lucy (Bowditch) Stone.* **School:** *Hopkinson's School, Boston, Mass.*
Years in College: 1894–1898. **Degrees:** *A.B.*, 1898; *LL.B.*, 1901.
Married: *Alice Balch, Boston, Mass., Oct.* 30, 1909. **Children:** *Richard, 2d, Aug.* 1, 1910 (*died Aug.* 4, 1910); *Richard Noyes, Feb.* 7, 1912; *Ellen Balch, Oct.* 19, 1913.
Business: *Lawyer.*
Address: (*home*) *Woodland Road, Jamaica Plain, Boston, Mass.*; (*business*) 50 *State St., Boston, Mass.*





FREDERICK AUGUSTINE STERLING, 2D



✠JOHN WALKER STEWART





CHARLES CHAUNCEY STILLMAN

Eastern Yacht Club, New York Yacht Club and the Brook and Knickerbocker Clubs of New York City. Ames was fond of yachting and in the summers spent many weeks sailing and racing his own yachts. He also hunted at Norfolk, often importing the highest class English and French horses, and was interested in sports of every kind.

In the World War Ames served with the State Guard, in which he was commissioned captain in the Thirteenth Regiment, in June, 1917, and in August of that year he was promoted to major.

OAKES AMES

Born *at North Easton, Mass., Sept.* 26, 1874. **Parents:** *Oliver, Anna Coffin (Ray) Ames.* **School:** *Hopkinson's School, Boston, Mass.*
Years in College: 1894–1898. **Degrees:** *A.B.*, 1898; *A.M.*, 1899.
Married: *Blanche Ames, Lowell, Mass., May* 15, 1900. **Children:** *Pauline, Oct.* 22, 1901; *Oliver, May* 20, 1903; *Amyas, June* 15, 1906; *Evelyn, Jan.* 9, 1909.
Business: *Botanist.*
Address: (*home*) *Borderland, North Easton, Mass.*; (*business*) 94 *Ames Building, Boston, Mass.*

MOST of those immortals who constitute the Class of '98 went forth joyously, when they graduated, to conquer the world. I simply stayed on. My name has appeared in the Harvard Catalogue every year since 1894. As student and officer I have spent more than half my life in connection with Harvard University.

My work in the University has been light. For a short time I struggled with the undergraduate mind. I struggled with it long enough to realize that the undergraduate is a peculiar creature whose point of view I cannot grasp. Then, in 1914, I joined the Faculty of the Bussey Institution and began to teach graduate students. I have had them from the four corners of the earth. The average graduate student is a marvellous product of higher education. He brings a rejuvenating influence into the life of his teacher.

In the realm of finance my contacts have been negligible. As trustee of my father's estate I keep in touch with the world beyond the research laboratory.

When the year 1917 brought my country in direct contact with the War I served on the National Research Council. This organization acted as the Department of Science and Research of the Council of National Defence. In further fulfillment of War duties I undertook to teach in the Students' Army Training Corps at Harvard. I remember that when I went to meet my class for what proved to be

the last time, the classroom was empty. It was the day when the news came that peace had been declared.

In my scientific researches I have visited the tropics numerous times; visited the museums of Europe and formed delightful contacts with scientific men. Public office I have neither cared for nor striven for. As chairman of the school committee of Easton I served several terms.

I am not one who believes that a woman should swamp her identity by changing her name when she marries. My wife did not have to change her name. My daughter, Pauline, graduated from Smith College last year. The other, Evelyn, is preparing for college at the present time. Oliver Ames 2d, is now a freshman in Harvard College. The other boy, Amyas, expects to reach Harvard year after next. I love my family, my home, and my work.

PUBLICATIONS: Seven volumes on one subject; contributions to scientific periodicals.

GEORGE DECATUR APPLETON

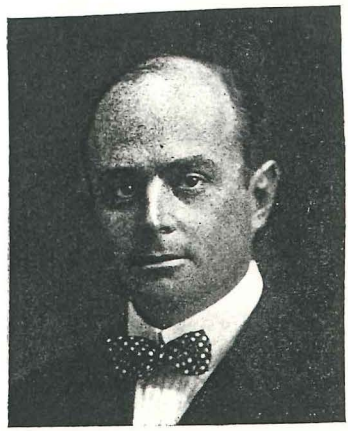
Born *at Boston, Mass., July* 1, 1875. **Parents:** *George Batterman, Maria Eliza (Mowery) Appleton.* **School:** *Boston Latin School, Boston, Mass.*
Years in College: 1894–1898. **Degree:** *A.B.,* 1898.
Married: *Josephine Chamberlin Walker, Brockton, Mass., Feb.* 20, 1904.
Child: *Jean, June* 29, 1910.
Business: *Clerk.*
Address: (*home*) 28 *Livermore Road, Wellesley Hills, Mass.;* (*business*) 74 *State St., Boston, Mass.*

THE job which my father secured for me in the office of Tucker, Anthony & Co., bankers, is the only job I ever had and bids fair to be the only one I ever shall have. I am happy in the association with a set of men, both fair-minded and high-minded, such as comprise the personnel of this firm, especially Nathan Anthony. The work is absorbingly interesting, since a study of security values and fluctuations necessarily implies a world-view of current history and evolution. For several years I have written the brief "market letter" which is published weekly.

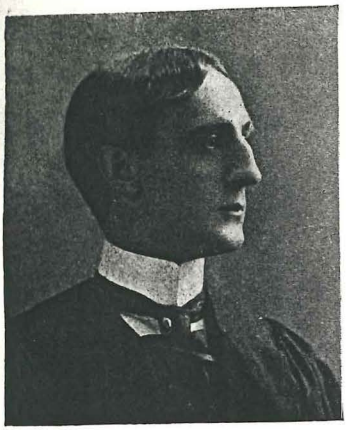
My "hobbies" are family and friends, and it is my great good fortune to be rich in both. My friends include a wide variety of types, and I am proud of them as a lot. My family is as devoted a unit as could well be imagined.

As for traveling, one trip abroad and one to the Pacific Coast, are the only extensive wanderings to my credit. The Pacific trip was at the invitation of my wife's father, the late E. W. Walker of Brock-





✠ FREDERICK LOTHROP AMES





OAKES AMES





GEORGE DECATUR APPLETON

By RTF
1932

The Harvard Forest

The Harvard Forest consists of 2100 acres of varied woodland situated in the town of Petersham, in northern Worcester County, Massachusetts, about seventy-five miles west of Boston. In addition to the original tract, the Forest has had a number of accessions given for special purposes: in Winchester, New Hampshire, twenty acres of primeval pine and hemlock forest, one of the very last remnants of such forest in New England and of great value for scientific purposes; in Hamilton, Massachusetts, 120 acres of coniferous plantations, established and given to the Forest by the late Nathan Matthews and embodying one of the earliest and most extensive experiments with native and exotic softwoods yet made in the country; in Petersham, a fifty-acre tract of mixed woods, given by the late G. F. Schwarz for demonstrating adaptations of forestry to landscape architecture; and finally a valuable stand of timber covering more than 150 acres and contiguous to the main tract, loaned by the New England Box Company for an indefinite period for joint experimental work in forest management. Contained in the Petersham ownership is a thousand-acre bird refuge of unusual interest and value, which is jointly maintained by the University and the State.

The Harvard Forest lies on hilly country at an elevation varying from 800 to 1400 feet above sea level. It is divided into three blocks of 750, 800, and 550 acres each, which are located respectively northeast, northwest, and southeast of the village. The northeast block covers the slopes and surrounding areas of Prospect Hill. The northwest block includes the basin of a large pond and marsh, and the southeast block takes in about two miles of the valley of the Swift River, with a pond and small water power

along its course. One of the blocks is included in a state wild life reservation covering 1000 acres. Although most of the terrain is upland, with a wide variety of slope and exposure and a characteristic soil of fine sandy loam, in the valley bottoms are extensive bog sites and the more zerophytic development of gravel ridges and small sand plains. About fifteen miles of good wood road provide access to almost any portion of the tract.

As to species, the composition of the Forest exemplifies, in consequence of its elevation above sea level and its geographical position, an interesting overlap between types characteristic of the north woods and those prevailing in southern New England and the middle states. The forest includes practically every phase of forest succession which has occurred in central New England, from authentic remnants of the original primeval forest to the large variety of transition or temporary types which have followed either the abandonment of old fields or the cutting of lands not cleared for agriculture. Representative types are mixed hardwood and softwood in approximately the climax phase, pure old field white pine, transition hardwood, beech and hemlock, pure spruce, pure hemlock, mixed pine and hemlock, and the more recent old field associations, such as poplar and birch, pure gray birch, and pitch pine. Species typical of the central hardwood region are white oak, scarlet oak, tupelo, sassafras, red cedar, and shagbark hickory. Representatives of the northern forest region are paper birch, red spruce, black spruce, larch, and red pine.

Owing to an unusually fortunate arrangement of age classes in the growing stock and to excellent markets and accessibility, the Forest has been operated from the start on a sustained yield. The general rotation for sawtimber is sixty years, although some stands which include timber of high quality are left to grow up to eighty or

four
one hundred years. With twenty/years of intensive management, great progress has been made toward the development of a normal forest with a regular distribution of age groups periodically maturing, and an increase of annual production toward the maximum. The initial stand was estimated to be ten and a half million feet of sawtimber with a current increment of two hundred and fifty thousand board feet. In twenty-four years approximately four million in 1928 million board feet have been cut. Cut-over areas have been satisfactorily reproduced, and the total amount of productive land increased by over two hundred acres. In 1932 the merchantable growing stock stood at approximately 12 million in 1928 million board feet, and the annual increment has risen to about four hundred thousand board feet, which is the amount of the present annual cut.

As operated by the University, the Forest has three principal objectives:

1. A model forest to demonstrate the practice of forestry. Up to recently the methods, both business and scientific, involved in growing and maintaining forest crops have been but scantily developed in this country. To see an organized forest where the various stages of growth are properly represented, where all the slow processes of silviculture are in successful operation, and where a regular yield in lumber is available without depletion of the forest capital, it was necessary to go to the Old World. Today the Harvard Forest, by a fortunate combination of its history, location, and management is approaching that unique condition.

2. An experiment station for research in forestry. In this function the Forest, both by the special investigations which it has conducted in problems of silviculture and management and also through the lessons learned in twenty-four years of operation, has developed a

workable system of handling the regional forest types. The principal feature of this evolution has been the determination of the ideal combinations of species to which the existing temporary types should be converted, and the methods by which this conversion may be brought about. The details of this process are illustrated by the cutting areas, plantations, etc., which have come under treatment during twenty-four years of management, all of which are under systematic observation and record in respect both to silvical changes and costs. In addition, there have already been established a number of permanent sample plots for the study of such problems as comparative rates of growth of thinned and unthinned stands; relative development and responsiveness of advance growth of different species when released by cuttings; annual growth of selected species; relation of plantations to varying conditions of soil, ground cover, and shade. The Forest maintains a nursery in which, in addition to the species grown for reforesting cut-over or blank areas, a number of other commercial trees are raised for experimental purposes. The plantations, both commercial and experimental, now cover an area of 180 acres, and these are extensively supplemented, for the purpose of observation and comparison, by many others, not only on lands immediately adjacent but in the neighboring towns.

The material available from experimental work on the Harvard Forest, the continuing research in silvical problems, and the tangible results of management, now illustrate to a high degree the fruitful combination of research and practical application.

3. A field laboratory for students. A forest is as essential for the training of a forester as a hospital for that of a doctor, and the longer a forest has been under management, the more instructive it is to the professional student. A student at the Harvard Forest may com-

bine research or special training in any of a number of fields of forestry with practical experience in all the phases of operating a forest property. The yearly business management, from the cutting to the marketing of the lumber, is controlled and recorded by a thoroughly up-to-date accounting and cost analysis system, such as is used by large companies; and journal and photographic descriptions are made of the silvicultural results of work in the woods and of the annual changes which occur. In the headquarters building are a working library and a laboratory equipped with modern apparatus for chemical and physical work. There are thus exceptional facilities for study both in the clinical or applied phase of forestry and in the fundamental factors from which knowledge is being increased or practice confirmed.

Requirements for Admission

Admission to study at the Harvard Forest is open to graduates of colleges and scientific schools of good standing who present satisfactory evidence of character and qualifications. Candidates for the degree of M.F. are expected to have a bachelor's degree in forestry. Persons who have had the equivalent of such training in professional experience may, in special cases, be admitted, but not as a rule as candidates for a degree.

Those who wish to ~~be candidates~~ work for the degree of Ph. D. may or may not be holders of a degree in forestry. The doctor's degree is based not upon study for a prescribed time or in fulfillment of a determinate program and never for miscellaneous studies, but on the ground of high attainment in one of the special branches of learning upon which the applications of forestry are based. The candidate ~~for this degree~~ is expected to have had, in addition to his bachelor's degree, elementary chemistry, physics, and geology together with a reading knowledge of either French or German.

Conditions of Graduate Study

Forestry dealing with the maintenance for human use of one of the most highly organized and complicated forms of vegetation has in recent years encountered a wide diversification of problems. With the widespread changes in industrial and social conditions now going on, it is apparent that the functions of forests in national life are not only more numerous than has been realized but more vitally related to other phases of life, such as agriculture and grazing, water supplies and power, game production, and recreation. ~~Thus the earlier conception of forestry as primarily a means of wood production is no longer accurate.~~ The management of forest properties for whatever purpose is very largely an administrative problem and will continue to be in charge of men with a standard amount of professional training plus executive ability. There is now, however, greater and greater need for men qualified to solve new problems both in the biology and economics of forests. This means a kind of thorough training in the fundamental sciences and the specialization for a particular field that are involved in the training for the doctor's degree. Forestry constitutes the focus and the point of view for the project of investigation or direction of specialization. Thus forest pathology or entomology requires a knowledge and interpretation of the ecological factors governing the life history and succession of forests as well as the practical aspects of handling and maintaining forest crops. Questions of utilization or of public relations involve ~~dealing with~~ important factors of economics and sociology. The handling of the forest itself as a purely silvicultural problem has yet to be improved and illuminated by a better understanding of the biology and metab-

olism of forest soils, the mutual influence of factors and physical factors, limitations upon growth and reproduction

For training in directions such as these, the Harvard Forest, with the departments closely associated, offers unusual opportunities for advanced study.

New Hampshire Lumber Survey

Manchester, N. H.,
July 20, 1925.

TO LUMBERMEN AND WOOD USERS:

The New Hampshire Lumbermen's Association and the Harvard Department of Forestry are co-operating in a survey to provide more complete utilization of native lumber in our local markets. It is the object of this survey to inform producers of all possible outlets for their particular stock; to develop new uses for woods not easily salable; to regain if possible some of the trade in medium grade softwood now held by western and southern operators; to assist consumers in locating their requirements locally instead of incurring high freights by buying from distant points; to see if changes in manufacture or of grading will not prove mutually profitable to producer and consumer; and to bring about a better and wider market for all kinds of lumber grown in New Hampshire.

It is planned to visit wood working and lumber-using concerns throughout the State so as to get complete information, not only as to kinds, amounts, and grades used annually in the different industries and in building operations, but also how much and what kinds of lumber are shipped in from outside sources. It is apparent, that imported woods are seriously cutting down the market, particularly for Pine, Hemlock, and Spruce. This condition, with the recent falling off in the demand for wooden boxes, means in the very near future a much reduced valuation of stumpage. This reduction in the taxable value of timber will have to be made up from other forms of property. Thus it is of vital importance to the welfare of the entire State that stumpage values be maintained.

With this in view we ask your co-operation in completing this survey, the result of which will be published for the benefit of all.

THE NEW HAMPSHIRE LUMBERMEN'S ASSOCIATION,
Manchester, N. H.
Owen Johnson, President

THE HARVARD FOREST,
Petersham, Mass.
Richard T. Fisher, Director

carry on proof: "Send proof to Prof. Fisher"

Vol. XI, No. 4

CMB

UTILIZATION AND ROUND-EDGE LUMBER

By R. T. Fisher,
Professor of Forestry, Harvard University

The closest utilization of saw-timber so far developed in the United States is practised in the woodlot region of Central New England. Southern New Hampshire and north-central Massachusetts contain some of the chief centers for a wide variety of wood-using companies, whose products include boxes and box-shooks, match-blocks, sashes and blinds, wooden ware, furniture, toys, and ~~other~~ novelties. Among them these companies use practically every species native between Connecticut and the Canada line, and the amount of their annual consumption runs to several hundred million of feet. In the town of Gardner, Massachusetts, for example, the furniture factories use at least twenty-five (25) million a year, nearly all of it hardwood. The consumption of pine for the general locality in question is at least double that of hardwood. The lumber supply for this market comes principally from New England and northern New York, but a considerable percentage of the higher-priced stock, both hardwood and softwood, comes from as far south as Virginia and Tennessee and as far west as Idaho and Washington. This latter is bought and sold "on grade"--that is, according to the standard inspection rules of the wholesale market for the particular species. The native and relatively locally grown lumber which makes up the bulk

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of the raw material is not, and cannot be, marketed according to definite specifications. This is because it is almost universally sawed into waney or round-edged boards, which may vary very widely in respect to such qualities and defects as grading rules usually specify, without losing their suitability for use in a given industry.

The round-edged board came in with the manufacture of commodities made of small and varied parts of standard sizes. It has made possible a utilization that is very nearly complete, and has resulted, both in the woods, the saw-mill, and the factory, in a yield of usable lumber per unit of cubic log-contents that is greater than under any other existing saw-practice. It has also brought with it a method of log and board measurement, which while apparently simple and uniform, is actually complex and variable, both in its relation to cubic volume and to the customs and practice of market and mill.

The greater part of round-edge lumber is manufactured by portable sawmills, usually operating with their woods-crews as independent contractors, either for the factories owning timberland or stumpage, or for land-owners and managers who are marketing their own lumber. The great bulk of the logs are cut in ~~twelve~~ 12-foot lengths; but lengths of ~~ten~~ 10 and ~~eight~~ 8 feet are also used to utilize tops or for the most economical division of the tree. In pine, butt-logs of good quality are frequently cut ~~fourteen~~ 14 feet, and in some localities, particularly the southern part of the region, ~~sixteen~~ 16 feet. Practically all pine timber is cut at least to ~~four~~ 4 inches in the tops, and for some uses even as small as ~~two~~ 2 inches. Stump-heights are very generally kept nowadays below ~~six~~ 6 inches; and on smooth lots, where the obstructions to sawing are few

and the quality of the timber justifies the slight extra expense, root-swellings are "boxed" or notched in with the axe and the trees sawed so as to leave stumps scarcely ~~three~~ 3 inches high. For such cases some operators profice vide their choppers with cushions to kneel on, made of burlap bags stuffed with hay, and pay them an extra ~~ten~~ 10 cents a thousand for getting the lower stump. The saving of from ~~five~~ 5 to ~~fifteen~~ 15 feet of the better quality of lumber usually found in the butt logs, if figured at the reasonable stumpage price of a cent a foot, will often add from one to three dollars a day to the money output of a felling crew.

In the case of pine, sound trees tall enough to make a single log are commonly cut to a breast-height diameter of ~~five~~ 5 inches. Hardwoods are not commonly cut as small, ~~seven~~ 7 or ~~eight~~ 8 inches being a more common limit; but there are frequently slim, smooth trees of still smaller diameters, growing in thick stands, which yield one or two logs. An instance comes to mind of a gray birch, ~~seven~~ 7 inches d.b.h. and nearly ~~sixty~~ 60 feet high and growing in dense pine, from which two ~~twelve~~ 12-foot logs were cut, yielding about ~~forty~~ 40 feet board measure. In general, the diameter in the tops to which hardwoods are cut averages about ~~seven~~ 7 inches, and fluctuates between ~~five~~ 5 and ~~eight~~ 8, according to the character of the crown. Since every tree, regardless of species, that will make a saw-log is cut, and since a saw-log need only be large enough to yield a single board scaling from ~~two~~ 2 to ~~five~~ 5 feet, it can readily be understood that a portable-mill operation may take practically all material except small limbs and tops, not even excepting dead trees if sound, or heavy limbs if, as the loggers say, they do not "crook two ways." In the occasional case where the limb-wood can be sold as fuel, even the slash is very

considerably reduced.

To the woods operator, the great virtues of round-edge sawing are its high board-foot yield and the great economy of motion which it allows in the mill, where there is, as a rule, but one saw, and where the manufacture of any more finished sorts of stock greatly multiplies the necessary motions. Logs sawed in this fashion are said to be sawed "alive" or "through and through,"-that is, they are not turned down, as would be the case in squaring up for dimension stock or square-edge lumber; but all the boards are taken off in the same plane and without being subsequently edged. Thus ordinary crooks or sweeps have little effect on the yield in board feet, since the log can be set on the carriage, so that its crook comes in the plane of the saw. The boards are measured and marked on the narrow face. The marker or surveyor, guided at times by a board rule, but more often by his judgment alone, determines the average width inside the bark. This, in the case of a board from a normally smooth and straight log, will be the width at the middle; but with a board from near the outside of a crooked or very knotty log, it may be the average of the widths of several merchantable sections of the board separated by areas of wane where the bark runs clear across. Thus, in view of the comparatively large percentage of small and inferior timber made into round-edge lumber, the element of judgment involved in board-measurement is very considerable. In mills of good standing, however, the marking or surveying is apt to be done with fair accuracy, because the contract payments for all of the woods operations are based on the mill measure, which in turn is usually required by contract to "hold out," or agree with the delivered or factory measure, ~~at the point of sale~~ which is the basis of sale.

It is commonly said by mill men that 1200 feet of round-edge lumber is the equivalent of 1000 feet of square-edge lumber sawed from the same run of logs. This relation seems to be fairly accurate, except that as the size of the logs increases, the difference between round- and square-edge sawing becomes less and less, and is practically negligible for diameters above ~~twenty~~ 20 inches. With crooked, coarse, or defective logs of whatever diameter, the advantage is still more with round-edge sawing, owing to the disproportionate loss in "squaring up." But though round-edge lumber in general yields from ~~ten~~ 10 to ~~twenty~~ 20 per cent more than square-edge, the amount in excess varies considerably with the manner of sawing and with the thickness of the lumber. Take for example the board-foot yield from sawing 2 1/8" plank, a common thickness in the round-edge market. To begin with, according to the custom of the market, the eighth inch in this kind of stock is disregarded in measuring and is thus given to the buyer to cover shrinkage and planing. A 2 1/8" plank sawed from a ~~twelve~~ 12-foot log ~~six~~ 6 inches in top diameter may show a difference of nearly ~~three~~ 3 inches between the narrow and the wide faces. Such a plank with a measured face of ~~three~~ 3 inches would contain ~~six~~ 6 board feet. If the same plank had been sawed into two 1" boards, the yield would have been ~~eight~~ 8 board feet, represented by two faces, one of ~~three~~ 3 and the other of ~~five~~ 5 inches; and the saving of the disregarded eighth, balanced against the additional saw-kerf of one quarter of an inch, would have left only three eighths of an inch more waste in sawdust. It is obvious that the smaller the logs, the greater will be the loss due to this wane or difference between narrow and wide faces. On the other hand, as the size of the log increases, the difference in width between the two faces of the plank becomes less and less; and with

2-Graham (1)

logs over ~~sixteen~~ 16 inches in diameter, the loss in board-foot content and of the unmeasured eighth is more than offset by the saving in saw-kerf, to say nothing of greater economy of handling in the mill. In consequence of this shrinkage in yield for thick lumber, it has become the custom in fairness to the seller to take an inch siding or side-board off the log immediately after the slab, so that the first plank sawed will have its narrow and wide faces more nearly equal. These sidings are often somewhat of a drug, and always bring from two to four dollars a thousand less than plank; but they effect a marked increase in the total board-foot output.

The influence of thickness, i. e., amount of wane, on board-measure, with the correlative factor of gain or loss in saw-kerf, is to be reckoned with in all round-edge lumber. In general, the highest yields for medium-sized logs are obtained from sawing 1 1/4", 1 1/2", and 1 3/4" lumber, since these thicnesses allow a good face without excessive loss in sawdust, and are moreover reckoned on a full board-measure basis. Complete studies of comparative yield from sawing different kinds of round-edge stock are not available; but the table given below exhibits some significant comparisons. It shows the differences in board-foot yield between three well-known log-rules, all based on square-edge sawing, and the output actually obtained from the same sizes of logs when sawed to three different "saw-bills" or kinds of stock, two of which are entirely round-edge, and ~~two~~ one mixed round- and square-edge. The figures for the round-edge lumber are taken from mill tallies made on the Harvard Forest, at Petersham, Massachusetts; those for the mixed lumber are from "Forest Mensuration of the White Pine in Massachusetts," published by the State Forester. In the case of the Harvard tables, the mill measure has been checked with that at the factory, where, according to the general custom, each board was remeasured on delivery

(Table)

COMPARATIVE YIELD OF ROUND-EDGE AND SQUARE-EDGE SAWING

Twelve-foot logs, board-foot contents,

Top D.I.B.-Inches	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Square-edge scale rules,																
Doyle	-	-	-	3	6.	8	12	19	27	37	48	61	75	91	108	127	147
Scribner	-	-	-	12	18	24	30	40	50	59	73	86	107	119	139	160
Maine	-	-	-	15	23	33	39	51	62	78	90	107	121	134	154	174
Mixed square-and round-edge scale rule,																
[1] Pine (1", 1 1/4", 2 1/8")	13	17	22	29	37	47	58	70	83	96	111	129	146	165	184	
Round-edge scale rules,																
[2] Pine (2 1/8")	3	8	14	21	30	39	49	61	73	87	101	117	135	157	181	208
[3] Chestnut (1 1/2")	8	12	16	22	32	42	53	67	83	101	119	137	157	176	197	218

[1] From mill-tally scale by Mass. State Forester; logs sawed into mixed round- and square-edge lumber; complete scale for all log-lengths based on ~~1200~~ 1200 logs; percentage of square-edge "runs from nothing in the smallest logs to more than 50 % in the largest."

[2] From Harvard Mill-tally scale; logs sawed into 2 1/8" plank with approximately 10 % 1" sidings; figures based on 511 logs.

[3] From Harvard mill-tally scale; logs sawed into 1 1/2" round-edge, with 20 % 1" boards, mostly sidings; figures based on ~~101~~ logs.

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without the figures (in these cases) being appreciably "cut" or raised.

(Table)

From the point of view of utilization, the advantage of the round-edge sawing is not merely in the excess of yield for a given-sized log but also in the fact that logs too small to be squared at all will yield merchantable lumber when sawed through and through.

The fundamental ecomony of round-edge sawing, and the even more important relation between quality and price are to be learned only by a study of the utilization of the lumber at the factory. The ways of cutting up the board are as varied as the finished products. For each industry there are certain general properties required or desired of the lumber, both as to thickness, width, strength, grain, and degree of knottiness. In the making of match-blocks, for example, it is necessary to have pine that is straight-grained, reasonably tough and close-fibered, and wholly free from knots. Wood of this quality is obtainable, of course, from large forest-grown trees with a high percentage of clear wood. Such timber, however, is relatively scarce, and usually more valuable for other uses. Match stock therefore usually means second-growth pine from ~~thirty~~ 30 to ~~seventy~~ 70 years old, in which the height growth has been sufficiently rapid to produce fairly long internodes of clear wood. Provided the annual growth has not been rapid enough to make the wood too brittle, and provided the grain is straight, the size of the tree makes no difference.

The bulk of match stock, which is always sawed 2 1/8", is first planed to ~~two~~ 2 inches. It then goes to the cut-up saw, where ~~it is~~ the block stock is taken out of it. This means pieces of any length, so long as the grain is right and the whorls of knots not too

large or close together. The balance of the board, in certain standard lengths, goes through a re-saw and becomes 7/8" box-shooks. These may be of any width, and even with tapering sides, and after being edged and matched are glued together and trimmed so as to make one side of a standard box. Some box-factories even have machines which get the tongue of the matched shook out of the edging, so that the waste from the box-shook making is all small and easily taken care of under the boilers. The block-stock goes directly from the cut-up saw to the individual block-saws, without edging or trimming. At these saws, all the clear stock is cut out in transverse blocks or sections two inches wide with the grain, and the bark or edging is trimmed off the sides of each individual block. The whorls of knots, which form a very small percentage of the selected board, drop through a chute and are conveyed to a shed for sale as kindling. Utilization like this, in which the final product is so small, and in the case of the box-shook, so allowably irregular in shape, is what makes the crooks, wane, and coarseness of the round-edge board have so little effect on the amount of usable material.

The sash and blind industry makes more exacting demands as to quality, but exhibits an equally close utilization. Nowadays, most of the best stock used in this business comes from the West; but the second-growth pine still supplies the bulk of the material for all but the "number one" class of product. Sash and blind stock, which is usually sawed 1 3/8" and 1 5/8", must yield a good percentage of clear or straight-grained lumber in longer pieces than are required in many of the other pine-using industries. With the exception of genuine virgin pine, the only timber that will yield the desired qualities is either large second-groth with some percentage of clear in the butt logs or with small and few knots, or else very rapid-grown "sapling" pine with

internodes of ~~two~~ 2 feet or more. In the sash and blind mill the man at the cut-up saw has a much more complicated job than in a match factory; for he has a much larger variety of pieces and qualities to cut for. Here, as in a match shop, the plank is separated into stock fit for the various sizes of frames, styles, muntings, and so forth, and into a lower grade of remnants which go into match-blocks, blind-slats, and the like. The cutting up of the sash stock is, however, not merely a matter of cutting out the whorls of knots, but also in wide lumber from fairly old trees, of cutting narrow pieces lengthwise so as to pass between the knots. In a sash and blind factory, owing to the better quality of the lumber used and to the greater variety in the size of the manufactured piece, the waste is also practically nothing.

Other industries, such as the toy business, achieve an equally complete utilization with much cheaper and inferior lumber. Not only are there certain toys, such as hobby-horses, which can be made out of wormy and blue-stained pine largely consisting of knots, but there are many composed of parts as small as a man's little finger, and of concealed sections, which can thus be made of the smallest and poorest waste. In fact, it may almost be said, taking into account all the possible industries to which round-edge lumber may go, that the only actual waste shipped from the sawmill is bark.

From the standpoint of the forest manager with timber to raise and sell, it is obvious that the high degree of utilization offered by the round-edge market is exceptionally favorable to intensive forestry. Yet the variable yields arising from the sawing of different thicknesses and the fact that definitions of grade appear but vaguely till the board is actually cut up in the factory add peculiar difficulties to the problem of marketing.

In general, the terms box-boards, chair stock (chestnut), sash and blind stock, etc., stand for certain average qualites of lumber; and in general, too, these qualities, if well understood by the seller, mainly govern the price of the lumber. But among the wide variety of industries making up the market, the qualities required for the making of particular articles may differ widely, or overlap, or even coincide. Naturally each concern tries to buy the highest quality of lumber that it can without going above the prevailing price; and it very frequently happens that a company may buy on these terms a lot of lumber mill-run or a tract of stumpage which contains a very considerable amount of much better quality than their particular business requires. In such a case the better grade is usually saved out and sold to other companies for a higher price. From the cheapest class of pine lumber, such as is used for example by certain toy-manufacturers, to the better qualities as exemplified by sash and blind stock, there is a range of price amounting on some markets to $15 a thousand; and between these two extremes there may be a number of other prices representing intermediate qualities as demanded by other industries. Moreover, to go back to the standing tree, this wide range of quality is only in small part dependent upon age, but even more upon composition, density, life-history, and soil-conditions; so that a given tract of timber may be convertible either into box-boards alone, or box-boards plus a good percentage of sash and blind stock, or into lumber of a quality standing somewhere between the two. In fact, theoretically, a given tract of timber may be separated into a considerable number of the recognized price-classes of lumber. ~~and in varying proportions.~~ But the amount of the money return is not merely a question of maximum average price; it is also a matter of how much the board-thickness

required for a certain price is going to affect the total board measure for the sale. This means that round-edge lumber should be sold before the timber is cut. In fact, except by persons long and well connected in the business, it is folly to sell it otherwise.

In deciding a sale, a number of facts must be known and considered with reference to each other. Take for a simple example a tract of second-growth pine which obviously contains nothing better than boxboards. The available market may include three concerns, one using 2 1/8", another 1 1/4", and another 1". Supposing the price to be the same in all three cases, the choice for sale depends simply on a comparison of the board-foot yield for the three thicknesses and on comparison of hauling and freight rates,--themselves somewhat affected by lumber thickness. Suppose, now, that the timber is largely or in part of qualities better than boxboards. It is then not merely a question of board-foot output and freight rates, but also whether the timber as a whole will average good enough for a better price, or whether if the better quality is saved out for separate sale, the price of the balance may not be too greatly lowered. Very often, especially for small tracts, it is better to market the whole lot mill-run and sawed to a single order for a medium price than it is to split the sale, saw to several orders, and get only a low price for the poorest, and often the most, of the lumber. In general, the larger the total amount of timber to be handled, the better the opportunity for a classified sale to different markets and a consequent raising of the average price.

For the forester or operator of timberland, there should be another element in utilization besides the elimination of waste material. That element is financial economy. It should consist not only of efficient operation in the woods and sawmill, but also of lumber sales at maximum market rates. The utilization of the timber does not need

much looking after; the buyers will take care of that; and when they buy ~~$20~~ twenty-eight dollar lumber for the price of boxboards, the seller will not discover it by any greater wastefulness in woods or mill. But the productiveness of the forest is not utilized, nor can it properly be gauged as a business possibility, unless the money return to the forest is the best which the existing market will allow.

Just as in the examples already discussed, there is a range of price-class in pine corresponding to qualities which, both in the woods and the factory, are recognizable if ill-defined, so are there with chestnut and with many species of hardwood. It is peculiarly the forester's business, if he would take advantage of the opportunities of the round-edge market, to understand not only the detailed uses and the prices of the lumber at the factories, so as to know the value of his timber in the woods, but also to trace the silvical factors which lie behind its production. It is not uncommon, ~~possible~~, for example, to find on the same spoil and of the same ~~rotation~~ age, pine that will sell for $18 and pine that will sell for $28. In the so-called woodlot region, which, as the old timber is used up, is constantly widening in area, the portable mill and the round-edge board have already pushed material utilization to all but a maximum. Forest management has yet to adjust itself to this opportunity, first, by ~~more~~ controlling more exactly the measurement and marketing of second-growth lumber, and, second, by growing timber that will improve upon the quality of the volunteer stands.

Yale profile

By RTF

Academic Year

The academic year is ordinarily divided into two terms: the fall-winter term from the Monday preceding the last Wednesday in September to the second Sunday in February, and a spring term from the Monday following the second Sunday in February to the second Sunday in June. Students who are candidates for the doctor's degree or whose program of research requires it may in certain cases utilize the summer as a third term, from the middle of June to about the middle of September.

Registration

Students of forestry are expected to register at the Harvard Forest, Petersham, Mass. at the beginning of the academic year. In cases where by previous correspondence the student's work is to begin at the Arnold Arboretum or another University department, he may register at the College office in Cambridge.

Tuition

The regular tuition fee for an academic year is $. Special students who may be taking particular courses or part time work are charged at a reduced rate to be arranged.

Bond Requirements

Every student must file with the Bursar a bond in the sum of $200. signed by two bondsmen, one of whom must be a citizen of the United States, or by a surety company duly qualified to do business in Massachusetts, as security for the payment of University bills; or he may deposit $50. as security and pay in advance all sums for which he shall become liable to the University. No officer or student of the University is accepted as a bondsman.

Living Arrangements

The headquarters building of the Harvard Forest at Petersham combines the purposes of a dormitory with offices, workrooms, laboratory, and library. Students may engage rooms containing plain furnishings, including bed with mattress and pillow, for $2. per week. Light and heat are furnished, but each man is expected to provide his own bedding and to take care of his own room. Board is furnished by a commissary jointly supported by the Forest and the students at a cost to the students of approximately $7.50. a week.

Requirements for Degrees

The degree of M.F. is granted to properly qualified candidates for the completion with credit of a satisfactory project of research or specialization. This is expected to be at least the equivalent of four full courses.

The doctor's degree is based not upon study for a prescribed time or in fulfillment of a determinate program but on the ground of high attainment in one of the special branches of learning upon which the applications of forestry are based. At least one full year of resident study is required; but except in the case of an experienced investigator, who may have completed elsewhere a considerable portion of his research, the degree is never granted on fulfillment of the minimum term of residence. The requirements for the degree will necessarily vary with the previous training and progress of the candidate and upon the field of knowledge in which his work lies. In general, the doctor's degree is based upon the completion of a satisfactory research project embodied in a written thesis approved by the supervising instructor or committee, the passing of a general examination both on the subject matter of the thesis and on knowledge of the necessary underlying sciences, and on the ability of the candidate on

completion of his program of work to read both French and German well enough to deal with the literature of his subject.

Scholarships

The income from the Bliss endowment is usually divided into two or more parts, depending upon the number and qualifications of the applicants. Grants are awarded only to those who are specializing in forestry or, in exceptional cases, to men in applied botany or zoology whose research bears upon some problem concerning the growth and distribution of forests or the structure, physiology, or pathology of forest trees.

Staff of the Harvard Forest

Richard Thornton Fisher, A.B., M.F., M.S., Director

Albert Collins Cline, S.B., M.F., Assistant Director

Paul Rupert Gast, Ph.B., S.M., S.D., Assistant Professor of Forestry

Neil Wetmore Hosley, S.B., M.F., Instructor in Forestry.

Instructors of Related Departments

The Arnold Arboretum

Oakes Ames, A.M., Supervisor, Professor of Botany.

John George Jack, Assistant Professor of Dendrology.

Joseph H. Faull, Ph.D., Professor of Forest Pathology.

Karl Sax, Ph.D., Associate Professor of Plant Cytology.

Division of Biology

Charles Thomas Brues, S.M., Associate Professor of Economic Entomology.

William Henry Weston, Jr., Ph.D., Professor of Cryptogamic Botany.

William John Crozier, S.B., Ph.D., Professor of General Physiology

For the administration of degrees, all biological departments of the University are in the same faculty. Research students will thus work primarily under the direction of the men in whose departments their major interest lies.

Silviculture, Forest Management, and Silvical Research

Under this head are grouped the general fields of work in which ordinarily the candidate for a degree in forestry will choose his project of research.

1. Environmental Factors and Silvics

Ecological problems concerned with the derivation and tendencies in succession of existing forest types, most of which are obviously transitional and therefore not adapted for permanent management. For studies of this sort the Petersham region with its two hundred years of social and economic changes - a history ranging from original forest through a century and a quarter of agriculture and back to seventy per cent of forested area - offers material which is as significant as can be found anywhere in the country.

Forest soils, their physiology as related to physical and chemical factors, bacterial and fungal activity, and to the effect of varying forest cover. In this latter connection the conversion of coniferous to hardwood types at Petersham has already produced significant changes in soil profiles and apparent fertility, which indicate the great importance of soil evolution as an adjunct to the development of silviculture. Projects of this sort may be conducted either by laboratory or field work or both.

2. Experimental or Applied Silviculture

There are many unsolved problems connected with the handling, maintenance, or conversion of existing forest types, some depending on empirical or descriptive study, and some involving the increasing application of biochemistry and biophysics to the study of forest physiology. For studies in this direction the large variety of forest conditions and the great accumulation of recorded operations on the Forest, of which many interpretations remain to be made, furnish abundant material.

3. The Operation of an Organized Forest.

Such a study is especially adapted for men who desire to fit themselves for the management of woodlands where similar conditions prevail. This includes in general the handling and upbuilding of the growing stock, determinations of growth and volume, and the business of forest operation from the planning of the annual cuts to the marketing of the product. As this type of operation is fast growing in importance, the study of problems connected with it is especially useful.

4. Economic Problems and Utilization.

Everywhere the interrelation of the general economic structure, markets, utilization, etc., with the possibilities of silviculture is more and more obviously of equal importance with the forest technique itself. New England is now especially involved in difficulties of this nature: limitation of markets through extraregional competition, unscientific taxation, the need of wider and more economical utilization, the social readjustments required by organized forestry, coordination of land uses. It is where such questions are most acute that the data for their solution are to be found. The Harvard Forest is in a region of many and varied woodworking industries, of both rural and manufacturing town problems, of abundant transportation facilities. A number of projects in tuilization and marketing have already been undertaken; many others of economic significance remain to be solved.

There are also types of forest problems, many now highly important, in the study of which a combination between two or more sciences is necessary. The student whose special purpose requires it may devote as much of his time as is needed to collateral work in

pathology, entomology, dendrology, or plant anatomy; in which cases the facilities of the Arnold Arboretum or the Bussey Institution are available. Whatever the special emphasis of a student's work, it is designated for the purposes of administration under the following head:

Forestry 20b. Research in Silviculture and Forest Management.

Messrs. Fisher, Cline, Hosley, and Dr. Gast.

Rule copy

HARVARD UNIVERSITY

SCHOOL OF APPLIED BIOLOGY

DEPARTMENT OF SILVICULTURE AND FOREST MANAGEMENT

Harvard Forest
Petersham, Massachusetts

The Department of Forestry of Harvard University will conduct a canvass of the kinds and uses of wood consumed by the principal industries of Springfield. Director R. T. Fisher, Assistant Director A. C. Cline and a party of graduate students from the Harvard Forest at Petersham, where the University carries on experimental work in forestry, will visit manufacturers to get together systematic information as to the amount and forms of wood utilization in the city. The purpose of the study is to increase the practicability of timber growing by determining the possibility of better marketing for forest owners in the state. The Chamber of Commerce is cooperating in the work. Springfield has been chosen for the canvass because of its central location, unusual rail communications and obvious industrial growth. Results of the study will be made available in published form as well as through direct demonstration by the Harvard Forest. The public importance of such a survey lies in the fact that productive handling of woodlands and the reclamation of thousands of acres of waste land by the farmers and other non-public owners can be undertaken only when and as forest products pay the cost of growing them. At present, although the market for New England timber is varied, there is still much apparently unavoidable waste in the cutting up of the tree, a number of varieties are not salable, and the methods of manufacture at the sawmills continue to necessitate a heavy freight charge in proportion to the material finally used. Through a survey like the present, improvements may suggest themselves that will enable forest owners not only to dispose of what they now have more economically, but to plan more wisely for the timber crops of the future.

conference of manufacturers for action. This survey is now going on. While complete results are lacking, the indications are that if the industry can effect certain improvements in financing, operation and selling, it should retain a substantial share of the container business.

Considering the present difficulties of native lumber in general, they can be summed up as (1) shrinkage in utilization for low grade softwood; (2) falling off in the quality and grade of lumber produced; and (3) increasing competition from outside the state. New England cannot afford to lose her immense present and potential income from the production and manufacture of forest products. The first essential is to keep the woodworking industries successful and permanent; and this can only be done, as economic conditions change, by such comprehensive and cooperative studies as the New England Council is now conducting. On the other hand, timber, the raw material, can be permanently supplied only by the practice of forestry. Timberland operators need to know that an important source of profit lies in the better handling of forests; that even today increased growth and better quality can be secured by practicable improvements in cutting methods.

If lumber interests have been slow to modify their handling of the woods, forestry interests and forestry propaganda have not sufficiently adapted their policies to market and economic conditions. At a time when low grade lumber is more than ever difficult to sell and when its principal outlet - in box boards - is reduced, the general public, even that portion of it which owns timberland, is still being urged on all sides to plant trees, principally white pine in pure plantations. In the present situation this alone is poor business and poor forestry. Besides being peculiarly subject to disease and insect pests, the average pine plantation can never provide anything but box lumber, the low grade material which is always difficult to use.

Retail lumbermen's Journal

HARVARD UNIVERSITY
SCHOOL OF APPLIED BIOLOGY
DEPARTMENT OF SILVICULTURE AND FOREST MANAGEMENT

March 26, 1924.

Harvard Forest
Petersham, Massachusetts

The Practice of Forestry in Central New England

How is forestry practiced, and what are its possibilities as a business? For fifteen years the Harvard Forestry Division at Petersham, Mass., has been trying to demonstrate answers to these questions in concrete form. On this tract of 2,000 acres of second growth pine and hard wood, an amount of lumber equal to the increase of the whole area has been cut annually. To make this procedure possible indefinitely requires first, effective and not too costly means of replacing the forests, that is, replacing the mature stand with a young one, and second, the care of the new crop to the end that it shall produce timber and not forest weeds. These jobs are the two "brass tacks" to which all the arguments will come down -- if we are to bring cut-over land back to production.

The practical details of handling forest crops are difficult to understand without the forest, and the method that may work in one case is useless in another. The Harvard Forest has had under test, for cost as well as effect on the woods, a great variety of systems of treatment. It has shown, for example, that taking off a stand of white pine in two cuts, three to six years apart, will ordinarily produce an abundant new crop of naturally sown seedlings. On accessible land of fairly light soil, the slightly greater cost of this system over

Harvard Forest
Petersham, Massachusetts

the usual one cut is amply justified by the result, and is less than that of tree planting which is sometimes the only alternative. Another phase of the problem is how to prevent mixed young growth on cut-over lands from developing (as such crops usually do) into comparatively worthless hard woods. In many cases such stands contain at the start a substantial amount of valuable trees, such as pine or ash. By lopping or cutting back the faster growing but poorer hard woods at a cost of $3 to $5 per acre, this mixture can often be made to produce a $300 acre of saw timber instead of a $50 acre of cord wood. Weeds are no less active in forests than they are in gardens.

Although forestry is a complicated business and its practicability is limited by local conditions of ownership, transportation, and marketing, it has been shown on the Harvard Forest that reckoning all essential costs or carrying charges, second growth pine or the better hard woods can be grown for less than the present stumpage price. Probably few retailers will be in a position to take on this phase of the lumber business. But as distributors of the product they might help establish the business of forestry by co-operating in the most vital matter of all -- marketing.

A very few years ago West Coast fir and pine were just getting a foothold in New England markets. Today they have largely replaced native pine and will soon do the same by spruce. This is not wholly a matter of price and supply. It is true that the

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great bulk of existing native pine goes into the wood working industries, and is below grade for the retail trade. It is also true that Western #2 can be laid down in Boston in quantities or sizes, and at prices not easily to be met by the producers of the native wood. Already many users who a short time ago demanded white pine or spruce, now prefer fir and western pine. The white pine has been steadily falling off in grade as the better stands were cut out, and it has been easier to sell it as round edge lumber for factory use. In this wholesale utilizing the idea of grade has been easily lost sight of -- especially by the saw mill men. Nevertheless it is a fact there is still a fair percentage of second growth pine that, rightly manufactured, will grade #2 or better, and there are still users who have not forgotten that, grade for grade, white pine for general use is the best soft wood in the United States.

To bring back any immediate attraction to the possible production on New England's millions of cut-over acres means that private ownership will have to see a reasonable profit in so doing. Federal, state, and town forests, already grown to a respectable table, will necessarily handle much of the less desirable and public improvement areas. But any appreciable contribution to the general wood supply has got to come from the enterprise of the people who own 9/10 of the forest land. For such people it is not enough to know that fire protection is fast becoming effective, that at least in Massachusetts and New Hamp-

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shire taxes on young stands can be postponed until the timber is cut, and that the freight differential is greatly in their favor. Most of them must pay for their forestry out of earnings, but if they can market their product for the best price its quality will warrant, they cannot only meet the present cost of silviculture, but they will perhaps get an incentive to produce something better than low grade lumber in the crops to come.

As the situation is today, the immature pine that is coming on, both natural and planted areas, is mainly of poorer quality than the second growth that has been available heretofore. Much of this is undesirable even for box lumber; still less will it suffice to replace any lumber now being imported. Forests or price set limits to what lumber can be bought or sold in a given market. But custom is always a powerful factor, and the custom of all using native pine itself is hard, particularly in inland towns. Cannot the retailers, in favorable localities, help the timber operator realize that better grades mean better prices, not only in marketing of today but for the timber of the future?

Dominicala

No. trucks 9196
color - dark gray
Trks
wt. w/ load 4500
H.P., bore & stroke
Year 1921
model
4 passenger touring

H.P. 33

Bore 4" x 5½"

Stenographic report of extemporaneous
Speech made at the Products Conference in Washington, Nov. 18, 1924, subsequently corrected and amended for publication.
Waste, n Wood Utilization,

PROFESSOR R. T. FISHER: Mr. Chairman and gentlemen. My story is about a small corner of New England, and an old one, and I think it may gain its chief interest from the fact that this portion of Massachusetts and New Hampshire represents a definite second economic phase, a phase not yet reached elsewhere in the United States. So far as my remarks today apply to it, it is about forty miles square and about 200 years old, economically and socially speaking. The first settlers came there in the first quarter of the eighteenth century, when the whole region was substantially forests. In the first 140 years, they brought the forest area down to approximately 30 per cent. That is, they had nearly 70 per cent of the total land area under farms or grazing. After that, from then on until 1850, the agricultural element stood about still. Since 1850 the percentage of open land has been steadily falling, and natural reforestation following upon the abandonment of this open land has brought about exactly the reverse condition. Today we have in that neighborhood about 70 per cent of our area in some sort of woodland, and less than 30 per cent in farms. The first century was wholly agricultural, with no industry at all except small local water mills. The second century has wound up with a woodworking community. There are some twenty towns within thirty miles of where I live, which are largely woodworking, and the main activity of those towns, stretching back into the timber, is supported very largely by wood. The point that is interesting to us, I think, as conservationists, is that all that very considerable investment and material prosperity is based upon timber that has grown since the Civil War.

To many of you here who come from regions where timber is big, the pictures that you will see of these little New England trees will be laughable. But the test of the value of a tree is not its size, but how much value and utility it furnishes to the population. As I see this problem of conservation, it is double-barreled. Until we are able to

utilize the tree with a return that will enable us to put some money back in the land, we cannot have forestry. On the other hand, we cannot have the tree unless we know how to take advantage of and maintain the permanent productivity of the forest.

The Harvard Forest is a tract of about two thousand acres. It is now producing approximately four hundred thousand feet annually of saw timber, and a good many hundred cords of wood, as many almost as we can find a market for. But in all of the sixteen years the Forest has been in operation, the thing that has been forced upon me over and over again is that we cannot have more silviculture, we cannot put more intensive treatment into the woods until we can find use for this or that unmerchantable species or waste product. So we have been constantly jumping from one end of the problem to the other.

As we found out more and more how to handle the forest as a crop, we were able to apply these improvements increasingly by virtue of an improving market for low grades, small sizes of stick and less desirable species. Today, broadly speaking, any kind of tree, either hardwood or softwood, that will saw a live edge board with a 4 to 6 inch face, is salable. Naturally, even with this kind of market, the completeness of utilization is limited by the cost of transportation. Nevertheless, the central New England region has actually reached a point where close utilization has made silviculture pay. Many thousand acres in the neighborhood of the Harvard Forest are being productively and permanently managed. To a considerable extent this outcome has been due to a happy combination of economic factors. But whatever the cause, the consequence is that many communities in the region are potentially, if not actually, enjoying a permanent yield of wood with the stability of business that goes with it.

The following photographs illustrate certain methods used on the Harvard Forest in securing the establishment and satisfactory growth of a new crop after the cutting of mature timber.

Figs. 1 and 2 show the same area in the years 1911 and 1923 respectively. Fig. 1 represents an even-aged stand of white pine 60 years old. A heavy thinning has been made for the purpose of admitting light to the forest floor so as to stimulate the germination of seed. In this operation both logs and limbwood could be profitably utilized, and the very small remainder of slash was burned. In the course of the ensuing six years abundant reproduction took place, amounting for much of the area to 30,000 seedlings per acre. In Fig. 2 is shown the same area as it looked in 1923. The remainder of the original stand was cut in 1918. Since then the pine reproduction has recovered from the slight suppression due to shade from the old stand, and is now growing vigorously. These two views show the possibilities of bringing about reproduction through the so-called shelterwood method.

In Fig. 3 is illustrated a process of treatment ordinarily indispensible to the establishment of a satisfactory young crop. In many pine forests, where pine reproduction is usually lacking, there is already a more or less complete thicket of hardwood seedlings and saplings. This advance growth is sometimes desirable in itself, but always so vigorous that unless checked it will overtop and kill young pine seedlings, which may have originated at the time the old stand was cut. To correct this condition, whether to produce an adequate crop of pine or to make sure that the desirable species of hardwood will survive, it is necessary to weed or clean the young crop while still in its early stages, before the worthless elements have hopelessly suppressed the valuable. In Fig. 3 such species as poplar, red maple and gray birch, and all too rapidly growing stems are being cut back in order to set free white ash, red oak, and white pine.

In Figs. 4 and 5 is shown what can be accomplished by making the best of such natural reproduction or advance growth as already exists in the forest. The two views apply to the same area, a tract originally covered by a stand of mixed pine and hardwood, approximately 65 years old. View #4 was taken in the winter of 1909, immediately after the clearcutting of the stand, and before the last of the slash was burned. The abundant reproduction of hardwood, not visible in the picture, was intentionally cut back to the ground during the logging. In Fig. 5, a photograph made in 1921, the new crop is finally established in satisfactory density and composition. Originally consisting of a great variety of hardwood species, both good and bad, it has been weeded or cleaned twice at a combined cost of less than $7 per acre. The result is a solid stand of white ash, hard maple, red oak and paper birch, already well pruned of side branches and promising a high grade of saw timber.

The operations shown in these pictures, although involving a slight increase in the cost of logging and a small investment in the new crop, have not prevented the realizing of a substantial profit over and above the charge for stumpage.

Transcript 2/1/25

Forestry Survey

The Central New England wood survey begun by the Harvard University forestry school promises much practical value. This survey has started with a canvass of wood-using manufacturers in this city, of which there are many. It will be carried into other centers. The object is to obtain a wider knowledge of the extent to which various woods are used in manufactures. As an advantage of such information it should be possible to effect a better adjustment of supply and demand in respect to our native woods, encouraging more cultivation of some kinds and contriving to widen the market demand in others. New England has a lot of rather low-grade young timber growth, the marketable value of which depends largely on economy of handling. Some is neglected and wasted through lack of good marketing information.

With all that has been done in the introduction of wood substitutes, woods still have their multifarious uses. Moreover Yankee ingenuity has availed to increase the number of uses and should continue to do so. What kinds of wood are most profitable? Of what kinds is there a scarcity and of what kinds a surplusage? How far are New England producers occupying a field to which they are primarily entitled? These are some of the questions on which light should be cast by the survey just begun. Director Fisher deserves all the support that can be given him by industrial interests in furtherance of his undertaking.

Republican 2/1/25

Raising Our Own Timber

The movement to "sell" New England timber to New England wood consuming manufacturers, in which the Harvard department of forestry with headquarters at the Harvard forest at Petersham is taking the initiative, is in line with the efforts to boost New England products in general for home consumption. Last fall "New England week" made its appearance on the calendar. We were advised to "think New England, talk New England, live New England." A few loyal New Englanders gave a fresh impetus to the movement to "sell" New England to New Englanders.

The idea of selling New England wood to New Englanders is newer than that of boosting New England agricultural and dairy products. But it is just one more spoke added to the New England wheel which it is hoped sometime in the future will roll this section of the country into a state of approximate economic independence.

The Harvard department of forestry, whose work is described in an article in another section of this paper, is eminently fitted to point the way by which New England woodlands may become successful competitors with western timber, which has enjoyed more or less of a monopoly in the high grade wood market in the East. On its tract of over 2000 acres it is conducting research and experiments into the most efficient methods of forestation by which a forest can be made to yield a continuous and indefinite supply of marketable timber without depleting its capital.

It is also interested in proving methods of handling lumber in the sawmills so that by finer workmanship in sawing and preparing lumber for market the product will compare favorably with the high grade workmanship which characterises the western product. With the results of its research readily available to the public, New England forests should not only be able to successfully compete in the open lumber market, but also be turned to better account than in the past toward the solution of the problem of wood shortage in this country. Europe faced this problem many years ago and thereby developed a system of scientific forestation. The Harvard forest, operated as a model example of scientific forestry practice, stands ready to act as guide in the matter of better forestation and leader in the move to spread the gospel, "Sell New England timber."

REPORT OF THE COMMITTEE ON FOREST TAXATION TO THE EXECUTIVE COMMITTEE OF THE MASSACHUSETTS FORESTRY ASSOCIATION.

AN ACT FOR THE TAXATION OF FOREST PRODUCTS AND THE CLASSIFICATION AND TAXATION OF FOREST LANDS.

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CORRECTED COPY TO NOVEMBER 18, 1921.

SECTION I. An owner of forest land, valued on the town tax list of the preceding year, for land and growth at not more than twenty-five dollars ($25.00) per acre, and which does not contain more than twenty (20) cords per acre on the average, but which is so stocked with trees as to promise a minimum prospective average yield per acre exclusive of water, bog, or ledge, of twenty thousand (20,000) board feet for soft woods or eight thousand (8000) board feet for hard woods, or for mixtures of the two, a volume between these limits as is indicated by the relative percentages of the two classes of growth, may apply in writing to the town assessors, to have said land listed as "Classified Forest Land."

SECTION II. Within thirty (30) days after the receipt of said application, the assessors shall decide whether the property fulfils the requirements for classification, and shall notify the owner of their decision, giving their valuation of the tract as land alone and if within the ten days of notification, the owner accepts their decision, the land shall be recorded forthwith in a book, kept for the purpose, as "Classified Forest Land" together with the valuation placed upon the land alone, which valuation shall be fixed for the period of forty years and on which the regular annual property tax shall be levied. When "Classified Forest Land" is sold or exchanged, the obligations of this act devolve upon the new holder of the title.

SECTION III. The standing growth in "Classified Forest Land" shall not be taxed, but the owner of such land except as hereinafter provided.

shall pay a Forest Products Tax of six (6) per cent of the stumpage value, of any wood or timber cut from such land during the period of Classification one tenth of which shall be paid to the State. The trees standing on such land shll not be included in the town valuation in apportioning the State Tax among the towns. The owner shall make a sworn return to the assessors before t e first day of May in each year as to the amount of all wood and timber cut from such land during the preceding year ending April 1, but an owner may cut wood or timber from his "Classified Forest Land" provided it is for personal use or the use of a tenant only, and not in excess of twenty-five dollars ($25.00), stumpage value in any one year, free of tax and no return shall be required on the same. Any buildings or other structures standing on "Classified Forest Land", and so much of the land itself as is used in connection therewith shall be taxed separately as other real estate.

SECTION IV. When in the judgment of the assessors "Classified Forest Land" contains on the average per acre twenty-five thousand (25,000) board feet for soft woods, or ten thousand (10,000) board feet for hard woods or for mixtures of the two a volume between these limits as indicated by the relative percentages of the two classes of growth they shall notify the owner that two years from the date of notification the "Forest Products Tax" of six (6) per cent of the value of the standing timber based on the above volumes will be levied and that the land and timber will, at that time, be taken from the classified list and placed in the general property tax list. Should the owner elect to reduce the volume of timber below the said volume for its class, within the two years, the land shall remain classified, but if five years after any cutting the total growing stock on the tract no longer fulfils the requirements as to

average prospective yield as stated in Section One, the tract may be taken from classification by the assessors. An owner may withdraw his land from classification at any time by the payment of the land tax and the forest products tax of six (6) per cent on the estimated value of the standing timber. Within thirty (30) days after an owner requests to withdraw his land from classification, the assessors shall determine the taxes due thereon which must be paid before the land is taken from the classified list.

SECTION V. In case of dispute as to the eligibility of land for classification or as to the volume of wood or timber contained on such land, or cut therefrom, either party may appeal to the State Forester who shall examine the property, who shall hear both parties and whose decision shall be final.

SECTION VI. Any owner of "Classified Forest Land" who fails to comply with the requirements of this act shall upon conviction therof be punished by a fine of not less than ten dollars ($10.00) nor more than five hundred dollars ($500.00) and not withstanding said penalty the land may be withdrawn from classification by the Assessors.

SECTION VII. All acts or parts of acts inconsistent with this Act are hereby annulled, except that land already classified under Chapter Sixty-One of the General Laws shall not be affected by y this act.

SECTION VIII. That this act shall take effect ninety (90) days from date of enactment.

HOUSE . . . . No. 1490

The Commonwealth of Massachusetts.

HOUSE OF REPRESENTATIVES, March 29, 1922.

The committee on Taxation, to whom was referred the petition (accompanied by bill, House, No. 441) of the Massachusetts Forestry Association for the taxation of forestry products and the classification and taxation of forest lands, report the accompanying bill.

For the committee,

JAMES T. POTTER.

The Commonwealth of Massachusetts.

In the Year One Thousand Nine Hundred and Twenty-Two.

AN ACT

Providing for the Taxation of Forest Products and the Classification and Taxation of Forest Lands.

Be it enacted by the Senate and House of Representatives in General Court assembled, and by the authority of the same, as follows:

SECTION 1. The General Laws is hereby amended by striking out chapter sixty-one and inserting in place thereof the following: —

CHAPTER 61.

Taxation of Forest Products and Classification and Taxation of Forest Lands.

Section 1. An owner of forest land, valued on the town tax list of the preceding year for land and growth at not more than twenty-five dollars per acre, and which does not contain more than twenty cords per acre on the average, but which is so stocked with trees as to promise a minimum prospective average yield per acre, exclusive of water, bog, or ledge, of twenty thousand board feet for soft woods, or eight thousand board feet for hard woods, or for mixtures of the two such volume between these limits as is indicated by the relative percentages of the two classes of growth, may apply in writing to the city or town assessors to have said land listed as class-

ified forest land, and such application shall contain a description of said land sufficiently accurate for identification.

Section 2. Within thirty days after the receipt of said application the assessors shall decide whether the property fulfills the requirements for classification, and shall notify the owner of their decision, giving their valuation of the tract as land alone, and if within ten days of notification the owner accepts their decision the assessors shall give him a certificate containing the name of the owner and a description of the parcel to be classified, and stating that the land described has qualified for classification under the provisions of this act. Upon the recording of this certificate by the owner with the registry of deeds for the county or district where the land lies the parcel shall become classified forest land. Each parcel of land so classified shall thereafter be designated in the annual valuation list of the town, in the column provided for the description of each parcel of land, as classified forest land so long as the parcel remains classified. The valuation and tax annually assessed upon land classified under this act shall not include the value of forest trees growing thereon. When classified forest land is sold or otherwise changes title the obligations of this act shall devolve upon the new holder of the title.

Section 3. The standing growth on classified forest land shall not be taxed, but the owner of such land, except as hereinafter provided, shall pay a products tax of six per cent of the stumpage value upon any wood or timber cut therefrom, one tenth of which taxes collected by the town shall be paid to the state treasurer. The trees standing on such land shall not be included in the town valuation in apportioning the state or county

tax among the towns. But an owner of classified forest land may cut wood or timber from such land for his own use or for the use of a tenant of said land only, and not in excess of twenty-five dollars stumpage value in any one year free of tax. Buildings or other structures standing on classified forest land shall be taxed as real estate with the land on which they stand. Classified forest land shall be subject to special assessments and betterment assessments. The owner shall make a sworn return to the assessors before the first day of May in each year of the amount of all wood and timber cut from such land during the year ending on the preceding first day of April.

Section 4. When in the judgment of the assessors classified forest land contains on the average per acre twenty-five thousand board feet for soft woods, or ten thousand board feet for hard woods, or for mixtures of the two such volume between these limits as is indicated by the relative percentages of the two classes of growth, they shall notify the owner that two years from date of notification the forest products tax of six per cent of the value of the standing timber based on the above volumes will be levied and that the land and timber will at that time be taken from the classified list and placed in the general property tax list. Should the owner elect to reduce the volume of timber below the said volume for its class within two years the land shall remain classified, but if at the end of five years from time of cutting the growing stock on the tract does not qualify for classification the tract may be taken from classification by the assessors, and any taxes due thereon collected. An owner may withdraw his land from classification at any time by the payment of the land tax and the forest products tax of six per cent on the estimated value of the standing timber. Within thirty days after an

owner requests to withdraw his land from classification the assessors shall determine the taxes due thereon, which must be paid before the land is taken from the classified list. When in the judgment of the assessors classified forest land becomes more valuable for other use than the production of trees they may, after thirty days' notice, withdraw said land from classification, and any taxes due thereon shall be paid at the time of withdrawal, provided that the owner may appeal against withdrawal to the commissioner of corporations and taxation, whose decision shall be final. Whenever land is withdrawn from classification the assessors shall record in the registry of deeds a certificate setting forth such withdrawal, and containing reference by book and page of record of the certificate under which said land was classified.

Section 5. In case of dispute as to the eligibility of land for classification, or as to the volume of wood or timber contained on such land, or cut therefrom either party may appeal to the state forester, who shall examine the property, who shall hear both parties, and whose decision shall be final.

Section 6. Any owner of classified forest land who fails to comply with the requirements of this chapter shall, upon conviction thereof, be punished by a fine of not less than ten dollars nor more than five hundred dollars, and in addition to said penalty the land may be withdrawn from classification by the assessors.

SECTION 2. Notwithstanding the passage of this act all land and the trees, wood, and timber thereon which are, on the date when this act takes effect, subject to the provisions of chapter sixty-one of the General Laws shall continue to be subject thereto in accordance therewith.

C O P Y

SOME CONDITIONS WHICH PREVAILED IN THE INDUSTRY

MAKING ASSOCIATED ACTIVITY NECESSARY.

No Market Nor Production Statistics Available.

1. Affiant further says that prior to the adoption of open competition plan by the Hardwood Manufacturers Association of the United States, there were in existence no accurate nor reliable statistics or data touching the question of production, sales, shipments, prices, consumption, etc., of hardwood lumber.

2. There were no means whereby a lumber manufacturer could forecast the needs of the market so as to regulate the character of his production in reference to dimensions, grades, etc., so that the needs of the consumer might be adequately served. Many hardwood manufacturers recognized the need of such data. They, also, recognized the value to the consumer as well as to the manufacturer, of properly adjusting the character of production to the needs of consumption, in respect to the kinds of products into which the logs should be converted in the process of manufacture. It was also clearly recognized that with the prevailing unscientific adjustment of production to the needs of consumption, a stable market was impossible because of over-production of one item necessarily resulted in under-production of another item and vice versa, and this, regardless of whether or not the total production of all items remained constant.

3. The relatively few manufacturers who had well developed sales organizations were able to keep fairly well informed on

the needs of consumption and general market conditions, and from the various facts which came to their notice, to formulate a fairly intelligent conclusion as to the market conditions upon which to base their prices. In the matter of character of production, however, they were not able to form intelligent conclusions because of the fact that they were entirely ignorant as to what other manufacturers were producing, and therefore, although they might be aware of a shortage of certain items of stock, they did not know how much of these items were being produced by other manufacturers, or how much was in the process of seasoning, and should they, by reason of their knowledge of a shortage of certain items in the market, increase their production of those items, they might and often did find that, by the time those items had been seasoned and ready for the market (which process requires from three to six months), that others, also producing in like ignorance of conditions, had quantities of the same items of stock ready for the market, and as a result, there was an over supply, thus making a large part of the lumber so produced unsalable, - there being no need for it. Those who were so positioned by reason of finances, limited piling room, or other conditions, that they could not hold these items until the demand should pick up, were forced to sell them at a price so low that buyers were willing to purchase and hold them until the demand should return. In other words, they could only be sold at a price low enough to be interesting to a buyer as a speculative proposition. The fluctuations in price resulting from these conditions were often very large, and it was not

uncommon for some prices to decline sharply when other prices were advancing, and when the demand for hardwood lumber as a whole was on the upward swing.

NO COST BASIS FOR ARRIVING AT VALUES.

1. No means has yet been found whereby the cost of producing lumber can be allocated to the individual items produced. All the woods found in the hardwood forests are, generally speaking, purchased at a lump price, without any differentiation of species. In the logging operations, it is impossible to allocate the cost to the various species, although there is known to be a difference in the cost of handling them by reason of the difference in size of the logs, and relative position in which the various species grow in a hardwood forest, etc. Even if such difference could be ascertained so that the logging costs could be allocated properly to each species, or even to each log, the continuity of this allocation could not be maintained, because various grades and sizes of lumber are produced from each log. The hardwood manufacturer must take the log as he finds it, and in the process of sawing at the mill, get out of that log the best grades he can. It is impossible to tell in advance what these grades will be. He can regulate his production as to thickness and other dimensions, so that the product will be adaptable to a variety of uses, but this regulation is confined to the limits imposed by the nature of the log, and the proportions of grades he can get in the various sizes are limited by the character of the log. The conditions surrounding the manufacture of hardwood lumber make necessary the sawing of logs as they come from the forest so that, in the course

of a day, the mill will often produce some of every grade and kind comprehended in the scope of hardwood grades, as well as such variety as to dimension and thickness as the producer may deem necessary. Therefore, when the product is finally piled on the yard, there is a tremendous variety of items, due to the variety of species, and the different grades in each species and thickness. The producer has on his yard this great variety of items, a considerable proportion of which must be sold below the cost of production, the prices at which they are actually sold ranging normally from a point below the cost of production to a point considerably above. Generally speaking, the typical hardwood forest produces the smallest percentage of the higher price stock, and the larger percentage of the lower price stock. Whether the net result of the manufacturer's efforts is a profit or a loss depends upon whether the average price received on this great variety of grades and kinds is higher than the average cost to produce; there is no fixed relation between each other in the price of these various grades, nor is there any fixed relation between the price of any of the grades and the cost to produce.

2. It is clear from the above that in establishing a selling price of each grade, the producer has no cost basis to guide him, He cannot take his cost figures and, from that basis, arrive at a price that would be fair on each grade, nor can he arrive at the lowest price he could safely ask for any grade without loss.

NO OTHER BASIS OF PRICE THAN MARKET CONDITIONS.

1. The manufacturer must, therefore, have accurate information of stocks, the needs of consumption and current prices,

to enable him to sell each grade, thickness, and kind at a price in harmony with general conditions, in the hope that the average price received from the sale of all his various items will yield a profit over abd above the average cost to produce. A knowledge of market conditions is, therefore, of paramount importance to the manufacturer, and in this respect, his position is different from that of the manufacturer or producer or practically all other commodities.

HARDWOOD LUMBER HAS NO COMMON MARKETS.

1. Although a knowledge of market conditions is of vital importance to the manufacturer, hardwood lumber unlike grain, cattle, cotton, and many other basic commodities, has no common market. There are no current price quotations, no statistics as to receipts at consuming points, as to production, as to supplies offered, nor of prices asked or bid.

SOURCES OF MARKET INFORMATION PRIOR TO THE ADOPTION OF THE OPEN COMPETITION PLAN.

The manufacturer has been wholly dependent upon such information or misinformation as the buyer, in his effort to drive as good a bargain as possible, saw fit to impart.

1. The consuming buyer, as a general rule, purchases a very limited number of grades and kinds. He is in touch with many mills, and is in position to have, and generally does have, a much better knowledge as to the available stocks of the grades he uses, and the demand, than the producer working alone can possibly have. In a word, the manufacturer, working in the dark, except for the fragmentary and uncertain information indicated above, is confronted with the buyer, against whom he is at a

disadvantage, because of the buyer's greater knowledge, of the conditions pertaining to the particular item which he wishes to purchase.

2. The wholesaler, for the most part, buys lumber outright from the manufacturer, and sells to yards and factories without handling the stock. By reason of his intimate and daily contact with the consuming trade, he is in a far better position than the manufacturer to know the needs of the market, the market prices and all of the facts and circumstances which enter into the making of prices. A great many of the manufacturers get what knowledge of the market they have chiefly through the wholesaler who comes to them as a buyer. This applies more particularly to the smaller manufacturers. There are in the United States, somewhere between twelve and fifteen thousand independent units manufacturing hardwood lumber. All the larger and stronger units have well organized sales departments and are in position to directly ascertain the needs of consumption. Further, the small manufacturer, particularly, by reason of the nature of his activities and his isolated location, not only with respect to the markets, but with respect to other manufacturers, is not able to keep in touch with changing market conditions.

The above is a general statement of conditions which obtained in the industry in 1916, and for many years prior thereto, and which obtain in a very large degree today. These unsatisfactory conditions were intensified by the lack of grade standardization and the various evil practices arising therefrom.

Sent to the Hampshire County Improvement League, 4/23/25

The Harvard Forest has just completed and will shortly publish as a bulletin a study of the advantages of forest crops containing mixtures of hardwoods, or broad-leaved trees, with pine, as compared with the ordinary pure stands of white pine. It developed in the study that in general the white pine woodlots are not maintaining themselves as they did formerly either in quality or quantity. Those which are cut over almost always come up next to hardwoods, and the younger pine stands that are coming in on open lands are much sparser and contain many more worthless species than formerly. Furthermore, pine when growing in pure stands and in large contiguous areas is especially susceptible to insect damage and to disease. The study showed that much of the land now or recently occupied by pine ordinarily bore hardwoods or hardwoods and pine, and is more adapted to that kind of growth. It appears also that pine mixed with hardwoods maintains its vigor to a greater age, is more rapidly pruned of branches and consequently produces a higher grade of wood. The combination of species brings about and preserves more favorable growing conditions in the soil and tends to reduce damage from insects and disease. Finally, and particularly important from the practical point of view, mixed forests containing pine can often be established on cut over lands where the attempt to secure a crop of pure pine would be too costly. The bulletin attempts to show in general how by certain practical measures it may be possible to develop more valuable timber crops by less expensive methods. Any system that will counteract the present tendency in New England forests toward the production of poorer and poorer grades is of first importance in making forestry more successful.

The Harvard Forest is making its contribution to American Forest Week be planting more than double its usual quota of trees. In order to demon-

strate as time goes on the value and productiveness of mixed forests, it is planting in various combinations and both on cut-over land and on old fields white pine, red pine, white spruce, Norway spruce, European larch and hemlock. Approximately 50,000 seedlings of these species are being set out. The kinds mentioned exemplify those types of trees which are relatively rapid in growth and require considerable light, and those which are somewhat slower and able to grow in considerable shade. By mixing these two types of tree on favorable soils it is possible to get what almost amounts to two crops on the same area. The trees which can thrive in the shade help keep the ground moist, kill off the side branches of their neighbors, and are able themselves to produce a substantial quantity of timber. By the end of the present planting season the Harvard Forest will have fifty acres or more of plantations which will demonstrate these conditions.

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THE CANVASS OF SPRINGFIELD LUMBER USERS BY THE HARVARD FOREST

Market Study as a Basis for Promoting Forestry

The canvass of wood-using industries now being carried on in the Springfield district by representatives of the Harvard Forest at Petersham will have, it is hoped, a much wider significance than a mere collection of Statistics. In a study where so many factors are involved, it is not safe to predict exactly what useful conclusions will be reached. The main intention, however, is to put the practice of forestry on a more business-like basis. The general public is now well aware of the fact that forests in general are alarmingly depleted, that the production of forest products in Massachusetts, to say nothing of New England, is far below the consumption. If the community is to get any use and income out of our thousands of acres of waste land, it is only by developing the business of wood production that it can be done. From the point of view of the owner of woodland, particularly the small owner, the abstract importance of forests cuts less of a figure than the question whether he can afford the cost of starting or maintaining a forest crop, and whether the current or final returns will pay him for the outlay. The great bulk of our forest land, both actual and potential, is privately owned. Except where practiced under public ownership, forestry is a business like orcharding or dairying, and unless the returns are sufficient and reasonably certain, it cannot be expected that private owners will undertake it.

There is no region in the United States where today conditions are more favorable to the practice of forestry than in central Massachusetts. The management of the Harvard Forest, which has now been in operation for sixteen years, shows that continuous growth can be maintained and all costs of maintenance and production met, including interest, with a fair profit

besides. But not all timberland is so favorably located with respect to markets, or in such comparatively good growing condition as the Harvard Forest. Speaking in general both from the point of view of the timberland owner and of the consumer, many of the conditions of manufacture, distribution and utilization are unsatisfactory, and to this extent work against both a more desirable handling of the forest and a more economical use of its products by the consumer. A few examples will show how these difficulties work out.

A very few years ago native white pine found a considerable outlet in the building trades. Now not only white pine but a large percentage of northern New England spruce has been superseded for this use by western lumber. It is true that at present the bulk of our native pine is of too poor a grade for ordinary building material, and has been used largely for box lumber. Nevertheless, it is also true that much of the western lumber is no better than what could be made from the best of our native pine. The western material has been manufactured by large mills, sawed true to dimension and well finished. It has also been available promptly and in large lots. On the other hand, the native pine has come to be cut chiefly by small portable mills, not always with the best equipment, and under conditions which often made proper seasoning impossible. Generally, too, there are no facilities for finishing. Thus, many retailers no longer like to handle native pine and their customers are becoming educated to prefer the imported varieties. Is it possible that by better methods of manufacturing and handling, a percentage of this local retail business might be regained for white pine? When we consider that the freight bill alone on much of the western lumber is $15 a thousand, it would seem to be economical for all concerned to find a way to use similar lumber that could be delivered at from $2 to $4 per thousand.

Another important problem is how to eliminate waste. Under present methods not more than 35% by volume, and usually less, of the individual

tree is actually utilized in the finished product. Two-thirds, therefore, is lost in the woods, the sawmill, or the shop. Besides, this direct waste of material, there is an indirect waste in cost. Most of the lumber got out by Massachusetts mills is shipped rough in the form of boards, which thus pay freight on a considerable percentage of material that is lost in the shop or factory. The practice of sawing lumber round edge, that is, through and through the log leaving the bark on, is general in central New England and has resulted in important economies. In certain industries, however, attempts have already been made to cut the board up into standardized pieces or roughed out sizes from the boards as they come from the log. This practice is reported as in vogue at the sawmill of the Ford Motor Car Company. With a large number of different sized pieces to be got out, it is possible to utilize closely almost any size log or odd length of board, and instead of having to pay freight on the waste in bark, edgings, crook, and unsoundness, only material actually usable in a motor car is shipped. To apply this principle to native lumber would involve changes in woods equipment and in factory methods. It may not be possible, but it is certainly successful in some industries and may prove feasible for some uses here. By similar methods, it might be possible to utilize varieties of timber not now salable.

Another drawback to the marketing of native timber is the difficulty of distribution. Much of our timberland is in small holdings, such as farm woodlots. Usually the individual tract contains a number of varieties of timber. Some of it might command a good price, but often the quantity of any one kind is so small it would not pay to cut and ship it. Often too, the owner does not know where that particular variety is salable, or cannot afford the expense of finding his market. To meet such a situation, may it not be possible in certain localities to work out some scheme of cooperative management whereby small quantities of lumber could be assembled for more economical delivery? In the long run, timberland must be managed in

large units, for the cost of distribution is the controlling factor in the value of forest products, and to reduce it is of advantage both to the producer and the consumer.

So far in the development and promotion of forestry, the chief emphasis has been placed upon production, upon the methods and cost of planting and upon the growth of timber crops, in Massachusetts, chiefly white pine. It seems to be timely to recognize both that our native woodland contains a good many other varieties of timber, and that some are either not marketed at all or cannot always be marketed to advantage. In the sum total of our wooded area hardwoods outweigh softwoods. It is only by developing the greatest possible value in timber crops that an incentive can be provided for their production. Ordinary woodland such as grows up after cuttings or develops on abandoned land is producing not only more and more of the comparatively worthless varieties of tree, but also a poorer and poorer grade of lumber. This situation makes it increasingly easy for importations from other parts of the country to take and hold the markets, and the growing shortage of supplies, the use of substitutes, and the increasing distance from which wood must be shipped are constantly changing the methods of utilization. It would seem, therefore, that an analysis of the actual conditions of production, manufacture and distribution would help not only to make existing timber more valuable, but to indicate what kinds and qualities of timber are most desirable to grow. In many of the towns of Hampden, Worcester, Hampshire and Berkshire Counties, more than 60% of the total area is classifiable as woodland. Of this total of not less than half a million acres, only a small percentage is actually producing anything better than cordwood. Experience on the Harvard Forest has shown that it is possible at a definite cost and at the right time to convert much of this unproductive forest into a potentially valuable crop. It is to make this potential value a recognized value and

thus more effectively demonstrate the business possibilities of forestry that the present canvass of wood utilization in Springfield has been undertaken. If the results prove promising, the study will probably be extended to other localities in the state.

Corrected stenographic report of address

given at the New England Council
meeting in Hartford October 1926

Mr. Chairman, Ladies and Gentlemen: I am here perhaps a bit under false pretenses, because it seems as if it ought to have been some member of the wooden box industry who did the talking.

I am reminded of a political contest in some middle western state where a man who had formerly been a veterinarian but had gone out of the business undertook to run for office. The campaign got pretty hot and at one meeting someone of his opponents suddenly interrupted him and said,"Is it true that you are a veterinarian?" Whereupon the candidate said, "What's the matter? Don't you feel well?" (Laughter)

I am not a box man. I am a forester. But I have been intimately associated with the wooden box industry in my profession of handling timberlands, the business management of the land that produces the raw material. I am not here to report accomplishment, but progress.

Mr. Filene said that the survey of the wooden box industry is done. The field work of interviewing the individual manufacturer is done, just the figures gathered in the interviewing of, I believe, about 95% of the producers of wooden boxes in New England. Those figures were turned over to the Statistical Department of the Harvard Business School without identification of names. Those figures will be summarized and digested by the statisticians in that office and when the work is complete they will be considered by the Research Committee and ultimately laid before representatives of the wooden box industry, I hope with constructive suggestions.

Certain things, however, can be said now, certain broad facts which the survey has brought out and which tend somewhat to correct impressions hitherto held.

Twelve million dollars are invested in plants and machinery in the wooden box industry in New England. It is not true, as has been generally assumed in the last few years, that the consumption of pine box lumber for boxes has greatly fallen off. Four hundred and fifty million feet of lumber, practically all native New England pine, went into wooden boxes last year. There has been, on the other hand, a very considerable increase in the general use of containers for manufactured goods in the last five years. A considerable part of that increase has been taken up by other forms of container, principally fibre and ply-wood, but relatively the wooden box has held its own, and it seems not unlikely - in fact, I venture to say it is certain - that the wooden box has a real and enduring place in the shipments of manufacturers.

That 450,000,000 feet of lumber was used by 175 separate managements and perhaps 185 to 190 actual individual factories. I am speaking now of at least 90 to 95 per cent of the total industry that produces wooden boxes. There has been, however, during the five-year period which we have been studying a shrinkage in the price of box lumber of from $5 to $6. That is not so large as it seems because it is a shrinkage from wartime prices and wartime demands. Neither has the whole of that shrinkage been passed back, as some people think, to the cost or price of the stumpage or standing timber, but quite a percentage of it has been absorbed by reductions in operating costs between the stump and the sawmill.

The most significant fact, however, and the one that I want to leave with this audience, is the grand total of money represented by the sales of wooden boxes and where that money goes. Twenty-five million dollars represented the gross sales of wooden boxes last year.

Now the box business, as I see it and as I hear it referred to amongst gatherings of the so-called basic industries, is regarded perhaps as a sort of poor relation. We do not hear much about the box business as an element in the sum total of lumber products. But consider those $25,000,000 which were paid in last year for wooden boxes in New England. Not less than eight or nine millions of those dollars stayed right in the towns where the standing timber grew. Probably three to four million dollars represents the price paid for the timber standing. That went, much of it, to farmers and small individual holders in the small towns, and often to men who, ostensibly farmers, would not have been able to survive at all if they had not had that income from their wood lots. Another portion of that eight or nine million dollars went to woods workers and choppers, to teamsters and truckmen, and all the workers and organizations that stand between the timber and the piled lumber at the mill. Now, where does that money go next? There is eight or nine millions of dollars of purchasing power that is spread around in the small towns in the back country. It goes in purchases, it goes to the local storekeepers, and they in turn buy the print goods, buy the shoes. It also goes in freight to the railroads. In other words, that wooden box industry has a right to hold up its head, and it has a very particular right to be fostered and encouraged, because it not only reacts upon the prosperity of the other industries, the so-called basic industries, but above all it maintains the rural population. It is the biggest single timber product in New England today outside of pulpwood. It is far ahead of other kinds of timber and it is capable of being maintained. One and one-half million acres of ordinary white pine land would produce by its annual growth the 450,000,000 feet of lumber that the wooden box industry uses today.

Some of the other speakers have referred to the interdependence of New England industries. Here is one that has a peculiar interdepen-

dence. It is peculiarly important to the country districts, because it raises their purchasing power and maintains their standard of living, and it is peculiarly important also to the industries which want to sell things to the country districts and want to keep the railroads efficient that they should in turn keep the wooden box industry on its feet. (Applause)

An editorial for the Traveller, November 26, 1926.

No state in the union has a sounder forest policy than Massachusetts. It has nearly 100,000 acres of state forest and the prospect of more. It has the machinery for efficient fire protection, combining both state and town organizations. It has a forest tax law which permits any owner who actually keeps his land producing to pay the bulk of his tax when his timber is cut. It has a well organized forestry department, which administers state forests, fire protection, state nurseries, advice to private owners, etc. The major necessities of public aid, as in taxation, fire protection, and the development of a fair proportion of our idle land, are already in operation.

But on any large scale forestry responds only to economic law and the self interest of the community. It is the owners of the 50% to 60% of our area now classed as woodland who must realize that forestry is profitable before we can check our timber depletion. We must first of all stabilize and improve our woodworking industries, as the New England Council is undertaking to do for the wooden box business, so that the incentive to good forest management will increase. We must educate the public to prevent forest fires instead of paying taxes to put them out. Most of all it is important to correct the widely held notion that forestry is reforestation, and reforestation is planting trees - for the grandchildren. The area of natural woodland outweighs the area suitable for planting a thousand to one. A dollar's worth of forestry in the woodlot is worth two dollars' worth on a plantation, both in profit and wood production.

Sent to O. M. Butler
Am. Forestry Assn
4/14/27

Published in June 1927 issue of
Am. For. & For Life as
A Museum of Forest
Antiquity

331:348

PRIMEVAL FOREST GIVEN TO HARVARD

In a rough and inaccessible corner of Cheshire County, New Hampshire, there has survived up to comparatively recent years a block of 5,000 acres of primeval forest. For two generations this tract has been in the hands of one family. Little by little it has been logged off until only a few considerable portions of the original forest remain. Nowhere else in New England is there any remnant of virgin pine forest which is equal in size and authenticity to this so-called Pisgah Forest in southern New Hampshire.

Realizing that without prompt action this last sample of original woodland would vanish, a number of public spirited donors have purchased an isolated area of approximately twenty acres which has been deeded to the Harvard Forest to maintain and protect unaltered as a sample of forest conditions that have now practically disappeared from central New England.

For the purposes in view this piece of old forest, although small, is peculiarly well located. It lies mainly in a long hollow on the summit of Pisgah Mountain. On two sides there are ledges having almost the character of rim rocks, which keep the forest floor moist and protected and greatly enhance the beauty and visibility of the forest. The nearest public road is several miles distant, and from the end of a lumber road one must walk a mile and a half up an old trail to reach the big trees. This isolation together with the character of the surrounding forest makes the danger from fire relatively slight; and the steep approach through second growth hardwood makes the contrast with the tall forest on the summit unusually impressive.

The dimensions of the trees in the Pisgah stand do not equal the records of old growth pines in more favored locations, but they are

nevertheless far beyond the ordinary sizes of trees seen in New England woods today. As is usual in primeval forest, the pines overtop all other trees, rising singly or in groups 100 ft. to 140 ft. and with diameters at breast height up to 3½ft. or more. Slightly lower than the pines and forming in themselves a handsome forest are great numbers of hemlocks, among which are occasional spruces and a scattering of beech and oak, with much of the characteristic undergrowth and small plants which are found only in undisturbed forest. To judge from the age of trees in similar stands which have been cut on other portions of the property, the age of the Pisgah pines is from 200 to 300 years, well antedating the arrival of the first white men.

Apart from the beauty and picturesqueness of the tract, it will have, particularly for ecologists and foresters, a real scientific interest. The problems of forestry and ecology are very much concerned with understanding the operation and importance of the physical factors in second growth forests where the influence of man and his agencies has brought about unstable and changing conditions. Only by the observation of the primeval forest can such alterations in forest condition be finally interpreted.

The Pisgah Forest will not be in the usual sense a public reservation. Primarily it is a museum of forest antiquity to which interested persons will always be welcome. Its interest and value will be the greater in proportion as it remains unaltered and undisturbed.

Written to give over the radio at Medford Hillside Jan. 1925? but not delivered. Sent to the Barre Gazette, Mar. 17, 1927. Delivered over WNAC April 24, 1927.

HOW TO MAKE WOODLANDS PAY

Fifty to sixty per cent of the area of Massachusetts is woodland, and in some sections, like northern Worcester County, a large part of the livelihood of the inhabitants comes directly or indirectly from wood. Yet with wooded area increasing, timber is failing.

Between 1850 and 1875 more than half the tilled area of back country farms was abandoned. The natural reseeding of these lands produced millions of board feet of second growth white pine which, with the timber already growing on uncleared areas, has for years furnished the raw material for one of the most important groups of industries in the state, the manufacture of boxes and box shooks, pails, woodenware, toys, furniture and other wooden products. Many flourishing towns owe almost their whole business existence to wood working industries, and from the woodlot to the freight car often from 50 to 75 cents of everybody's dollar comes from a tree. Without their woodlots very many of the present owners of farms could not always make both ends meet. The owner not only sells his timber but he and his neighbors get paid for cutting the logs, for hauling them to mill, for piling lumber, for teaming it to the railroad. Even the towns themselves get much of their revenue from the taxation of forest property. The seller of woodlot timber gets $8 or $10 a thousand feet, which amounts to a return per acre of from $200 to $500. By the time his lumber gets to the factory or dealer, it will have accumulated a value of from $30 to $40, and all these additional dollars represent wages and business for somebody. In short, the woodlot constitutes real wealth, and in many cases, the chief wealth, in our communities.

Up to now we have received this wealth purely as a gift from nature, in part even as a consequence of the failure of agriculture. But just when we have come to count upon it as a business asset, we are begin-

ning to lose it. Our timber is being cut much faster than it is growing. Largely through carelessness we are burning thousands of acres every year. Insect pests are increasing in numbers and distructiveness. Most serious of all, through lack of intelligent management, the most usable kinds of tree are being largely replaced by cheap or worthless kinds; and the more the forest weeds increase, the more costly and difficult it becomes to reestablish or maintain the kind of forest that will help the community to live. We cannot have forests unless we keep fires in check; but even without fires we cannot have good forests unless we apply the same degree of care and skill to their management that the farmer has learned to give to his orchards and cattle.

Every woodlot owner, even though he may not be a forester, can apply certain common sense measures to his timberland that will quadruple its value and productiveness. There are thousands of acres of old farm lots growing up to mixtures of gray birch and white pine. While the pines are less than a few feet high, the birches protect them to some degree from drought and exposure; but on all except very sandy soils, the birches finally kill out the pines and prevent their ever reaching timber size. Experience on the Harvard Forest has shown that by cutting the birch while the pines are still thrifty, a yield of pine can be secured that may be worth from $200 to $300 an acre, instead of $30 or $40 an acre, which the birch might have been worth if it had been left to kill out the pine.

Another simple and profitable principle in dealing with woodlots is not to cut young fast growing stands of saw log species for cordwood. Recently I saw a solid stand of several acres of red oak, five to eight inches in diameter and standing next to a state road, being cut into cordwood, which would net about $2 a cord. Oak is now one of the most valuable of timber trees and this stand, which was exceptionally straight and fast growing, was increasing each year by a value of more than $10 per acre.

The owner of this woodlot threw away a certain return of at least $500 per acre for a present income of not more than $40. By going a little farther from the road, he could have cut at slightly more cost a lot of birch and maple whose removal would have greatly improved other portions of his woods.

Many people think that the best way to grow timber is to let nature do it. Before the white man came to America and with several centuries to work in undisturbed, nature did a very fair job. Nowadays nature unaided is not producing good forests any more than she is producing good vegetable gardens without weeding and cultivation. Everybody is familiar with the great areas of cut-over land covered with thickets of young hardwoods, commonly referred to as "brush". Left alone, these areas produce nothing but clumps of crooked sprouts mixed with small weed trees like gray birch and pin cherry. If these weeds are cut back while the stand is still small the many hundreds of seedlings and saplings of valuable trees like ash, oak, paper birch, and sugar maple, some of which are almost always present, will survive to make a crop. This kind of forest weeding is one of the cheapest and one of the most profitable measures in the practice of forestr

When we come to full grown or mature woodland, there are ways of harvesting the crop without leaving the land stripped and unproductive, in other words, making the old trees furnish seed for a crop of new ones. One of the simplest ways is to take off the stand in two cuts, the first a heavy thinning, the second a clean cutting. During the last ten or fifteen years this method has been unintentionally followed in many of the woodlots of Middlesex County, particularly in the towns of Lincoln and Concord. In the fight to control the gypsy moth, many hardwoods, particularly oaks, have been cut or killed in stands made up in part of pine. The result of this accidental thinning has been to stimulate the germination of thousands of seedlings so that now one sees thickets of young pine coming up everywhere under the thinned cover of the older forest. When

the old trees are cut and even if a considerable part of the young growth is damaged, there will be a new crop successfully established.

In general, one of the great obstacles to successful forestry is the slash or tree tops that usually have to be left when timber is cut. This debris not only makes a serious fire hazard, but often lies in such heavy piles as to smother out young seedlings over much of the cutting area. Sometimes, when towns are near, much of the material in these tree tops can be sold or given away for cordwood. If not, it is good insurance and nearly indispensable to the success of the new crop of trees to get rid of it by burning. This can be done or should be done only at seasons and in weather when fire cannot possibly run on the ground. It is best and cheapest to do it when the slash has had time to dry out and during a light rain or after a light fall of snow.

Still another general guide to the development of woodlots should be the favoring or encouragement of several salable species instead of only one or two. White pine is still a valuable timber tree, but today it has many pests and is subject to a number of diseases. Grown in mixture with other trees, particularly hardwoods, it is less susceptible to all kinds of damage, produces a better grade of lumber, and maintains a vigorous growth to a greater age. A number of other kinds of tree are now even more valuable than pine. Therefore it is well to favor also such species as red oak, white ash, paper birch, sugar maple, yellow birch, and basswood.

The woodlot should be looked upon by its owner not as a neglected asset to be sold once in a generation for what it will bring, but as an important piece of invested capital which is always piling up, if not actually paying, interest every year. If it is studied and improved from time to time, its productiveness will increase and its yields will become more frequent. Well stocked, well managed woodland in Massachusetts may well return a net income of three to six dollars per acre per year. When

it is remembered that most woodlots stand on soils incapable of producing any other crop, such an income, with the long chain of labor and business activities which goes with it, is worth the attention, not only of every forest owner, but of every citizen who wants prosperity.

Report of Speech by R. T. Fisher before the Massachusetts Forestry Association, December 8, 1927.

Mr. President and members of the Massachusetts Forestry Association: The subject which Mr. Reynolds asked me to talk about is not exactly the subject on which I am going to speak. I am going to try to sum up observations on the forestry movement up to now and to draw from them some lessons some conclusions as to the kind of progress and the direction which it should take in the future. We have behind us now twenty-five years of forest advertising which has been carried on by a great many organizations and agencies. We have created a great public consciousness of forestry, but it seems to me that the direction of that consciousness or understanding is no longer the best. The public I think by any test that one may apply understands forestry to be reforestation, and they understand reforestation to be the planting of white pine. That is indicated and proved by almost any publicity about forestry which you read or hear. It is borne out by the reports of the state foresters. It is perfectly natural that we should pick upon white pine as the objective crop. White pine was and still is the principal native species that is and can be grown, manufactured and converted into wealth in central New England. The ~~the~~ conception of forestry as reforestation and the conception that all we need to do is to put the forest back on land where there is none and the conception that forestry is planting and waiting for a harvest is far from the true conception. Forestry is an industry, an enterprise that will pay its expenses as it goes and return profit besides. We have learned a great deal in the last five years about forests and forest growth. We have learned partly by this mysterious research which nobody seems to understand, by economic changes that have taken place in New England in the last ten years, and we have learned by the accomplishments of our colleagues in Europe in the last five yeats in producing and maintaining the best soil.

The pine plantation has a number of drawbacks that I for one did not suspect fifteen years ago. It produces none but low grade lumber. It is possible that it may be modified by pruning, but in general it produces only low grade lumber. It is subject to a number of destructive pests that are difficult to control, the pine weevil and the blister rust, to mention no others. Finally, we now know that the ordinary pure pine woodlot practically ceases to grow at about fifty years of age. I have been asked why second growth pine does not grow to the size of the original growth. It is because a pure stand of conifers, particularly pine, builds up a highly acid soil which prevents decomposition. After forty or fifty years you get a soil condition that is static; it does not produce the nutrients that the tree must have; and it is impervious to water and air. This soil condition has been recognized in Europe and has been analyzed by Dr. Hesselman of the Swedish Forest Experiment Station so that we now know that the pine plantation has some real drawbacks that cannot be obviated. It produces a stagnation of soil, to name it in a rough way. As a business enterprise, as a project to recommend to forest owners, it falls in my opinion somewhere between a speculation and a savings bank deposit. At best, having regard to the ; at worst, it is pure speculation.

We talk about the necessity for reforestation. As a matter of fact in Massachusetts there is 30% more land covered with trees now than there was 100 years ago. The same is true for a large part of New Hampshire, Vermont and Connecticut. Why talk of reforestation when we have an immensely larger area of growing trees than we did to begin with? At Petersham on the Harvard Forest we began twenty years ago to convert out pine woodlots into mixed stands, partly because that change was already at work - Everybody is familiar with the invariable conversion of softwood stands to hardwood after they are cut over - partly because I was convinced

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The pine plantation has a number of drawbacks that I for one did not suspect fifteen years ago. It produces none but low grade lumber. It is possible that it may be modified by pruning, but in general it produces only low grade lumber. It is subject to a number of destructive pests that are difficult to control, the pine weevil and the blister rust, to mention no others. Finally, we now know that the ordinary pure pine woodlot practically ceases to grow at about fifty years of age. I have been asked why second growth pine does not grow to the size of the original growth. It is because a pure stand of conifers, particularly pine, builds up a highly acid soil which prevents decomposition. After forty or fifty years you get a soil condition that is static; it does not produce the nutrients that the tree must have; and it is impervious to water and air. This soil condition has been recognized in Europe and has been analyzed by Dr. Hesselman of the Swedish Forest Experiment Station so that we now know that the pine plantation has some real drawbacks that cannot be obviated. It produces a stagnation of soil, to name it in a rough way. As a business enterprise, as a project to recommend to forest owners, it falls in my opinion somewhere between a speculation and a savings bank deposit. At best, having regard to the ; at worst, it is pure speculation.

We talk about the necessity for reforestation. As a matter of fact in Massachusetts there is 30% more land covered with trees now than there was 100 years ago. The same is true for a large part of New Hampshire, Vermont and Connecticut. Why talk of reforestation when we have an immensely larger area of growing trees than we did to begin with? At Petersham on the Harvard Forest we began twenty years ago to convert out pine woodlots into mixed stands, partly because that change was already at work - Everybody is familiar with the invariable conversion of softwood stands to hardwood after they are cut over - partly because I was convinced

that the mixed stand produces a better quality of lumber and more sustained growth. At it happens the laboratory investigations of soils have been bearing out that point. This summer when Dr. Hesselman was at Petersham he saw what had been accomplished by the conversion from the pine type of forest to the mixed type, and the very alterations and improvements which his chemical experiments indicated would happen. Briefly, the soils which fifteen to eighteen years ago had reached this condition of stagnation and overacidity are now, where mixed stands are growing, converted into soils that look like garden loam. They have practically no leaf litter and are well supplied with angleworms. In other words, the mixed stand, mixed hardwood with as much softwood as can be grown with it, is slowly improving the soil, building it up, and keeping it active.

Now the point is there are thousands and thousands of acres in Massachusetts and still more in New Hampshire which contain a super-abundance of small young trees of valuable species already growing on the ground. Left alone, in the absence of any attention or improvement, these cut-over areas degenerate into forests of weeds, rank growing sprouts, that grow swiftly, overtop, and kill such valuable species as white ash, paper birch, etc. Thus you have a stand with no commercial prospect. If instead this young growth is weeded, it is a good deal better than a pine plantation which costs more money per acre to start. We now know for sure that mixed stand improve the soil and grow better quality timber. There are thousands of acres where Nature has already provided the material for a valuable forest, especially ~~such~~ mixed stands that can be weeded for $3 to $7 an acre and done completely so that better stands result. I have many times seen struggling pine plantations that have every prospect of making food for the weevil surrounded by hundreds of acres of trees that could be built up into a stand. In other words, I think we must set up an additional, if not a different aim.

We must put our time and money into the natural forest where

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Nature produces millions of new trees and take advantage of the immense natural production which Nature has to offer. This is simply a report on what has been done in a number of places and I know that the facts on which these conclusions are based are sound. But that does not finish the matter. There remains the necessity of making our forestry a business. We talk about timber depletion, the necessity of increasing the production of timber for the future. How can we do that unless and until forestry stands on its own feet as a profitable business, at least a business that produces cordwood, sawlogs, etc. for less money than it costs to sell? I think forestry has been presented too often exclusively as a public service, as a cause, a religion because everybody ought to believe in forestry. You can never bring it to light as a real business until you can organize it so that it can be a going concern. The plantation is just an item, a single small process in the business of growing trees. If you have 5,000 acres of forest that produce every year a million feet of lumber, the expenses for producing that million feet a year are only for keeping the forest growing. On the Harvard Forest we have an ~~expense~~ income of from 50¢ to $1. an acre after charging every item of expense and overhead that would be charged by a business concern.

There is one thing that must come next if we are going to make forestry succeed. We must get away from that concept of forestry as a necessarily deferred return. I think now we know - and I say this with increasing knowledge of timber owing interests - we need to direct attention to the natural forest, to the possibilities of organizing sufficient units of management so that these units can be handled for continuous production, so that each individual, if it turns out to be an association, will profit directly from the membership of all the others. Together they can market their material to much better advantage, reduce their cost, and they can bring into operation a really organized productive forest, which means a forest that is going to give returns at regular, if not annual, intervals.

The possibility of combining ownerships to get away from the handicaps of the small owner has already been tried in Sweden and Finland. There are associations of owners that would correspond to our small owners which are actually doing that. 50 - 200 acre lots are combined and put under one head and every year whatever is made goes for the good of the group and each man gets his share. These things are in successful operation already. I think the necessary tendency for forestry is toward the creation of more mixed stands in order to maintain an improved growth and better the soil conditions. We need to apply thought to the natural forest more than to the plantation and we need the organization of land units in combination to produce and maintain continuous production.

Published in the Journal for October 1928

PINE PLANTATIONS AND NEW ENGLAND FORESTRY

Forestry began to be promoted in New England only a little over a quarter century ago. In that period the federal Forest Service, the several associations, and later as they became established, the state departments and forest schools have built up an immense campaign of education. This publicity has largely determined the popular conception of forestry and hence the direction of its growth. Almost from the start and with increasing unanimity the programs and propaganda have been centered on the planting of white pine. For this there were obvious reasons: the abundance of natural old field pine, its rapid growth and ready market, the adaptability of abandoned or failing farms to planting, and, as a question of advertising, the ease with which the setting-out of little trees could be dramatized to the public. Leaving out fire protection (not in itself productive), progress in forestry is more and more commonly measured by the number of seedlings produced, distributed, and planted. Implied by this and often directly expressed is the assumption of vast deforested or waste areas which must be made productive. In consequence it is the common belief, shared by most timberland owners and apparently even by some foresters, that forestry means reforestation, and that reforestation means planting, generally white pine.

It is axiomatic that sufficient wood production is in the long run a regional necessity, and that the right kind of education will help bring it to pass. Furthermore, if forestry is to be a live industry, not only must economic conditions permit timber to show a profit on its cost, but, in Colonel Greeley's expressive phrase, "the people must become forest-minded". In the light of these objectives and now that twenty-five years of silvicultural experience and economic developments have passed, it is

timely to inquire whether the widespread emphasis on plantations of pine is a sound policy.

Pure pine stands both in natural woodlots and in plantations are silvically alike. At fifty to sixty years growth falls off rapidly, general health declines, and disease is frequent, especially red rot (Trametes pini). The soil tends to become impervious and unfertile under an increasing layer of raw humus and litter. Only low grade or knotty lumber is produced, and this poor quality is aggravated by injuries from the pine weevil, which is particularly damaging in the usual wide-spaced plantation. Blister rust, now widespread, is a matter of serious concern, and whatever may be said for control, the disease has proved most destructive in compact stands. Pure pine is a transition type, and except on the lightest soils reverts to hardwood or mixtures of hardwood and softwood. Viewed as a crop, the type, in spite of early rapidity of growth, is not in the long run productive, vigorous, or easy to maintain. Furthermore, there has been a gradual shrinkage in the use of low grade white pine, and western lumber has largely replaced the better grades of native softwood, not a large element in local production at best. Thus the price of box lumber - the main product of plantation or woodlot - is now almost 30% less than it was ten years ago, and considering the prospective supply and probable demand, it will be many years before the value will reach the previous high point.

These may be considered to be intrinsic defects inherent in the life history of the type and its relation to utilization. They have been greatly aggravated in the practice of planting by defects in method. The public has been supplied with thousands of cheap trees and told simply to plant them six feet apart. No special knowledge required. The results have been inevitable. There may be by now upwards of 75,000 acres of plantation in New England, most of it white pine. Because of poor stock carelessly handled and planted, or soil unsuitable for the species, or no account taken of competing vegetation, planting distance seldom considered,

excessive weevil damage, and above all, no check on forest weeds or discrimination between weeds and desirable components of the stand - because in fact the formation and care of a forest is not a simple problem, an appalling percentage of existing plantations are too poor to repay their cost.

The financial outcome of forestry is plainly the final test of its practice and progress as an industry. In this connection also the plantation complex has been a misleading influence. It has fixed the idea that forestry means a long deferred return, a wait of fifty years or more to get back both the investment and the possible profit. This conception naturally involves the figuring of compound interest on original costs and carrying charges. Thus, forestry presents itself financially not in its true form as a continuous business in which current expenses are met by periodic returns, but as something between a speculation and a savings bank account, with a tendency toward the former that is only partly neutralized by the worthiness of the cause. It is true that self-supporting or continuously profitable forests cannot be created over night, but there are many where this condition could be approached in varying degrees; and to have the nature and financial constitution of such enterprises continually obscured by the bugaboo of compound interest has been a real obstacle to progress.

All these objections, serious though they are, do not mean that the planting of pure stands of conifers, even of white pine, should be wholly discouraged. On the contrary, there is much true reforestation that should and must be done by planting, some of it even with white pine. The real objection is that from the standpoint of increased production and the promotion of practice, there are so many better ways of spending money and propaganda. There exists today reliable knowledge of New England forest conditions, of proven method in silviculture, of the marketability of products, which, if rightly interpreted, means a fundamental revision in the aims of forestry.

As alternatives to the pine planting policy - perhaps they should be called complements - three principal aims stand out. Taken together they make a concept of forestry which fits the present silvical and economic facts. In practice these involve policies which are interwoven and dependent.

First, mixed stands, either mixed hardwood or mixed softwood and hardwood.

Mixed stands, especially mixtures of hardwood or hardwood with softwood, tend to form and maintain fertile soil. In such stands, owing to rapidity of growth and natural pruning, the best quality of timber is produced, especially with softwood species. General forest sanitation is most effective, and insects and diseases are less likely to become epidemic. The original, pre-settlement forests were largely mixed hardwood with a varying element of softwood, and there is good reason to believe that only mixtures approach permanence of composition and health. Mixed stands are soundest from a business point of view: first, because they can most cheaply be established from growing stock now present on wild and cut-over land, either with the natural reproduction alone through weeding, or with natural reproduction and supplementary planting combined with weeding; and second, because the quality and variety of product make a safer investment. As regards the better species of hardwood, prices are already much higher than for low grade pine, and the indications are that for the next generation hardwood will be more valuable than softwood, being subject to less competition and more demand. In short, mixed stands are natural to the region, and they exist already - at least potentially - in a large percentage of young growth.

Second, development of the natural forest, both for its greater productiveness per dollar and as the only basis for early or sustained yields.

In Connecticut, Rhode Island, Massachusetts, and the southern halves of Vermont, New Hampshire and Maine, there are not less than 15,000,000 acres of woodland. This amounts to between 50% and 60% of the whole area, and at least 20% more than the region contained a hundred years ago. Three-quarters of this present forest began as cut-over land with the seedlings, mainly advance growth, of hardwoods that started under the previous stand, the sprouts from stumps, and some new reproduction, usually weed species that germinated at or near the time of cutting. The other quarter comprises the variable and more gradual replacement on old fields, most often white pine or gray birch, or mixtures of the two. Tens of thousands of these acres contain for the first few years the elements of a first class new forest, either of hardwood or hardwood and softwood. Hundreds of thousands are approaching an early and nearly worthless maturity through the increasing dominance of forest weeds and defective trees. In the middle and older stages of growth, through thinnings in the better stands, through more selective logging in mature or uneven-aged timber, much can be done to build up growth and forest capital and to enlarge income, both present and future; but as an alternative to planting, as a means of adding productive acres to the land, the early weeding of suitable immature wild stands will show two to four times the return per dollar.

Third, economic solutions, such as cooperative selling, forest owner associations, fairer taxation and market improvements.

Notwithstanding the blight of western overproduction, which only time can lift, and which has not helped to make the productive handling of our timberland more attractive, there are directions in which economic factors might be changed for the better. A sound theory of production and financin is indispensable. In the long run no industry can live which cannot pay its operating expenses and fixed charges out of income. A properly organized forest will meet this test, but the small unit of forest will seldom do so; the plantation, with its deferred return, never. A promising way

out, said to be already in successful operation in Finland, is through associations of owners for purposes of management and marketing. With a sufficient and convenient grouping of holdings and above all, under an able manager, there could certainly be secured more regular and frequent yields, lower costs, and more advantageous selling. The quality and hence the price of lumber could be raised, both immediately by more selective logging, and gradually by better silviculture. Such a plan would tend to put both production and financing on the only basis compatible with forestry namely, continuity. A similar point of view is needed for final solution of the tax difficulty, much of which arises from the false conception that forests are frozen assets, to be liquidated only at long intervals, and must consequently be subsidized by some form of exemption. If forests can be thought of and expected to be units of continuous or periodic yield, as ultimately they must be in fact, taxation will be greatly simplified. In the matter of markets also it is possible by concerted studies and better organized relations between producer groups and consumer groups to find ways of economizing in distribution, of more varied disposal of low grade products, and even of developing new uses for species not now in demand.

Broadly speaking, forestry must be faced both by the public authoritie and by the private owner as a genuine industry with the same technical, financial and economic requirements as any other. In other words, if the community is to become truly "forest-minded", it needs silviculture that will get the best production for a given expenditure, forest properties that will keep on producing, and the best possible adjustments to markets and utilization. As the principal item in the program, the planting of pine does not seem to fill the bill.

Resume of speech given before the
New England Research Council on
Marketing and Food Supply Dec. 7, 1928.

Prospects for Utilization of Land for Timber in New England

HARVARD FOREST LIBRARY

For both natural and economic reasons a large part of upland New England must come to be used for forest production. Leaving out the northern portions of Maine, New Hampshire, and Vermont, which are already devoted to wood production, chiefly for pulp, not less than one-third of the remaining area cannot be put to any other foreseeable use except the recreational, which is auxiliary to forestry. Already farm lands abandoned in 1840-60 have by natural reforestation yielded twelve billion feet of pine in the last thirty years. This represents a manufactured value of over $400,000,000., all distributed through local wood-working industries, principally in the smaller towns within the region itself. Thus a substantial portion of our present livelihood and industry is already dependent upon the use of the land (accidental though it has been) for timber growing. The loss of this item of production would probably mean a serious reduction of inland population.

Nature unaided will never reproduce this resource, because neither the areas favorable for seed nor the desirable seed itself are now available. Nevertheless, the technique of forestry already developed in New England is adequate to maintain the necessary timber whenever and wherever economic conditions justify the cost. During the period from just before until after the war it was possible in many localities to maintain timber production by forestry for less than the current net value on the stump. Lately a fall in the use and value of native lumber through competition of substitute products and of Western material has weakened the business incentive to forestry. Minor deterrents have been burdensome taxation, public ignorance of the methods of forestry, and the general belief that Nature will produce successive crops unaided. Forest production as a

going business can come only through changes in social and economic conditions. Taxation must be adapted to the financial status of forest enterprises. The inefficiency of small, scattered ownerships must be obviated by owner associations for management and selling. Most important of all, markets must be bettered through new uses or more outlets for by-products of native timber, especially softwood. With these favoring improvements the present regional business in lumber products of at least $25,000,000. annually might easily be doubled.

Written by Tom Gill and edited by R.T.F. for the Forestry Almanac Dec. 1928 for 1929 edition

HARVARD

The area longest devoted to the demonstration of forestry in the United States is the Harvard Forest, located at Petersham in northern Worcester County, Massachusetts. It comprises three separate tracts, totaling a little over 2100 acres, of which about 1900 are forest, and the rest swamp. ponds, and grassland.

This tract for the past twenty years has been under systematic management for the purpose of demonstrating methods of maintaining and promoting forest crops, ~~and~~ of furnishing information on the operating costs of organized forests, and as an experiment station for research in forest production and utilization.

Lying in a transition zone between the central hardwood region and the northern, the Harvard Forest contains species of both types. Of the northern species one finds ~~black~~ red spruce, beech, basswood, sugar maple, yellow birch, paper birch, red pine, and even an occasional balsom. Representatives of the central hardwood region are white oak, red maple, black birch, tupelo, sassafras, and pitch pine. The species of most importance are white pine, white ash, red oak, white birch, sugar maple, and hemlock.

Originally the Harvard Forest was a mixed and many-aged stand of hardwood and softwood. White pine and hemlock made up the bulk of the softwoods, the pine occurring as a very tall and scattering overstory. On the deeper soils the forest tended to become pure hardwood.

Most of this area was cleared for farms over 150 years ago and the land abandoned. Today, except for a few fragments of the original forest, the stand is second growth, about seventy-five years old, and practically all even-aged. At the time of acquisition in 1908 the Forest contained

ten million board feet, with an estimated annual growth of two hundred fifty thousand feet. Since then approximately four million board feet have been cut and the existing growing stock amounts to twelve million board feet. About four hundred thousand board feet are now cut annually.

The personnel of the Forest conducts every phase of the lumber and cordwood operations from stump to market. A resident superintendent and three men form the permanent crew. The original capital investment was $55,000., but liquidation of the property today would return more than twice that amount. A cost accounting system covering every important item of the business is regularly kept. The Forest is under the direction of Professor Richard T. Fisher, assisted by A. C. Cline.

With its present overhead the Forest is able to sell timber at a net profit of between two and four dollars per thousand board feet, and at the same time build up the working capital of timber and improve the condition of the stand. Yet the same personnel could handle a forest area four times the present size and greatly cut down unit costs for overhead.

For replanting blank areas the Forest maintains a nursery. About two hundred acres of open land, largely abandoned pasture and old field, are now nearly restocked by plantations of white pine, red pine, Norway spruce, Scotch pine and European larch.

The Forest has published a series of bulletins embodying the results of research and experience which are on sale by the Harvard University Press, Cambridge, Mass.

By RTF

THE MANAGEMENT OF THE HARVARD FOREST

Part II, 1920-1928

(The following are the principal purposes of this bulletin: to bring together all essential facts of historical, economic, or technical importance that have transpired since the last edition; to show by comparative figures and otherwise the physical progress made in the handling of the growing stock; and to display by photographs in series the most significant methods of handling typical forest conditions that have developed.)

Tentative Outline

1. Acquisition.

   Summary with dates of acquisition of property including changes by exchange or purchase and accessions other than the main tract.

2. Location and Area.

   This might include also more specific directions as to how to reach the several properties.

3. Physiography and Soil.

   In addition to the general material in the first edition, there might be added here an account of the principal basic soil types represented and their climatic relation to the general soil types of the Northeast.

4. Objects of Management.

   This should include besides a statement of the specific objectives of the Forest an analysis of its indirect value to the community in respect to recreation, wild life, and historical interest. This discussion would lead to a definition of restrictions and reserved areas and the reasons therefor.

5. History and Composition of the Forest.

This section might be substantially covered by the introductory matter in Bulletin 8. It should be made as full and accurate as possible in the light of developments since 1920.

6. Markets and Utilization.

Material under this head should cover not only the significant changes in marketing since the establishment of the Forest but a statement of conditions obtaining at present and their bearing on management.

7. Derivation and Development of Silvicultural Policy.

This is an interpretation of the whole history of management and derives from forest history, economic conditions, and lessons learned in handling the Forest. It should embody definitions of method as applied to all recognized cover types on the Forest. The approach to these statements might be made by summarizing the experience of 23 years with each of the several types.

8. Control of the Growing Stock; Regulation.

Control is principally by silvicultural objectives, economic and financial conditions, and current knowledge of volume, increment, and age distribution. A part of this discussion should be the best possible comparative figures for 1908 and 1928 of area by composition, changes in age groups, volume of growing stock, and increment. Most of this material might be displayed in tabular form.

9. Operating Methods: Logging, Milling, etc.

This section also should be treated to some extent historically and with some critical analysis of methods in general.

10. Accounting and Records.

An account of the skeleton set-up of Forest accounting and of the number and character of the records maintained at the Forest.

11. Costs and Returns.

In this connection it is to be remembered that specific costs applying to any particular operation or year are mis-

leading unless the controlling factors, such as man-hours and variations in the size and value of timber, are dealt with. A general statement might here be made showing the progress of the whole investment in relation to important ups and downs of market or character of operation.

12. Protection: Organization and Equipment.

This is an account not only of the measures taken by the Forest itself but also of contributing security from town and state.

13. Conduct of Research.

How the operating and experimental areas under observation and record combine with a development of special projects to build up a slowly clarifying system of technique in forestry and allied activities.

14. Publications.

Bibliography of bulletins and other articles dealing with work at Petersham.

15. Illustrations of Methods.

This section is to include the best possible series of pictures illustrating silvicultural methods in the woods. Each series is to represent a single type and operation covering a period of years with essential facts about silvical conditions, methods, and results embodied in the captions of the photographs.

Sent to Dr. Wheeler 1/2/29
for the Harvard Library
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8 V.

THE HARVARD FOREST

The Harvard Forest, as a demonstration tract and research laboratory, is the oldest of its kind in the United States. It was acquired in the autumn of 1907 through the generosity of Mr. John S. Ames of North Easton, Massachusetts, of the Class of 1901, who gave the money necessary for its purchase and an additional sum for the repair and outfitting of buildings. The land is situated in Petersham, Massachusetts, and about 1800 acres of it were previously owned by Mr. James W. Brooks. In order to perpetuate the forest and render it useful both to the town and the cause of forestry, Mr. Brooks offered it to the University for a price substantially below its estimated sale value. At the same time owners of adjoining land, Messrs. J. J. Higginson, Edwin C. Dexter, Joseph C. Smith, Henry S. Bennett, Charles S. Waldo, and William Simes, and Mr. Brooks himself, offered to give contiguous lots and holdings amounting to between 200 and 300 acres. These gifts simplified the boundaries, secured the approaches, and rounded out the areas to an aggregate of about 2100 acres. In addition, the Forest manages an adjoining tract of 250 acres belonging to the New England Box Company, on which joint experimental work is carried out. An important recent accession to the holdings of the Harvard Forest consists of a twenty acre tract of virgin white pine and hemlock situated in the town of Winchester, New Hampshire, and which is to be maintained as nearly as possible in its natural state forever.

The Harvard Forest lies on hilly country at an elevation varying from 800 to 1400 feet above sea level. It is divided into three blocks of 750, 800, and 550 acres each, which are located respectively northeast, northwest, and southeast of the village. The northeast block covers the slopes and surrounding areas of Prospect Hill. The northwest block includes the basin of a large pond and marsh, and the southeast block takes in about two miles of the valley of the Swift River, with a pond and small water power along its course. One of the blocks is included in a state wild life reservation

NEW ENGLAND FOREST HISTORY AND BIRD LIFE

Summary of Address by R. T. Fisher
delivered before the New England Bird
Banding Association, January 15, 1929.

We hear much nowadays of the evils of shooting, lawful and unlawful; but few people realize how profoundly the wild life of central New England has been affected by the changes in the character and extent of the forests which the two centuries of the white man's occupation have brought about. In this period there have been four prevailing phases. The first settlers of the inland towns found 80% - 90% of the region covered with virgin forest. By the end of the first century they had converted 50% - 60% of this area into farm and pasture. The abandonment of farms from 1840 to 1880 brought back natural second growth, much of it pure white pine, to cover nearly three-quarters of the land again with forests. Now in the last forty years lumbering and increasing fires have, without reducing its area, converted this woodland into a wilderness of small and inferior hardwood stands. Each of these four phases, occurring at its peak in millions of acres, involved special conditions of cover and food supply.

The original forest was mixed hardwood and softwood, from large trees two to four hundred years old to small seedlings. It was rich in variety of species, both trees, shrubs, and small plants, and varied with dead snags and down logs. It was the most stable and complex of all the four environments under consideration. Most significant of all, it was almost devoid of the smaller short-lived tree species that feature our landscape today, gray birch, aspen, fire cherry, scrub oak, hawthorn, wild apple, etc. Probably wood warblers, creepers, nuthatches, woodpeckers especially the pileated, owls, and some thrushes outnumbered the birds of the open and woodland margins. Both partridge and woodcock must have been much more localized than today and uncommon over immense areas. Converting old forest by the million acres (1730-1830) must have enormously increased

the grass and ground birds, bobolinks, larks, buntings, some species of hawk, and probably quail and upland plover. Conversely, the birds of the big woods and the larger carnivores, fell off greatly in range and abundance. When with the decline of farming from 1840 on the land reverted to second growth pine, birch and alder runs, berry and thorn apple thickets, also on a tremendous scale, birds of the open decreased and some of the forest species, such as the hermit thrush, extended their range. From 1870 to 1900 before the motor car made all covers handy for increasing thousands of guns, there developed the greatest area of ideal cover and feed for partridge and woodcock known in our history, and both these species probably reached greater numbers than before or since.

But as the second growth pine became merchantable, it began to be lumbered to replace the vanishing old stands. Since 1895 from land formerly field and pasture, twelve billion feet of lumber with a value of $400,000,000 have been cut in Massachusetts, New Hampshire, and southern Maine. On this gratuitous crop a great population has been supported, but the industry is dwindling and a new forest environment of infinitely less economic value and probably the least favorable to wild life that the region has known is being created in immense areas. Logging, fires, and the absence of any effective forestry have steadily depleted or enfeebled the better species of tree, and have multiplied a thousand fold the forest weeds, gray birch, poplar, pin cherry, red maple, etc.; and although we now have 60% of our area nominally in woodland, it is mostly monotonous stands of small sprout hardwood, poor in variety of feed, unfavorable as to cover, and abnormally susceptible to insects and disease.

This change has certainly much reduced the area of what we know as good partridge cover, and is probably in part responsible for the decline of the species. This is indirectly supported by the case of the woodcock, which has locally at least maintained or increased its numbers. On the better soil the change from pine to hardwood by stimulating the decay of leaf litter

brings in earth worms, and the woodcock now breeds on many areas where formerly it would not stop.

In general, however, it is plain that in our increasing thousands of acres of impoverished hardwood, much bird life, both of forest and field, cannot flourish, no matter how well protected. It may be said that our treatment of the wilderness has been temporarily or economically expedient, at least for the many communities and localities which have profited by the free timber of natural origin; but in the long run and for the region as a whole, our policy has proved thoroughly bad, no less for wild life than for timber production. If game and the bird population are to serve their necessary function in the sport, agriculture, and forestry of the future, the importance of the forest environment must be definitely recognized in the scheme of management.

The Sportsman, March 1929.

OUR WILD LIFE AND THE CHANGING FOREST

R. T. FISHER
Director of the Harvard Forest

In the course of agitation for game conservation we hear much about the effects of shooting, vermin, and disease, and little about the ups and downs of the habitats, of the immense changes in the ratio between forest and field and in the kinds of trees and shrubs which were plentiful or scarce at different periods of our history. In twenty years' experience at the Harvard Forest, we have had an opportunity not only to see what happens on particular areas with gradual or complete change in the kind of forest, but also to piece together a pretty authentic picture of what has happened to the habitats of central New England in the two hundred years of the white man's occupation.

In this period there have been four dominant phases of cover or types of forest vegetation. The first settlers of the inland towns found eighty to ninety per cent of the region covered with virgin forest. By the end of the first century they had converted fifty or sixty per cent of this area into farm and pasture. The abandonment of farms from 1840 to 1880 brought back natural second growth, much of it pure white pine, which, with the remains of the original forest, restored nearly three quarters of the land to forest. Now in the last forty years lumbering and increasing fires have, without reducing its area, converted this woodland into a wilderness of small and ultimately inferior hardwood stands. Each of these four phases involved special conditions of cover and food supply.

The original forest was mixed hardwood and softwood, from large trees two to four hundred years old to small seedlings. It was rich in variety of species, - trees, shrubs, and small plants - and varied

with dead snags and down logs. It was the most stable and complex of all the four environments under consideration. Most significant of all, it was almost devoid of the smaller short-lived tree species that feature our landscape today, such as gray birch, aspen, fire cherry, scrub oak, hawthorn, and wild apple. Probably wood warblers, creepers, nuthatches, woodpeckers, - especially the pileated - owls, and some thrushes outnumbered the birds of the open and woodland margins. Both partridge and woodcock must have been much more localized than today and uncommon over immense areas. Converting old forest by the million acres (1730 to 1830) must have enormously increased the grass and ground birds - bobolinks, larks, buntings, some species of hawk, and probably quail and upland plover. Conversely, the birds of the big woods and the larger carnivores fell off greatly in range and abundance. When, with the decline of farming from 1840 on, the land reverted to second-growth pine, birch, and alder runs, berry and thorn-apple thickets, also on a vast scale, birds of the open decreased and some of the forest species, such as the hermit thrush, extended their range. From 1870 to 1900, before the advent of the motor car, there developed the greatest area of ideal cover and feed for partridge and woodcock known in our history, and both of these species probably reached greater numbers than before or since.

But as the second-growth pine became merchantable, it began to be lumbered to replace the vanishing old stands. Since 1895, from land formerly field and pasture, twelve billion feet of lumber with a value of $400,000,000 have been cut in Massachusetts, New Hampshire, and southern Maine. On this gratuitous crop a great population has been supported; but pine timber is dwindling and a new forest environment of infinitely less economic value, and probably the least favorable to wild life that the region has known, is being created in immense areas. Logging, fires, and the absence of any effective

forestry have steadily depleted or enfeebled the better species of trees and have multiplied a thousandfold the forest weeds - gray birch, poplar, pin cherry, red maple, and so on. And although we now have sixty per cent of our area nominally in woodland, it is tending more and more to monotonous stands of small-sprout hardwood, unfavorable as to cover and abnormally susceptible to insects and disease.

The evolution of each of these two last types of cover, the pine and the subsequent hardwood, indicates that the transition has a bearing on the relative numbers of the partridge and the woodcock, to mention the most conspicuous of the many species affected. The pine wood developed on old fields and pastures, together with more or less hawthorn, running blackberry, viburnum, blueberry, apple trees, and birches. The process of change from shrubby field to forest was gradual, and during the first twenty to thirty years the combination of vegetation was ideal for the partridge - increasing shelter, varied food plants, and open dusting places. From then on the pine rapidly closed up and most of the food plants, even the old apple trees, were killed out. Since the bulk of the pine woodlands reached this condition twenty to thirty years ago, the favorable cover was reduced to the margins where the pine gave way to brushy openings or the birch thickets more characteristic of recently abandoned fields. Thus there was going on a progressive reduction in good cover even before the logging activities of the last generation.

But if the maturing and removal of the old field pine has deprived the partridge of more and more of his best habitat, the process has, in many cases, accomplished the opposite for the woodcock. It has been shown at the Harvard Forest that under certain conditions the change from pine to hardwood is accompanied by a remarkable alteration in soil. Under a pine wood there is progressive accumulation

of leaf litter, often to a depth of four or five inches, in which decay is very slow and acidity high. With the change to certain species of hardwood, if the situation is not too wet or too dry, the original bed of leaf litter disappears in from fifteen to twenty years, the current fall of hardwood leaves decays almost annually, and the resulting fine humus merges with the mineral soil, sometimes to a depth of ten inches or more. There results a rich brown loam in which earthworms are characteristically abundant. On all such areas at Petersham, once the new forest has begun to close up, breeding woodcock have appeared in numbers, so that in the season of 1928, for example, there were apparently four pairs on a total area of forty acres where a yew years ago no woodcock were seen at any season. This transformation is not universal, but apparently confined to certain combinations of sites and tree species. In sum total, however, the change has taken place in favorable spots over wide areas. Thus, there would seem to be reason for the recent abundance of woodcock in northeastern covers.

It is a fair conclusion that such immense and successive disturbances of environment as man has wrought, involving indispensable factors of food and cover, bring about enormous fluctuations in wild life, regardless of shooting, vermin, or disease. If this is true, the corollary is that types of favorable cover must be recognized and maintained in sufficient areas. This, however, is not a simple matter. Practically all of our present woodland is in a state of transition, one type of vegetation giving way to another, often without much outward or visible alteration; and when fire or the usual cuttings occur, a tendency is started in a new and worse direction. A sanctuary or shooting area, for example, may lose the bulk of its food plants in a period of ten years merely with an increase in the size and density of the trees. Some areas like the present

impoverished hardwood sprout land are quite useless.

This is why forestry and game conservation must work together. For economic reasons the main objective of forestry in New England is to convert the present poor stands of forest weeds into good ones of valuable species; and though the trees and vegetation desirable for the needs of game may be different, the technique requires the same kind of knowledge and skill.

Written to be presented at the meeting of the Social Science Research Council committee on March 14, 1929

PLAN FOR RESEARCH IN THE UTILIZATION OF NEW ENGLAND PINE

Revised in May 1929 See So. Sci. Res. Com.

For fifty years the pine timber of central New England has been the critical factor in the livelihood of the rural population, and very nearly so in scores of small towns. The pine woodlots have saved farming from complete abandonment. It is pine and its value in existing industries which has furnished the chief incentive for all regional forestry. It is pine or other desirable timber which is the only possible crop for thirty to forty per cent of the land in southern New Hampshire, southern Maine, interior Massachusetts, and northern Connecticut.

The industries which have chiefly created this value, manufacturies of boxes, crates, woodenware, etc., have used twelve billion feet of pine in the last twenty-five years, with a manufactured value of $400,000,000., nearly half of which has gone to the small communities in which the timber originated. In the last ten years these industries, with the local lumber business incidental to them, have suffered a serious decline. Among the factors responsible are: increasing competition by substitute materials for containers, fiber, veneer, metal; inefficient marketing and adaptation of product to changing demands, partly due to the small size and dispersal of units of production; cheap Western lumber, displacing the better grades of native; costly transportation, due to unfavorable freight rates and manufacture too far from the source of lumber. The present results are a larger percentage of waste, both in woods and shop (up to sixty per cent of the tree); too small profit in the main product with no substantial development of new uses or enlargement of by-products to offset the decline.

With timber the principal resource and the only one adapted to a large percentage of the soil and social structure, maintenance of the value of pine is indispensable to the prosperity of the region. To meet this

situation requires, on behalf of hundreds of small industrial units and thousands of mill men, land owners, and laborers, the kind of organized research in the merchandising of materials which has been carried on in their own industries by the General Electric Company and the Du Pont companies. In preparation for this report there have been conferences with leading men among box manufacturers, woodenware companies, lumber producers, the New Hampshire Lumbermen's Association, federal and local foresters, and Professors Copeland, Cunningham, and MacNair of the Harvard Business School. Among these the opinion is practically unanimous that the prime need for research is in utilization, and that under the present conditions there is hope of real accomplishment in this direction. The present recommendation may therefore be taken to have the active approval and support of the principal trade and professional groups that would be concerned.

Definition of Project. The major part of the study should consist of direct research for extending the uses of pine. This will require five years' work and a fund of $50,000 annually. The plan involves, first, thorough analysis of existing uses and outlets, especially by-products and waste, with a view to determining such enlargements or combinations as the market may absorb or the facilities for assembly of material may admit; second, direct experimental work, involving the use of technical experts to discover possible new chemical or mechanical derivatives that may be expected to have adequate consumption. These being the main objects, it will be necessary to deal also, as incidental and as the need develops, with transportation, comparative rates on raw material and finished product, both by rail and truck; with markets and selling methods; and with conditions of land management and timber production. Work under the last three items would not cover the whole five year period, but each would be taken up for perhaps a year at a time.

Direction and Control of the Study. It is proposed that the investigation should be supervised and controlled by a committee of three, consisting of the Director of the Harvard Bureau of Business Research, Professor MacNair; Professor Melvin Copeland, Professor of Marketing; and R. T. Fisher, Director of the Harvard Forest. This committee would decide upon the plan of work, select the technical personnel, approve the expenditures, and direct the final assembly and use of results. In addition, there will be an advisory committee of five members, representing the principal industries or interests involved, such as the New Hampshire Lumbermen's Association, the Box Manufacturers' Association, the Woodenware Manufacturers' Association, and the New England Section of the Society of American Foresters. The function of this committee will be to meet periodically with the managing committee and to facilitate the securing of trade information, to provide means for experimental work in suitable factories, and to assume responsibility for desirable educational activities among the industries. As active head of the study a first class man must be secured, preferably from outside the special industries concerned, but with imagination and well versed in the fundamental principles of markets and merchandising. Such a man will cost from six to eight thousand dollars a year. He should have for assistants not only field men competent to assemble the necessary facts about existing utilization, but also one or more chemical experts such as might be secured from the U. S. Forest Products Laboratory or a concern such as A. D. Little & Company of Cambridge. On the minor phases of the study, such as transportation and marketing problems, there will undoubtedly be men from the University, either graduate students at the Harvard Forest or Business School, or other assistants, who could be assigned to this sort of work. From the conferences already held, it is certain that the organization here proposed will have the active help and cooperation of all the interests involved.

The research herewith proposed is widely recognized to be not only a matter of vital concern to the region, but also especially timely. Practically all the business, educational, and public agencies of the region are increasingly concerned with the industrial and social aspects of the native lumber business. All of these groups are in a mood to cooperate wholeheartedly, but so far both the means and the initiative have been insufficient to bring about any constructive action.

Please return to
R. G. Fisher
Boston Mass

PLAN FOR RESEARCH IN THE UTILIZATION

OF NEW ENGLAND PINE

May 1929

Business Research Advisory Committee

Social Science Research Council

PLAN FOR RESEARCH IN THE UTILIZATION OF NEW ENGLAND PINE

Conditions in the Pine-using Industries

For fifty years the pine timber of central New England has been the critical factor in the livelihood of the rural population, and very nearly so in scores of small towns. The pine woodlots have saved farming from complete abandonment. It is pine and its value in existing industries which has furnished the chief incentive for all regional forestry. It is pine or other desirable timber which is the only possible crop for thirty to forty per cent of the land in southern New Hampshire, southern Maine, interior Massachusetts, and northern Connecticut.

The industries which have chiefly created this value, manufacturies of boxes, crates, woodenware, etc. have used twelve billion feet of pine in the last twenty-five years, with a manufactured value of $400,000,000., nearly half of which has gone to the small communities in which the timber originated. In the last ten years these industries, with the local lumber business incidental to them, have suffered a serious decline. Among the factors responsible are: increasing competition by substitute materials for containers, fiber, veneer, metal; inefficiency in marketing and adaptation of product to changing demands, partly due to the small size and dispersal of units of production; cheap Western lumber, displacing the better grades of native; costly transportation, due to unfavorable freight rates and manufacture too far from the source of lumber. The present results are a larger percentage of waste, both in woods and shop (up to sixty per cent of the tree); too small profit in the main product with no substantial development of new uses or enlargement of by-products to offset the decline.

With timber the principal resource and the only one adapted to a large percentage of the soil and social structure, maintenance of the

value of pine is of vital importance to the prosperity of the region. To meet this situation requires, on behalf of hundreds of small industrial units and thousands of mill men, land owners, and laborers, the kind of organized research in the merchandising of materials which has been carried on in their own industries by the General Electric Company and the Du Pont companies.

In preparation for this report there have been conferences with leading men among box manufacturers, woodenware companies, lumber producers, the New Hampshire Lumbermen's Association, federal and local foresters, and Professors Copeland, Cunningham, and MacNair of the Harvard Business School. Among these the opinion is practically unanimous that the prime need for research is in utilization and marketing, and that under the present conditions there is hope of real accomplishment in this direction.

Practically all the business, educational, and public agencies of the region are increasingly concerned with the industrial and social aspects of the native lumber business. All of these groups are in a mood to cooperate wholeheartedly, but so far both the means and the initiative have been insufficient to bring about any constructive action.

More important still is the fact that the study should have more than a local significance. By virtue of its greater age and peculiar economic history, New England has been the first section of the country to develop substantial wood-working industries using second growth - and some man grown - as opposed to original virgin timber. Nowhere else has the necessary economic basis for continuous forest production and permanent tributary manufacturies been so nearly established. In fact, in a few specially favorable localities it has already come to pass. With assurance of an enduring market for the product, the needed readjustments and permanencies in manufacture and distribution would follow. So far the lumber production of the country has been migratory, with destructive exploita-

tion followed by abandonment and sterility. But phases analogous to the New England situation are already developing, notably in the South and Lake States; and with New England as a laboratory, the means which may be worked out for linking forest and factory, country and town, in a joint prosperity will have an increasing national application.

Definition of Project

For conclusive results this study should require a period of five years. It is proposed to devote the first year to a comprehensive analysis and summary of the industrial and economic status of existing pine industries. It is only with this information in hand that decision can wisely be made as to the directions in which further, more constructive investigation can be developed. Thus the present schedule defines only the work of the first year, leaving the details of projects for subsequent undertaking to be developed by the managing and advisory committees from a study of the first year's findings.

Outline of Study

First Year

The first year's program should include the following four divisions:

1. Assembly of available published data on pine and competitive products for the purpose of analyzing current trends.

   This would include publications of the Department of Commerce, U. S. Forest Service, state forestry departments, forest research agencies, and trade associations.

2. An estimate of the present and future supply of pine.

   Information under this head can be secured in part from state foresters and industrial timberland owners, and in part from a survey of timber resources which the Forest Service is about to undertake.

3. Industrial survey of pine production and manufacturing. (For detailed outline, see Annex)

   This will constitute the major part of the year's work and will cover boxes, woodenware, lumber, matches, toys, and minor uses. The following are the major items for analysis:

Lumber production and purchase

Organization and administration

Financing

Analysis of operating statements and balance sheets

Manufacturing

Markets and merchandising

4. Intensive study of particular plants.

This will be undertaken as and when the general survey discloses cases which appear to be significant with respect to improved methods of production, more complete utilization, more efficient marketing, and so forth.

Second to Fifth Year

The following are the probable fields for study after the general analysis of the first year:

Development of new uses for by-products

Potential consumption for new and existing products and for present substitutes

Reduction of production costs through
Regrouping of manufacturing units
Assembly or finishing plants for rough lumber
Local organizing of timber units
Elimination of freight on waste, etc.

Salvage of woods waste, limb wood, etc.

Favorable combination of major uses with by-products

Mergers or combinations of similar manufacturies

Continuing statistical service within the industries

Direction and Control of the Study

It is proposed that the investigation should be supervised and controlled by a committee of three, consisting of the Director of the Harvard Bureau of Business Research, Professor MacNair; Professor Melvin Copeland, Professor of Marketing; and R. T. Fisher, Director of the Harvard Forest. This committee would decide upon and supervise the plan of work, select the technical personnel, approve the expenditures, and

direct the final assembly and presentation of results. In addition, there will be an advisory committee representing the principal industries or interests involved, such as the New Hampshire Lumbermen's Association, the Box Manufacturers' Association, the Woodenware Manufacturers' Association, the New England Section of the Society of American Foresters, and such other specialists as may seem desirable. The function of this committee will be to meet periodically with the managing committee and to facilitate the securing of trade information, to provide means for experimental work in suitable factories, and to assume responsibility for desirable educational activities among the industries.

As active head of the study a first class man must be secured, preferably from outside the special industries concerned, but with imagination and well versed in the fundamental principles of marketing and merchandising. He should have as assistants competent field men with the necessary clerical and office assistance. After the first year some or all of the field men would be replaced by specialists competent in the chosen problems of utilization.

Budget for the Five Year Period

	1st Year	2nd Year	3rd Year	4th Year	5th Ye
Managing Director	$6,000.	$6,000.	$6,000.	$6,000.	$6,00
Field Assistants	(4) 12,000.	(2)4,000.	(1)3,000.	(1)3,000.	(1)3,00
Technical Advisors or Assistants	----	10,000.	10,000.	10,000.	10,00
Expenses of Laboratory or Factory Test		3,000.	5,000.	5,000.	5,00
Secretary to Director	2,000.	2,000.	2,000.	2,000.	2,00
Clerical, Statistical, and Tabulating Assistance	4,000.	2,000.	2,000.	2,000.	2,00
Supplies, Equipment, etc.	500.	500.	500.	500.	50
Travel	5,000.	5,000.	5,000.	5,000.	5,00
Contingent	5,000.	5,000.	5,000.	5,000.	5,00
	$34,500.	$37,500.	$38,500.	$38,500.	$38,5

Total, $187,500.

ANNEX

Preliminary Schedule for Industrial Survey (3rd Division)

Lumber Production and Purchases

A. Stumpage owned or bought currently

B. How operated

1. By contract

2. By own mills

C. Lumber bought in open market

1. Native, or

2. Extraregional

D. Footage used annually

1. Prices

2. Radius of buying

3. Freight charges

4. Inventory carried

5. Seasoning

a. air dried, or

b. Kiln dried

E. Independent sawmills, operation in relation to

1. Quality of lumber

2. Transportation

3. Seasoning, etc.

F. Assembly or finishing plants

1. Extent of sorting or grading for resale

2. Recent improvements in sawmill or woods manufacture

G. Suggested improvements in relations of timber owners, mills, transportation, and factories

Organization and Administration

A. For individual plants, organization charts covering departments of woods, factory, office, and sales

B. Existing combinations of plants

C. Trade association activities

Financing

A. General financial structure

1. Corporation, partnership, proprietorship

2. Common stock, preferred stock, bonds

B. Capital investment

C. Banking affiliations

D. Extent of current bank borrowings

E. Financial relations with brokers or commission men

F. Credit terms

G. Ratio of collections to outstandings

Condensed Profit and Loss Statement and Balance Sheet

Name of Company . . . . . .

Street . . . . . City & State . . . . . .

General Type of Business Engaged in . . . . . .

NET SALES, 1928		$.....
Inventory of lumber and other manufacturing materials at beginning of year	$.....	
Add		
Purchases of lumber and other manufacturing materials, including transportation costs	.....	$.....
Deduct		
Inventory of lumber and other manufacturing materials at end of year		.....
Net cost of purchases		$.....
Add		
Yard and handling expense		.....
Total cost of purchases		$.....

NET SALES (brought forward)			$.....
Total cost of purchases (brought forward)		$.....	
COST OF MANUFACTURING			
Net inventory of goods in process and finished products at beginning of year	$.....		
Add			
Direct mill labor-manufacturing	.....		
Direct mill labor - making up	.....		
Manufacturing overhead	.....		
Gross cost of manufacturing	$.....		
Deduct			
Inventory of goods in process and finished products at end of year	.....		
Net cost of manufacturing		.....	
Total product costs			.....
MANUFACTURING MARGIN			$.....
Shipping and delivery expense		.....	
Selling expense			
Wages of salesforce	$.....		
Commissions	.....		
Travelling expense	.....		
Advertising	.....		
Other selling expense	.....		
Total selling expense		.....	
Administrative expense			
Executive salaries	$.....		
Office salaries	.....		
Office supplies, postage, stationery, telephone, and telegraph	.....		
Interest on borrowed capital	.....		
Other administrative expense	.....		
Total administrative expense		.....	
Losses from bad debts		.....	
Miscellaneous expense		.....	
TOTAL EXPENSE			.....
OPERATING NET PROFIT OR LOSS			$.....
Add			
Cash discounts taken on purchases			.....
BUSINESS PROFIT OR LOSS			$.....

Financial Statement

ASSETS		LIABILITIES	
Cash	$.....	Notes payable	$.....
Notes Receivable	.....	Accounts payable	.....
Accounts Receivable	.....	Common and preferred stock	.....
Inventories	.....	Surplus	.....
Prepaid items	.....		
Plant, less depreciation	.....		
TOTAL ASSETS	$.....	TOTAL LIABILITIES	$.....

Number of active partners or executives in 1928 .....

Total amount charged as expense for salary or proprietor, partners, or executives $.....

Is property occupied by business owned? .... Leased? ....
If leased, what was annual rent paid in 1928? $.....

Total number of employees (including executives listed above) .....

Manufacturing

A. Volume of production

1. Footage

2. Dollars

B. Classes of product

1. Sale of each

2. Extent of seasonal fluctuation

3. Ease of forecasting sales

C. Prices and price trends

D. By-products

1. Waste

2. Waste recoveries

E. Recent changes in products as to

1. Relative volume in sales of each class

2. Changes in design or construction

3. Making to order or for stock

F. Employees

1. Number

2. Wage payment

a. piece work, or

b. time

G. Power

1. Water

2. Steam

3. Electricity

Markets and Merchandising

A. Types of consumer

B. Geographical scope of market area

C. Regional concentration and limiting factors

D. Sales channels

1. Direct sales

2. Commission agent or broker

3. Jobber

E. Salesmen

1. Number

2. Allotted by

a. territory

b. Industry

3. Reports

a. type

b. frequency

4. Frequency of call

5. Method of payment

F. Branch offices

G. Sales promotion

1. Individual advertising

2. Association advertising

3. Other means

4. Service in design or adaptation to fit customers' needs

a. salesmen's suggestions

b. special department

H. Bases of competition

1. Price

2. Quality

3. Design

4. Promptness of service

I. Shift of customers to other materials or products and why

1. Names of important customers lost

2. Commonest complaints

3. Canvass of consumers (active and lost) as to reasons for change

a. customers' requirements

b. specifications

c. buying reasons

J. Competition

1. With similar products and with substitutes

2. By competitors within and outside the region

K. Prices

1. How established and quoted

2. Discounts: trade, quantity, cash

L. Actual and potential consumption of existing by-products

1. Suggestions for new uses or combinations of existing uses

2. New types of customer recently developed

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May 1931

NEW ENGLAND FORESTS

Biological Factors

by

R. T. FISHER

NEW ENGLAND FORESTS

The Original Climax Forest

When the first settlements began to be established on our coast, very early in the seventeenth century, New England was almost entirely forested region. The accompanying map indicates the general composition and distribution of the tree species originally characteristic of the district. Broadly speaking, the occurrence of these regional units of forest is governed by the climate, physiography, and soils. Thus northern New England was in the main covered with spruce and fir and the so-called northern hardwoods: beech, yellow and white birch, and sugar maple. Southern New England was mainly dominated by a large variety of hardwood species more characteristic of the Middle States, in which a number of species of oak and hickory predominated. Between these two extremes was a large more or less transitional area, roughly described as "Central New England", where white pine and hemlock mingled in varying proportions both with species characteristic of the adjacent regions to the north and south and with certain others, such as red oak and white ash, not originally so abundant in either. None of these regional units was sharply distinct, but each exhibited extensions due to the effect of elevation or of fundamental soil composition upon climate and moisture. Thus the northern forest is found extending well down into Berkshire and Hampshire Counties in Massachusetts, along the higher elevations of the Berkshire Hills, and in a few elevated spots in Worcester County. Similarly the oak forests of southern New England came north for a considerable distance into the lowlands of southeastern Massachusetts and up the Connecticut River valley. Cape Cod, almost a climatic and geological unit by itself, bore a forest principally of pine and oak.

In size and outward appearance these so-called original forests were in marked contrast to most of the woods of today. ~~For the most~~ In the main part the stands were mixed, often containing a great variety of species of many sizes and ages. If we disregard ~~for the moment~~ extremes of situation — such as mountain summits, sand plains, or swamps — and consider only the preponderance of area where temperature and moisture were not subject to wide variations, the life history of these forests, whether in the north or south, was much the same. Over central New England, for example, one may picture a forest in which broad-leaved trees and hemlock formed a dense stand from eighty to one hundred feet high, above which, either by small groups or single trees and varying greatly in abundance, white pines reached a height of 150 feet or more. It is generally believed that such a forest was self-maintaining, in other words that the losses through old age or injury were recruited from younger and smaller trees gradually developing underneath so that over periods of centuries and on the average the representation of species remained approximately the same, and the general size and appearance of the forest was unchanged. This condition of equilibrium is what is generally called a "climax forest". It means that if the stand is truly self-maintaining, all of the species represented are long-lived and more or less capable of reproducing and surviving for long periods under the heavy shade and prolonged suppression of the larger trees.

Physiological Changes in the Climax Forests

It is a popular if not a scientific idea that the primeval forest was almost as changeless as the hills. If the ordinary physical factors of temperature, rainfall, and the other manifestations of climate were ~~truly~~ regular in their operation and not complicated either by exceptional changes or by the influence of man, as on sheltered sites with deep soils, some forests might indeed remain unchanged for indefinite

centuries. If, however, we study — as has recently been done (1) — the detailed records of life history in such original forests as still remain, we find evidence, even with no human factors in operation but the aboriginal Indian, that there must have been over long periods important changes in the distribution of species and the character of the forests within each of our climatic regions. Undoubtedly forest fires are more prevalent and destructive today than when the Pilgrims landed; but there is convincing evidence that everywhere fires were of periodic occurrence both from the practice of the Indians and occasionally from lightning. The principal difference between the aboriginal forest fires and those of today was that the earlier fires were probably less destructive in the larger woods and less prone to cover big ~~areas~~ tracts in a single burn. In addition to fires ~~it~~ is ~~only~~ necessary to consider longer stretches of time, such as centuries or more, to find unmistakable signs of other destructive agencies; ~~such as~~ windthrow, generally occurring on uplands or exposed ridges and often prostrating large areas of trees; lightning, which sometimes kills a dozen or fifteen trees with one bolt; ice storms, shattering many acres of tree tops; and perhaps, Probably in the wake of these, ~~influences~~ fluctuating attacks from injurious forest insects or disease. ~~In fact, then,~~ It is likely that especially on drier and more exposed sites such periodic calamities as these, upsetting for a time and sometimes over large areas the equilibrium between local climate and soils and the natural requirements of tree species, ~~have been~~ were collectively the most powerful influence governing pre-Colonial forest history. ~~It is probable, for example, that~~ Without the recurrence of fires we should not have had the heavy forests of pine in central New England reported in some localities by the early settlers. It is likely also that without these periodic upsets providing breaks and exposures in the ancient forests, many of our short-lived, light-seeded

Please supply bibliographical reference to these studies, if published reports exist.

(1) Pisgah Life History etc.

species such as gray birch, pin cherry, and aspen would have been even more rare and restricted in distribution than in the original forest they actually were. ~~As~~ in the early forests as traversed by the pioneers, while areas of big timber certainly predominated, there must also have occurred many areas where reversions to younger woods or shorter-lived species were in progress. As a background for the study and understanding of forest succession and growth, and for interpreting the many and varied forms of degeneration which have followed settlement and development, the original or climax forest is invaluable. It is unfortunate for scientific as well as economic reasons that today less than five per cent of existing forests date back to the settlement of New England.

To understand what has happened to ~~this~~ the remaining ninety-five per cent of our original forest area, it is necessary to trace the progress of the use of land down to the present day.(2) In such a complicated development only the major tendencies may be touched upon. As regards ultimate effect upon the forest, we may almost disregard the century from 1600 to 1700. This was in the main a period of pioneering. For the most part the settlements and clearings, at first mainly for agricultural purposes, were confined to coastal strips of a few leagues in width or to the bottom lands of important rivers, like the Connecticut. Aside from the initial clearing, such timber as was used and the little which was exported was culled at convenient distances from the sea or along the principal rivers. Furthermore, much of the land thus cut or cleared has continued to be devoted to agricultural, industrial, or residential uses and may ~~thus~~ be omitted from consideration of forest history in general. ~~Thus~~ The bulk of the forest area, however, did not begin to be seriously altered until the early eighteenth century with the settlement and gradual development of the interior.

1 See R. N. Harper, "Changes in the Forest Area of New England in Post Centuries," Journal of Forestry, Vol. 16, 1918, pp. 442-452

In the forest history of the last two hundred years we may distinguish two main types of land use: farming and lumbering. Although at the start and in the typical small community of the eighteenth century the two forms of use were combined, the lumber business as it became better organized spread into the wilder portions of Maine, New Hampshire, and Vermont, where farming was difficult or impossible. We may thus for simplicity consider ~~central~~ southern New England, including roughly the area south of central New Hampshire, southern Maine, and southern Vermont, as a region primarily affected by agricultural settlement and the rest of the region, in general the wilder, colder, and more mountainous parts, as a district affected largely if not exclusively by lumbering. Each of these two main types of land use has had a profound effect upon the character and productiveness of the forests of today.

Forest History of the Farming District

In the farming district practically the entire area came to be covered by organized towns, most of them settled and incorporated during the first half of the eighteenth century. A steadily increasing area was cleared for crops or grazing, and the remainder of the original forest was utilized little by little for lumber and building material, generally used locally and manufactured in the small water mills which were common in every town. Early census figures for Worcester County, Massachusetts,(3) whose history is ~~probably~~ typical of most of the region, show that the percentage of cleared land rose steadily until about 1830, and at its maximum included from fifty-five to sixty-five per cent of the total land area, exclusive of ponds, swamps, etc.

About 1850 with the opening of the West, the development of the principal railroads, and soon afterward with the drain of the Civil War, ~~the process of~~ land abandonment set in in earnest. For a time the effect

(3) Decadal Census of Worcester &c.

upon the area in farms was partly neutralized by the clearing of new land hitherto in forest; but the decline has continued down to the present day so that nearly seven million acres were thus left to revert to nature between 1880 and 1925. From 1850 on, while New England farming and farming populations were rapidly declining, the old fields and pastures were seeding up to new forest, much of it pure stands of white pine. Meanwhile as the local supplies of original forest disappeared, woodworking industries, originating in the early towns and gradually developing with the improvement of markets and transportation, began to use these second growth forests, many of which by 1890 had reached merchantable size. From that date to 1925, for wooden boxes and woodenware alone, fifteen billion feet of pine lumber have been cut, over eighty per cent of which originated on old farms abandoned since 1845.(4) At a fair average yield per acre of 10,000 feet, taking good stands with poor, this is equivalent to one and one-half million acres and represents a manufactured value of not less than four hundred million dollars. More than half of this immense sum went to the populations of the towns where the timber grew, an unearned income which in many communities has gone far to keep the remaining farms alive.

Now that the use of old field timber has been in progress for more than a generation, still a third phase of land use, or, perhaps more properly, disuse, is well advanced, namely, an immense and increasing extent of cut-over area, ~~most~~ much of it covered with comparatively worthless stands of inferior hardwoods or underbrush, and much of it a frequent prey to forest fire. At the same time, especially in southern New England where hardwood forests predominated, great areas which had not been cleared for farms but which were periodically cut for local wood supplies became more and more degenerate in composition and vigor through the drain of repeated sprouting from the same stumps with less and less

(4) Study of Box industry &c. Survey of 7 Towns &c.

renewals by new seedlings. Today the amount of area only to be classed as woodland in the upland farming districts of New England, is at least sixty per cent, or a little more than what it was a hundred years ago. Nature has produced a second crop of timber; but according to any present or foreseeable use, the third crop is a liability rather than an asset.

Forest History of the Lumbering District

If now we consider the history of forests in the northern or lumbering district, we find a similar but less rapid decline in value and productiveness. In the earlier days of lumbering, especially in the state of Maine, only the larger, better trees were cut, at first white pine and later, as pine became exhausted about 1870, spruce, which was for a long time the principal building material in New England. Later with the development of modern sawmills and more efficient logging methods the forests were cut more heavily. Always there has been a steady reduction in the better species of timber trees, and though the earlier partial cuttings had a tendency to allow replacements in the forest and thus keep it moderately productive, the lumber areas of the north as a whole showed a gradual increase in the relatively inferior hardwood element as compared to spruce and pine. Here also, as in the farming district, cut-over lands were more apt to burn destructively and over large areas, resulting in a serious deterioration in the quality and quantity of forest production.

Depletion of New England Forests

Thus in two centuries the people of New England have used up all but a scant two million acres of an original forest covering thirty-nine of the forty million acres included in the six states. Not less than fifteen million of these acres became farm and pasture, of which at least ten million have been abandoned to revert to forest, thereby accidentally producing a supplementary crop of timber, the best of which has now also been cut down. We have still nearly twenty-five million

acres in woodland, but of this more than half is covered with comparatively valueless trees or undesirable species. For a region two-fifths of which is probably unfit for anything but the growing of timber this situation is economically discouraging. But even less favorable as related to the problem of restoring forest production for the future are the less obvious, indirect effects which this period of destructive or neglectful use has had upon the physical and biological factors of the forest - for example, the condition and distribution of tree species, the prevalence of pests, the fertility of soils, the fluctuations of wild life.

Effects of Forest Weeds

Today perhaps the greatest natural obstacle of all to successful forestry, at least in central New England, is the extent to which forest weeds, both trees and underbrush, have multiplied as compared with the species ~~which are~~ of greatest use and value. As long as most of the land was occupied either with tillage or pasture or by the still uncut areas ~~areas~~ of original forest in which only the long lived and better timber trees survived, the weed element remained in abeyance. ~~Even~~ Thus during the earlier abandonment of farm lands it was still white pine as the species most adapted to prompt reseeding which took possession of the fields and pastures; but as time went on with more land abandoned, the light seeded, fast growing species - gray birch, pin cherry, poplar, red maple, alder, to say nothing of many kinds of shrubs - were able to rival the pine and outstrip the larger, heavier seeded hardwoods in spreading over vacant lands. Still further impetus was added to the spread and development of forest weeds after the pine woodlots began to be cut and left, as they almost invariably were, to come up to a thicket of hardwoods. In ~~which often a good supply~~ such thickets the stock of valuable seedlings which originated under the pine stand ~~have struggled unsuccessfully to resist the suppression of~~ is gradually suppressed by the faster growing shrubs and forest weeds. Less

rapidly but nevertheless steadily a similar process has been going on in the wilder regions where lumbering has been the only treatment of land. Fires also, which only provide further area for more adapted to poor than to good species of trees, have aggravated the process. The increase in forest weeds as compared to desirable timber trees during the last two hundred years is beyond estimate. In central New England it is probable that there are at least five hundred acres of forest weeds to one of good timber, actual or prospective.

Deterioration of Soil

That our present woodland is so much of it intrinsically of little use is not the end of the trouble. Since the present associations of species occur almost wholly as results of farm abandonment, lumbering, or fire, they are often physiologically unsuited to the ~~degraded~~ sites they occupy and therefore, in the absence of fire, tend gradually to revert to some other mixtures more adapted to the local factors of soils and climate. Conversely, these temporary or transitional forests may often have an injurious effect upon the current fertility of soil, so that even where a given kind of timber may be commercially valuable, it does not follow that as a permanent forest crop for the land it may be safely ~~to~~ reckoned upon. A case in point is the large area of old-field pine already referred to, ~~and~~ which has proved so valuable a raw material for local woodworking industries during the last generation. These stands, originating on medium to better soils, often improved over their primitive condition by a century of farming or grazing, exhibited in early life a rapid growth. Experience and research at the Harvard Forest(6) have shown that such pine stands gradually arrest most of the organic decomposition which in a healthy forest tends to maintain soil fertility and at the same time exhaust the original top soil, so that at fifty to sixty years of age their growth suddenly falls off. On the other hand, the replacement of such pine stands with certain associations of decidu-

(6) H. F. Bull 15 10.

ous trees has proved a beneficial ~~influence~~ by restoring under the more active influence of temperature, moisture, and light, the metabolism of organic materials, which is indispensable to the productiveness of a forest soil. It is axiomatic that cultivation and fertilization as applied to agriculture will always be impracticable in forestry. The only way in which these processes can be kept up in forests is by the use of such ~~suitable~~ species as will ~~best~~ maintain the necessary decomposition of forest debris and favor the biological influences — earthworms, fungi, etc. — which supplement the action of physical factors. Not all natural forests accomplish this, since in all cases the general regional climate is the deciding factor; but many ~~kinds~~ associations are beneficial, especially if properly managed. To build up a favorable forest soil may be the work of years. With our present inferior second-growth forests, soils have widely deteriorated: first, by the transition to unfavorable mixtures of species or stands of inadequate density; and second, and often repeatedly, because forest fires have consumed the organic element in the soil.

Insect Pests and Diseases

This immense transition from mixed forests of older woods into smaller stands of short-lived or enfeebled trees has brought with it increasingly favorable conditions for insect pests and disease. In the original ~~mixed~~ forests the absence of large areas of any one type of vegetation of uniform age or condition prevented the undue development of pests peculiar to any given species. In the woods of today we find immense ~~areas~~ tracts of relatively unhealthy forest running strongly to one type of mixture or often to pure stands, and in consequence of their life history less vigorous than the forests they have replaced. How this has affected insects is indicated by the history of the white pine weevil, a native insect, and now one of the most destructive pests of white pine plantations. Relatively harmless in the original forests

where pine was not often in continuous bodies and where the percentage of younger stands at any one time was low, this insect found in the period of farm abandonment and the widespread reversion of these lands to pure pine a favorable environment on an immense scale. Today the pine weevil is so abundant and widespread as to destroy a large part of the value of most pine **stands** within its range.

Relation of wild life to Forest Environment

Among biologists the essential control of wild life by the character of the environment is admitted, if not yet understood in detail. **A** significant example may be found in the way in which the known fluctuations of the ruffed grouse and the woodcock in central New England have followed the progress of land abandonment, reversion to pine wood, and subsequently to various mixtures of hardwood. Neither of these species was naturally abundant in the heavy forests of early New England, but from 1870 to 1900 during the period of most rapid reversion of old fields to forest, both species reached the greatest abundance recorded by sportsmen. That the partridge has since steadily declined in abundance and the woodcock, at least recently, ~~steadily~~ and greatly increased, may well be accounted for by the changes which have taken place in the character of the cover and attendant food supply. (7)

The pine wood developed on old fields and pastures, together with more or less hawthorn, running blackberry, viburnum, blueberry, apple trees, and birches. The process of change from shrubby field to forest was gradual, and during the first twenty to thirty years the combination of vegetation was ideal for the partridge - increasing shelter, varied food plants, and open dusting places. From then on the pine rapidly closed up and most of the food plants, even the old apple trees, were killed out. Since the bulk of the pine woodlands reached this condition twenty to thirty years ago, the favorable cover was reduced to the margins where the pine gave way to brushy openings or the birch thickets

(7) "Our Wild Life and the Changing Forest" R.Y.K. The Sportsman May 1929

more characteristic of recently abandoned fields. Thus there was going on a progressive reduction in good cover even before the logging activities of the last generation.

But if the maturing and removal of the old field pine has deprived the partridge of more and more of his best habitat, the process has, in many cases, accomplished the opposite for the woodcock. This came about through the soil changes referred to above. In the soil under a pine wood there are no earthworms. With the change to certain species of hardwood, if the situation is not too wet or too dry, the original bed of leaf litter disappears in from fifteen to twenty years, the current fall of hardwood leaves decays almost annually, and the resulting fine humus merges with the mineral soil, sometimes to a depth of ten inches or more. There results a rich brown loam in which earthworms are characteristically abundant. On many such areas once the new forest has begun to close up, breeding woodcock have appeared in numbers. This transformation is not universal, but apparently confined to certain combinations of sites and tree species. In sum total, however, the change has taken place in favorable spots over wide areas. Thus, there would seem to be reason for the recent abundance of woodcock in north-eastern covers.

The Future of New England Forests

Looking to the future it is plain that even though rapid changes in utilization and the recent decline in the demand for native timber make it difficult to predict what kinds of forest should be the objective of forestry in the several regions, nevertheless it is safe to expect that somewhere between one-fourth and one-third of New England area must be used, if at all, as forest. If it is to be used as forest, its permanence and productiveness, whether for wood, the safeguarding of stream flow, protection of wild life, or recreation, will have to be secured by a proper understanding and control of the biological and

physical factors which have hitherto been so seriously upset. Much of the knowledge necessary for this kind of management is still lacking. The required principles, however, are ~~plain~~ without. In many ways the conditions obtaining in the original virgin forests were favorable, but ~~it~~ will not ~~do for~~ make a productive forest, ~~to try to~~ reproducing the complexities of their life history. Their very stability involved also an undue slowness of growth, a high percentage of defect, and, as compared with ideal conditions, relatively inactive soils. On the other hand, although much of our second-growth timber has had periods of excellent commercial value and has exhibited very rapid growth - as in the case of the white pine woodlot,- such types do not offer a safe model for sound forestry. Being in ~~almost all~~ nearly every cases the product of human interference with natural conditions, these types are almost invariably unstable, both as to composition of species and soil conditions. The silviculture of the future will copy the virgin forest by selecting the most valuable, fast-growing, or hardy species so mingled as to secure the greatest possible mutual protection from insects and disease, the best influence upon soil metabolism, and upon the quality of wood. It will follow to some extent also the more uniform density and concentrated production shown by the best of the second-growth forests, in which, for brief periods at least and for certain types, timely exposures of the soil and the predominance of certain beneficial species have produced high yields of wood as well as active fertility. Whatever may prove to be the economic or social objectives of New England forest policy, it will be necessary in the long run to understand and control an essential equilibrium of biological factors, on the one hand to avoid the wasteful complications of the natural process and on the other to restore and maintain the resources in good timber and productive soil which human occupation has by now so greatly reduced.

R. T. Fisher

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THE HARVARD FOREST
As a
Demonstration Tract

The Harvard Forest has belonged to the University for twenty-three years. In 1908 it represented merely what a hundred and fifty years of ups and downs in rural colonization had done to the virgin wilderness. In 1931 it represents what twenty-three years of intensive management have done to organize and improve the natural forest. In the long perspectives of forestry this period is trifling; but in a country where the average citizen has so recently exchanged the family axe for a niblick, it is sufficient to make the Harvard Forest the oldest institution of its kind in America and perhaps to make pertinent the query as to how it has functioned as a means of education.

In the use of the property by the Forestry Department of the University, there have been three objectives: a model forest to demonstrate the practice of forestry; a laboratory for the training of professional students; and an experiment station for research. But although the Forest has provided a field for countless exercises by students and the material for many bulletins and papers, it is not these but the forest itself which has translated the developing technique of management into realizable and convincing terms. It speaks in the only language which can be understood both by the wise and the simple - visible results.

The Forest consists of 2100 acres of varied woodland situated in the town of Petersham, in northern Worcester County, Massachusetts, where from earliest times woodworking industries have been an important item in the livelihood of the people. Well timbered almost all over, it contains a greater variety of the different stages of forest represented in New England history than can be found on an equal area anywhere else in the region. Besides authentic fragments of the original primeval

stands, it has phases of second growth and forest types characteristic both of the northern and of the central forests.

Conditions at the outset were peculiarly favorable not only to significant developments in silviculture but even more to the creation of a successful business enterprise in forestry. There being already on hand in the existing growing stock a merchantable volume of ten million board feet (1,430,000 cu.ft.), it was possible to meet the stipulation of the governing board of the University that the Forest must be self-supporting. This condition, as can readily be seen, has been a powerful influence for economy and efficiency in management. In the matter of markets, nearby industries have furnished an outlet for almost every species on the property, and there has been also a fair demand for fuel wood. By a happy accident of history and previous ownership there was also a fair distribution of age groups so that it was possible from the beginning to set up a working plan on the basis of a sustained yield. The Forest has had its own sawmill, a couple of motor trucks for hauling and delivery, and a small year around crew of woods workers under a resident superintendent. Aside from special projects of research, both biological and economic, the management has been directed toward the improvement of the growing stock in volume, increment, and age distribution, and the evolution of effective silvicultural methods for the reproduction and the maintenance of growth and quality.

The progress in these directions has been tangibly reflected in the forest itself. In twenty-three years five million board feet (710,000 cu.ft.) have been harvested from the forest; yet in consequence of the maturing of younger stands and the increasing increment of the period, the present merchantable volume is approximately twelve million (1,710,000 cu.ft.). The annual increment, originally estimated at two hundred and fifty thousand board feet (36,000 cu.ft.) is now about four

hundred thousand (60,000 cu.ft.), and the uniform distribution of age classes required for continuous production has been substantially approached. There has been a net income, available for improvements and equipment, of $1,000. to $2,000. a year, equivalent to 50¢ to $1. per acre.

Under the existing scheme of management it has been necessary to control the business and economic phases of operation as carefully as the silvicultural. In the system of records and accounts which has been developed, both these phases of work are dealt with. All labor costs, operating expenses, and the various forms of overhead, including interest on the capital invested, are currently posted and periodically summarized. Form sheets are provided for annual statements according to block, compartment, and type of the amounts cut in timber and other products. The status of the growing stock as regards volume, composition, age, and growth is kept track of in a card file in which each card carries the data on a single uniform stand, a number of which may occur in a single compartment. Such a file, in which annual changes due to cutting or planting are currently recorded, makes it easy to summarize the general condition of the growing stock at any time. In the matter of the silvicultural and biological aspects of the management, the records are even more comprehensive. In addition to the stand cards, notes and observations upon the cutting or experimental areas are filed by compartments. Permanent sample plots and other areas set apart for special studies are given an additional form of record. Finally, and applying to all forms of forest operation, there is a photographic file for preserving serial views of the same spot and a full set of large scale compartment maps on which all significant changes on the Forest are plotted.

The task of maintaining such a system of records is difficult, and quite naturally becomes more so as the areas under treatment or experiment increase. Nevertheless, experience has proved that the Forest is

valuable as a demonstration almost exactly in proportion to the completeness and accuracy of its records. As time goes on new and unforeseen problems arise for solution. With a forest whose history is accurately known in both economic and silvical terms, it is often possible to make a significant study which would have been impossible on unmanaged areas. Thus, adequate records may furnish in the end not only what they were originally planned for, but quite unexpected by-products of knowledge.

Through its continuing experience as a demonstration area the Forest has been able to establish certain concepts of silvicultural policy which have influenced not only the point of view of professional foresters but also the public propaganda which takes its cue from that source. For the past thirty years, which is about the life time of the profession in America, various public and semi-public agencies in the Northeast - federal and state forestry departments and private associations - have built up an immense campaign designed to educate the land owners to the production of timber. From the beginning this took the form of advocating coniferous plantations, generally white pine; and so thoroughly has this policy been advertised that forestry in the public mind of New England has been generally thought to begin and end with reforestation by planting. In consequence, after thirty years we have some hundred thousand acres of pine plantations so poor in quality that few of them will ever repay their cost.

By a curious irony of economic history there were several apparently good reasons for emphasizing the planting of pine. It was about 1900 that the extraordinary accidental production of enormous volumes of white pine on the farms and pasture lands abandoned in the middle of the last century began to be widely used in a great many local industries, particularly for the manufacture of wooden boxes. Originating on areas

especially adapted to white pine reproduction and at a time when in the existing remnants of original forest seed trees of inferior species were relatively scarce, these so-called pine woodlots, generally in pure stands, showed remarkable productiveness. At the usual cutting age of from fifty to sixty years volumes per acre ranged from twenty to fifty thousand board feet (three to seven thousand cubic feet), which in the prosperous pre-war days of the woodworking industries meant a stumpage value of from $300. to $500. an acre. How much this purely gratuitous reward of Nature for the failures of man has meant to the struggling farms of upland New England may be gathered from the fact that between 1895 and 1925 fifteen billion board feet (over two billion cubic feet) of second growth pine have been cut in central New England with a manufactured value of over $400,000,000., more than half of which has gone to the owners of the land and the local population which took part in the logging and milling. If one considers also how simple and understandable to the layman is the planting of trees as compared to the handling of established forests, it can be seen that there were obvious reasons for believing that pine plantations were a good thing to advocate. Unfortunately the use and value of old field pine have seriously declined, and the stands of recent origin are inferior in quality.

On the Harvard Forest almost at the outset of management it was decided not to attempt to maintain the pure pine type but rather to convert it into mixtures, either hardwoods alone or hardwoods with pine. This decision was based in part on the theoretical value of mixed stands and in part on the belief that the old field pine was a transition type not in the long run so suitable for the soils and climate as certain simplified forms of the original mixed types of the virgin forest. Subsequent observations made this policy seem additionally sound. The increment of the old field pine was observed to show an abrupt falling off from forty-five years on; natural pruning, especially in plantations,

was notably slow so that only low grade lumber could be produced; the abundant advance growth generally developing in the later life of the pine wood was always of hardwood species, often of the most valuable kinds, never of pine, which not only indicated a tendency to reversion but made a pine type unduly costly to maintain.

After eighteen years of converting pine stands to varying mixtures, there began to be observed a contrasting condition of soil profiles which conclusively showed why for the region and forests under consideration the mixed stand was the better objective (See Figs. 1 and 2). Under the pure pine cover decomposition in the humus layers became progressively slower, leaf litter in a more or less felted form accumulated to considerable depths, with the formation of but little true humus and accompanied by a gradual reduction in the depth and tilth of the top soil. This condition was apparently coincident with the falling off in growth. On the other hand under the hardwood or mixed types which had followed the cutting of pine, the reverse of this process had set in promptly: a rapid decomposition both of the organic layers previously accumulated and also of the current fall of leaves, accompanied by improvement in the depth and tilth of the top soil or enriched horizon. In this case also there was immediate response in the growth of the trees. It was apparent, too, that the prospective quality of the timber, as indicated by straightness of stem and rapidity of pruning, was notably better than with the pure pine. The outcome of this experience, which could only be achieved on a forest deliberately and efficiently devoted to the continuing observation and recording of silvicultural experience, has been quickly disseminated into the general professional consciousness not only by the men who have taken their professional training at the Forest but by large numbers of practising foresters who are continually visiting the tract.

Still another instance in which the Harvard Forest has been of service in defining a useful principle of regional forest management has been to demonstrate the economic and silvicultural possibilities of improved productiveness in natural stands. It has been a consequence of the propaganda for the planting of pine that little or no attention has been paid, even by forest owners who have undertaken planting, to the cut-over lands already forested by Nature, which have been vaguely supposed to be "devastated". By and large natural regeneration in New England has been uncommonly abundant, notwithstanding the almost complete lack of any conscious measures on the part of timberland operators to secure it. But although some sort of tree crop usually follows the logging operation, a hundred and fifty years of cutting, clearing for farms, natural reforestation of old fields followed by more cuttings and perhaps repeated fires, have profoundly altered the regional distribution of species. What is locally known as the weed tree, that is, small short-lived species such as gray birch, poplar, pin cherry, etc., together with immense areas of degenerate coppice have probably increased in the last century at least a thousand per cent. This means that more valuable species such as white ash, red oak, white birch, and pine have been correspondingly reduced, not because they are generally absent in the young growth which follows logging, but because they are progressively suppressed by the faster growing weeds and coppice. Indeed this regional degeneration in composition has gone so far that the weed element and its correction constitute the first and greatest problem in New England silviculture. Twenty-three years of dealing with this difficulty on and about the Harvard Forest have shown proofs in the form of highly valuable stands, first, that there are very large areas of cut-over land which, if taken in time, can be converted through the process of weeding or cleaning from potential worthlessness to excellent stands, often in almost ideal mixture; and second, that the cost of this

work per acre is generally far less than that of planting. This demonstration has very materially helped to influence the general realization that much of New England's twenty-five million acres of existing forest land has a realizable productiveness out of all proportion to the planting of new land.

The ways in which such lessons as these become available have multiplied through the years. Probably first in importance, if one considers the long view, would be the knowledge and grasp of fundamentals absorbed by the professional students who come to the Forest for graduate training and research. Such men naturally transmit and apply their philosophy more and more widely as time goes on. The results of all research projects as well as maturing reports on various phases of silviculture and management are published from time to time as bulletins of the Forest or articles in technical journals. To a considerable extent also local newspapers publish stories about phases of work that may be useful to the general public. There has been maintained also at Petersham a sort of unofficial service bureau. Through the Forest staff there is offered free to residents of the town and at cost to other land owners in the vicinity advice in forest management. This takes the form of estimates and valuation of timber, marking for cuttings, planting plans, etc. In many cases the actual work of logging and milling, planting, or weeding may be carried out for the owner by the woods crew of the Forest in combination with its own work. The Town Forest of Petersham is managed in this way. Through these kinds of direct service the Forest has contributed to the development, improvement, or reforestation of nearly fifty thousand acres in the surrounding region.

Last of all and perhaps most important are the outward and visible effects of applied silviculture, which may be seen on the forest itself and which with the written and other records embodying results and progress are shown to large numbers of visitors, sometimes as many as

two hundred and fifty to three hundred in a year. Most of these visitors are foresters from federal or state departments or from forestry schools. Many also are men interested in the biological sciences, and the remainder, a very considerable number, are forest owners or lumbermen. It is difficult to estimate the total effect of all these forms of contact between the Forest laboratory and the public and professional consciousness; but to one who has seen the process going on for over twenty years, it is obvious that there has been an ever widening diffusion of knowledge about the handling of forests which is coming to be reflected in the policies and methods of the region. It is not far from the truth to say that, for all around usefulness, no other means of education can equal a highly developed demonstration forest.

In the Harvard experience there has been more than a hint that forestry depends as much upon a state of mind as a state of markets. There has been little in the economic history of the United States to induce foresight or deliberate provision for the future. "America the land of the free" has been more than a slogan of patriotism; it has been almost a promise of material plenty. There has been free timber - two-thirds of a continent covered with the most varied and valuable reservoir of wood that the world has known, and with no cost of production. There has been free land - first the allotments to settlers in the thirteen colonies and then the immense disposals of public domain by the federal government. Along with free land went the implication of free use and access, not only on areas still publicly owned but also on private lands which still bore the aspect of wilderness. In some cases these traditions have acquired the force of rights, as in the early grazing on our public domain in the West and the policy established in all our states, that fish and game belong to the public and not to the owner of the land. In some regions, notably New England and the South, the idea that Nature will provide has been still further strengthened by the immense replacement of

usable second growth timber on abandoned farms, another free gift of raw material to a people already used to plenty.

A history like this has not conduced to the habit of taking thought, still less to any interest in or comprehension of the technical or economic processes of forestry. On the contrary it has given rise to some widespread fallacies that have helped prevent even such forms of forestry as existing economic conditions would have made profitable. There is the idea that investments in forests should yield a very high return, at least six per cent. There is the assumption, clearly reflected in the practice of New England town assessors, that only mature trees are timber and that sapling and seedling stages are worthless brush. There is the habit in the woods of cutting always the nearest and best trees, whether or not the poorer ones, whose removal would benefit the stand, are equally satisfactory. There is the conviction, still widely held among lumbermen, that since Nature always has produced our timber, it is necessary only to control fires and Nature will do it again. Finally, less clearly definable but no less definitely an obstacle to successful forestry is the obliviousness of the general public to the productive values of forest land, an attitude which is responsible for most of our forest fires and for much damage to trees and plants.

In the face of such a general state of mind as this, the most favorable economic conditions might well be slow in stimulating forestry. On the other hand, it is clear that where there is a reasonable understanding of the technique of silviculture, it is possible, even in the midst of destruction, to make a success of forestry. There are a number of ownerships in New England where the same land in the hands of a small wood-using industry has produced timber and a moderate income for several generations. These properties, like the Harvard Forest, have done their bit to spread the realization of how forests are actually managed and

of how very far the proper knowledge and purpose will go toward making them profitable. In the words of Mr. Ward Shepard, who for several years has been helping to guide the public relations of the Forest Service, "The solution of the forest problem depends far more on intelligence, will, and good workmanship than on economic predestination".

Sent to the Albany meeting of the NE Forest Research Council Feb. 5, 1931

HARVARD FOREST PLANTATIONS

Plantations on the Harvard Forest at Petersham have been established for various purposes annually since 1909, a period of twenty-one years, and in area now amount to 282 acres. The Black Brook Plantation at Hamilton, Mass., recently acquired by gift, was begun about 1900 and covers approximately 120 acres. Of the Petersham plantations 78 acres have been made on old field or pasture and 204 acres on various types and conditions of cut-over land. At Hamilton all plantations were started on old field or other open areas. The principal species used at Petersham have been white pine, red pine, white spruce, Norway spruce, Scotch pine, European and Japanese larch. The Petersham plantations were established both for the general purpose of maintaining or improving reproduction in the management of the Forest and for special experimental purposes. The Hamilton plantations were primarily intended as tests of climatic adaptation for all coniferous species that might conceivably be suitable. Thus many North American species are represented and many of the common ones from Europe.

For the Hamilton plantations up to recently no regular records have been maintained. At Petersham, however, in addition to data on establishment, there have been continuing records and observations so that there has accumulated much instructive material on many aspects of the planting problem. The following are significant points upon which the plantations are furnishing useful data: adaptations of exotic species to local climatic conditions; relation of species, age, size and form of stock to soil factors and competing vegetation; planting technique and costs under varying conditions; season of planting; geographical source of seed; planting to supplement inferior or scanty

natural reproduction; effect of varying mixtures and spacings for certain conifers and for conifers and hardwoods on quality and growth; weevil damage and its reduction by increasing density and by suitable mixtures; random and groupwise spacing on cut-over areas combined with weeding; physiological relationships of planted stock to physical and physiological factors of soil.

The Harvard Forest has two studies of plantations for which the field work is practically done and which are in process of preparation for printing. Both deal with the growth and behavior of existing plantations in the Northeast, one for Norway spruce and the other for European larch. It is expected that other reports will be issued as the various experiments and practices hitherto under observation become conclusive.

Sent to W. E. Hiley for the British Forestry Quarterly Published April 1931

THE HARVARD FOREST
As a
Demonstration Tract

The Harvard Forest has belonged to the University for twenty-three years. In 1908 it represented merely what a hundred and fifty years of ups and downs in rural colonization had done to the virgin wilderness. In 1931 it represents what twenty-three years of intensive management have done to organize and improve the natural forest. In the long perspectives of forestry this period is trifling; but in a country where the average citizen has so recently exchanged the family axe for a niblick, it is sufficient to make the Harvard Forest the oldest institution of its kind in America and perhaps to make pertinent the query as to how it has functioned as a means of education.

In the use of the property by the Forestry Department of the University, there have been three objectives: a model forest to demonstrate the practice of forestry; a laboratory for the training of professional students; and an experiment station for research. But although the Forest has provided a field for countless exercises by students and the material for many bulletins and papers, it is not these but the forest itself which has translated the developing technique of management into realizable and convincing terms. It speaks in the only language which can be understood both by the wise and the simple - visible results.

The Forest consists of 2100 acres of varied woodland situated in the town of Petersham, in northern Worcester County, Massachusetts, where from earliest times woodworking industries have been an important item in the livelihood of the people. Well timbered almost all over, it contains a greater variety of the different stages of forest represented in New England history than can be found on an equal area anywhere else in the region. Besides authentic fragments of the original primeval

stands, it has phases of second growth and forest types characteristic both of the northern and of the central forests.

Conditions at the outset were peculiarly favorable not only to significant developments in silviculture but even more to the creation of a successful business enterprise in forestry. There being already on hand in the existing growing stock a merchantable volume of ten million board feet (1,430,000 cu.ft.), it was possible to meet the stipulation of the governing board of the University that the Forest must be self-supporting. This condition, as can readily be seen, has been a powerful influence for economy and efficiency in management. In the matter of markets, nearby industries have furnished an outlet for almost every species on the property, and there has been also a fair demand for fuel wood. By a happy accident of history and previous ownership there was also a fair distribution of age groups so that it was possible from the beginning to set up a working plan on the basis of a sustained yield. The Forest has had its own sawmill, a couple of motor trucks for hauling and delivery, and a small year around crew of woods workers under a resident superintendent. Aside from special projects of research, both biological and economic, the management has been directed toward the improvement of the growing stock in volume, increment, and age distribution, and the evolution of effective silvicultural methods for the reproduction and the maintenance of growth and quality.

The progress in these directions has been tangibly reflected in the forest itself. In twenty-three years five million board feet (710,000 cu.ft.) have been harvested from the forest; yet in consequence of the maturing of younger stands and the increasing increment of the period, the present merchantable volume is approximately twelve million (1,710,000 cu.ft.). The annual increment, originally estimated at two hundred and fifty thousand board feet (36,000 cu.ft.) is now about four

hundred thousand (60,000 cu.ft.), and the uniform distribution of age classes required for continuous production has been substantially approached. There has been a net income, available for improvements and equipment, of $1,000. to $2,000. a year, equivalent to 50¢ to $1. per acre.

Under the existing scheme of management it has been necessary to control the business and economic phases of operation as carefully as the silvicultural. In the system of records and accounts which has been developed, both these phases of work are dealt with. All labor costs, operating expenses, and the various forms of overhead, including interest on the capital invested, are currently posted and periodically summarized. Form sheets are provided for annual statements according to block, compartment, and type of the amounts cut in timber and other products. The status of the growing stock as regards volume, composition, age, and growth is kept track of in a card file in which each card carries the data on a single uniform stand, a number of which may occur in a single compartment. Such a file, in which annual changes due to cutting or planting are currently recorded, makes it easy to summarize the general condition of the growing stock at any time. In the matter of the silvicultural and biological aspects of the management, the records are even more comprehensive. In addition to the stand cards, notes and observations upon the cutting or experimental areas are filed by compartments. Permanent sample plots and other areas set apart for special studies are given an additional form of record. Finally, and applying to all forms of forest operation, there is a photographic file for preserving serial views of the same spot and a full set of large scale compartment maps on which all significant changes on the Forest are plotted.

The task of maintaining such a system of records is difficult, and quite naturally becomes more so as the areas under treatment or experiment increase. Nevertheless, experience has proved that the Forest is

valuable as a demonstration almost exactly in proportion to the completeness and accuracy of its records. As time goes on new and unforeseen problems arise for solution. With a forest whose history is accurately known in both economic and silvical terms, it is often possible to make a significant study which would have been impossible on unmanaged areas. Thus, adequate records may furnish in the end not only what they were originally planned for, but quite unexpected by-products of knowledge.

Through its continuing experience as a demonstration area the Forest has been able to establish certain concepts of silvicultural policy which have influenced not only the point of view of professional foresters but also the public propaganda which takes its cue from that source. For the past thirty years, which is about the life time of the profession in America, various public and semi-public agencies in the Northeast - federal and state forestry departments and private associations - have built up an immense campaign designed to educate the land owners to the production of timber. From the beginning this took the form of advocating coniferous plantations, generally white pine; and so thoroughly has this policy been advertised that forestry in the public mind of New England has been generally thought to begin and end with reforestation by planting. In consequence, after thirty years we have some hundred thousand acres of pine plantations so poor in quality that few of them will ever repay their cost.

By a curious irony of economic history there were several apparently good reasons for emphasizing the planting of pine. It was about 1900 that the extraordinary accidental production of enormous volumes of white pine on the farms and pasture lands abandoned in the middle of the last century began to be widely used in a great many local industries, particularly for the manufacture of wooden boxes. Originating on areas

especially adapted to white pine reproduction and at a time when in the existing remnants of original forest seed trees of inferior species were relatively scarce, these so-called pine woodlots, generally in pure stands, showed remarkable productiveness. At the usual cutting age of from fifty to sixty years volumes per acre ranged from twenty to fifty thousand board feet (three to seven thousand cubic feet), which in the prosperous pre-war days of the woodworking industries meant a stumpage value of from $300. to $500. an acre. How much this purely gratuitous reward of Nature for the failures of man has meant to the struggling farms of upland New England may be gathered from the fact that between 1895 and 1925 fifteen billion board feet (over two billion cubic feet) of second growth pine have been cut in central New England with a manufactured value of over $400,000,000., more than half of which has gone to the owners of the land and the local population which took part in the logging and milling. If one considers also how simple and understandable to the layman is the planting of trees as compared to the handling of established forests, it can be seen that there were obvious reasons for believing that pine plantations were a good thing to advocate. Unfortunately the use and value of old field pine have seriously declined, and the stands of recent origin are inferior in quality.

On the Harvard Forest almost at the outset of management it was decided not to attempt to maintain the pure pine type but rather to convert it into mixtures, either hardwoods alone or hardwoods with pine. This decision was based in part on the theoretical value of mixed stands and in part on the belief that the old field pine was a transition type not in the long run so suitable for the soils and climate as certain simplified forms of the original mixed types of the virgin forest. Subsequent observations made this policy seem additionally sound. The increment of the old field pine was observed to show an abrupt falling off from forty-five years on; natural pruning, especially in plantations,

was notably slow so that only low grade lumber could be produced; the abundant advance growth generally developing in the later life of the pine wood was always of hardwood species, often of the most valuable kinds, never of pine, which not only indicated a tendency to reversion but made a pine type unduly costly to maintain.

After eighteen years of converting pine stands to varying mixtures, there began to be observed a contrasting condition of soil profiles which conclusively showed why for the region and forests under consideration the mixed stand was the better objective (See Figs. 1 and 2). Under the pure pine cover decomposition in the humus layers became progressively slower, leaf litter in a more or less felted form accumulated to considerable depths, with the formation of but little true humus and accompanied by a gradual reduction in the depth and tilth of the top soil. This condition was apparently coincident with the falling off in growth. On the other hand under the hardwood or mixed types which had followed the cutting of pine, the reverse of this process had set in promptly: a rapid decomposition both of the organic layers previously accumulated and also of the current fall of leaves, accompanied by improvement in the depth and tilth of the top soil or enriched horizon. In this case also there was immediate response in the growth of the trees. It was apparent, too, that the prospective quality of the timber, as indicated by straightness of stem and rapidity of pruning, was notably better than with the pure pine. The outcome of this experience, which could only be achieved on a forest deliberately and efficiently devoted to the continuing observation and recording of silvicultural experience, has been quickly disseminated into the general professional consciousness not only by the men who have taken their professional training at the Forest but by large numbers of practising foresters who are continually visiting the tract.

Still another instance in which the Harvard Forest has been of service in defining a useful principle of regional forest management has been to demonstrate the economic and silvicultural possibilities of improved productiveness in natural stands. It has been a consequence of the propaganda for the planting of pine that little or no attention has been paid, even by forest owners who have undertaken planting, to the cut-over lands already forested by Nature, which have been vaguely supposed to be "devastated". By and large natural regeneration in New England has been uncommonly abundant, notwithstanding the almost complete lack of any conscious measures on the part of timberland operators to secure it. But although some sort of tree crop usually follows the logging operation, a hundred and fifty years of cutting, clearing for farms, natural reforestation of old fields followed by more cuttings and perhaps repeated fires, have profoundly altered the regional distribution of species. What is locally known as the weed tree, that is, small short-lived species such as gray birch, poplar, pin cherry, etc., together with immense areas of degenerate coppice have probably increased in the last century at least a thousand per cent. This means that more valuable species such as white ash, red oak, white birch, and pine have been correspondingly reduced, not because they are generally absent in the young growth which follows logging, but because they are progressively suppressed by the faster growing weeds and coppice. Indeed this regional degeneration in composition has gone so far that the weed element and its correction constitute the first and greatest problem in New England silviculture. Twenty-three years of dealing with this difficulty on and about the Harvard Forest have shown proofs in the form of highly valuable stands, first, that there are very large areas of cut-over land which, if taken in time, can be converted through the process of weeding or cleaning from potential worthlessness to excellent stands, often in almost ideal mixture; and second, that the cost of this

work per acre is generally far less than that of planting. This demonstration has very materially helped to influence the general realization that much of New England's twenty-five million acres of existing forest land has a realizable productiveness out of all proportion to the planting of new land.

The ways in which such lessons as these become available have multiplied through the years. Probably first in importance, if one considers the long view, would be the knowledge and grasp of fundamentals absorbed by the professional students who come to the Forest for graduate training and research. Such men naturally transmit and apply their philosophy more and more widely as time goes on. The results of all research projects as well as maturing reports on various phases of silviculture and management are published from time to time as bulletins of the Forest or articles in technical journals. To a considerable extent also local newspapers publish stories about phases of work that may be useful to the general public. There has been maintained also at Petersham a sort of unofficial service bureau. Through the Forest staff there is offered free to residents of the town and at cost to other land owners in the vicinity advice in forest management. This takes the form of estimates and valuation of timber, marking for cuttings, planting plans, etc. In many cases the actual work of logging and milling, planting, or weeding may be carried out for the owner by the woods crew of the Forest in combination with its own work. The Town Forest of Petersham is managed in this way. Through these kinds of direct service the Forest has contributed to the development, improvement, or reforestation of nearly fifty thousand acres in the surrounding region.

Last of all and perhaps most important are the outward and visible effects of applied silviculture, which may be seen on the forest itself and which with the written and other records embodying results and progress are shown to large numbers of visitors, sometimes as many as

two hundred and fifty to three hundred in a year. Most of these visitors are foresters from federal or state departments or from forestry schools. Many also are men interested in the biological sciences, and the remainder, a very considerable number, are forest owners or lumbermen. It is difficult to estimate the total effect of all these forms of contact between the Forest laboratory and the public and professional consciousness; but to one who has seen the process going on for over twenty years, it is obvious that there has been an ever widening diffusion of knowledge about the handling of forests which is coming to be reflected in the policies and methods of the region. It is not far from the truth to say that, for all around usefulness, no other means of education can equal a highly developed demonstration forest.

In the Harvard experience there has been more than a hint that forestry depends as much upon a state of mind as a state of markets. There has been little in the economic history of the United States to induce foresight or deliberate provision for the future. "America the land of the free" has been more than a slogan of patriotism; it has been almost a promise of material plenty. There has been free timber - two-thirds of a continent covered with the most varied and valuable reservoir of wood that the world has known, and with no cost of production. There has been free land - first the allotments to settlers in the thirteen colonies and then the immense disposals of public domain by the federal government. Along with free land went the implication of free use and access, not only on areas still publicly owned but also on private lands which still bore the aspect of wilderness. In some cases these traditions have acquired the force of rights, as in the early grazing on our public domain in the West and the policy established in all our states, that fish and game belong to the public and not to the owner of the land. In some regions, notably New England and the South, the idea that Nature will provide has been still further strengthened by the immense replacement of

usable second growth timber on abandoned farms, another free gift of raw material to a people already used to plenty.

A history like this has not conduced to the habit of taking thought, still less to any interest in or comprehension of the technical or economic processes of forestry. On the contrary it has given rise to some widespread fallacies that have helped prevent even such forms of forestry as existing economic conditions would have made profitable. There is the idea that investments in forests should yield a very high return, at least six per cent. There is the assumption, clearly reflected in the practice of New England town assessors, that only mature trees are timber and that sapling and seedling stages are worthless brush. There is the habit in the woods of cutting always the nearest and best trees, whether or not the poorer ones, whose removal would benefit the stand, are equally satisfactory. There is the conviction, still widely held among lumbermen, that since Nature always has produced our timber, it is necessary only to control fires and Nature will do it again. Finally, less clearly definable but no less definitely an obstacle to successful forestry is the obliviousness of the general public to the productive values of forest land, an attitude which is responsible for most of our forest fires and for much damage to trees and plants.

In the face of such a general state of mind as this, the most favorable economic conditions might well be slow in stimulating forestry. On the other hand, it is clear that where there is a reasonable understanding of the technique of silviculture, it is possible, even in the midst of destruction, to make a success of forestry. There are a number of ownerships in New England where the same land in the hands of a small wood-using industry has produced timber and a moderate income for several generations. These properties, like the Harvard Forest, have done their bit to spread the realization of how forests are actually managed and

of how very far the proper knowledge and purpose will go toward making them profitable. In the words of Mr. Ward Shepard, who for several years has been helping to guide the public relations of the Forest Service, "The solution of the forest problem depends far more on intelligence, will, and good workmanship than on economic predestination".

for Davis + Macaloney's weevil case-study to be published by the MFA
Written 6/16/31

FOREWORD

The experience of the last twenty years has shown that the former high value and productiveness of the white pine woodlot were no indication that pure plantations of the same species would be equally profitable. The factors which made the natural crop a success have not been repeated with the artificial or planted forests. Even without the decline in use and marketability which old field pine has recently suffered, the reasons against growing it would still be conclusive. Pure pine stands bring about a deterioration of soil, which is reflected in early falling off of growth. They are highly susceptible to disease and injury. Natural pruning is slow, and even under the best conditions - expertness in planting and sufficient density - no high grade lumber is produced. Most serious of all, such plantations have greatly contributed to the present prevalence of the white pine weevil. In many parts of New England the destructiveness of this insect is now so great that without some corrective treatment the great majority of plantations will have lost what little prospective value they had in the beginning.

As a matter of general forest policy the way out is to turn to natural mixtures, widely available already in the young growth on cut-over lands, to grow white pine sparingly and always with other species, preferably hardwoods, a procedure which has been shown in many cases to be cheaper, always better for the soil, and condusive to a higher grade of timber and comparative freedom from weevil damage. For thousands of acres of existing plantations there is no hope of ultimate return unless a way can be found to improve the quality in at least a portion of the mature stand. The authors of this paper, a forester and an entomologist, have collaborated to find practicable means by which even a seriously weeviled plantation may be so improved as to promise a fair, and in some cases a considerable, profit.

Written Nov. 1933 for the Freshly News Digest
Put in Dec. issue
P 7 (1 col.)

Harvard Forest Passes Its Twenty-fifth Birthday

With twenty-five years of development as a demonstration tract on a sustained yield and as an experiment station for research, the Harvard Forest has "a record of continuity in intensive silvicultural practice ... probably unequalled in America". Since first put under management it has marketed in round figures seven million feet of lumber and three thousand cords of wood, and (up to 1932) secured an income sufficient to maintain its building and equipment, with a small surplus for forest improvement. The total growing stock has been enlarged by twenty per cent, the annual increment by thirty-five per cent, and the distribution of age substantially improved. From the studies and experiments that have had a prominent part in the management, it has been possible to work out the phases of succession, due largely to human occupation and misuse, from the original forest to the degenerate types of today, and to show what associations of species are best suited to the local sites.

Experience at Petersham has helped bring foresters to a realization of the present large and increasing preponderance of inferior species in New England woodland and developed the technique and shown the profitableness of weeding young stands to better composition and production. It has shown also some fundamental facts about how the kinds of trees in a stand affect the quality of timber and the fertility of the soil. Pure white pine, as in plantations or old field stands, produces relatively low grade timber and tends to reduce soil fertility. Mixed stands of the better hardwoods or hardwoods and pine conduce to active soil fertility and a better grade of timber, besides being more resistant to insects and disease. Thus for many years now the policy on the Forest has been to convert the prevailing old field white pine

type of the region into mixtures of hardwood or hardwood and pine, and to certain coniferous types only on the sandy or swampy sites. Results of this policy are now to be seen in stands of exceptionally high prospective grade and productiveness, and in some cases nearly fifty feet high.

As showing that these developments go far toward defining a sound regional forestry and in view of the occasion, it may be permissable to quote a letter from Colonel W. B. Greeley written in 1928 when he was Chief of the Forest Service:

> "The two days at Petersham last August stand out as red letter events for many reasons, among them that I felt closer on that occasion to native American silviculture than at any other time in my life."

Written Dec. 1933
for Report of Wood
Freshly
[Ward Shepard]

SILVICULTURAL EXPERIENCE WITH WHITE PINE
on
THE HARVARD FOREST

The Harvard Forest has been operated as an experiment station and demonstration area for twenty-five years. It lies almost in the middle of the State of Massachusetts, some seventy-five miles from the coast, and covers about 2200 acres of hilly upland, ranging in elevation above sea level from 750 to 1400 feet. In respect to climate and flora the locality is transitional between the northern coniferous forest and the central hardwood forest.

The evolution of silviculture on the Harvard Forest has been a process of slowly measuring the effects of two hundred years of misuse on the composition and life history of regional forests and of using this knowledge to define the most suitable forms and types for local sites and the methods by which they might be created or approached. In 1908, the date when the Harvard tract was first organized as an experiment station, substantially all the forests of central New England were of natural origin unmodified by any conscious or deliberate management. Forestry as a public enterprise was already being actively promoted; but silviculture was little more than a tentative application of European practice to silvical conditions only dimly understood.

The land use of the previous two centuries had had the perverse effect of creating without cost or intention an immense supply of second growth timber to replace the virgin stands which the early communities had cleared and used. Most of the early inland towns were agricultural, and by 1820 from fifty to seventy per cent of the area was in farm or tillage. There followed, beginning about 1850, an extensive abandonment of farm and pasture land. Being an ideal seedbed for white pine and accessible to stands with abundant white

pine seed trees, these areas were promptly reseeded, so promptly, indeed, that the resulting stands were substantially even-aged and often very dense. By 1900 sixty to seventy per cent of the land area was again in forest, much of it consisting of these old field stands of white pine. Meanwhile the virgin forest had been reduced by cutting to a very few small and inaccessible stands. The remainder of the forest area was represented by a second growth of mixed hardwood consisting of coppice and advance growth following the cutting of the original forest and rarely containing a little pine, and a vast amount of heterogeneous woodland, both old field and tracts repeatedly cut, which was characterized by enfeebled growth and inferior species. Thus, just as the natural supply of timber was nearing exhaustion, a new supply, resulting not from forestry but from the failure of agriculture, came into being; and during the twenty-five years from 1900 to 1925 it furnished woodworking industries with fifteen billion board feet of raw material.

The life history of this old field forest and its reaction to the wholesale clean cutting that lumber operators have hitherto applied to it, indicate that pure pine is a transitional type. Originating for the most part on the better quality of soils, such as were chosen for farming, the volume produced per acre in from fifty to sixty years often exceeded fifty thousand board feet (7100 cu. ft.) and averaged about thirty (4200 cu.ft.). Natural pruning was slow; and though knot size was often small, no clear timber was produced. In spite of early rapid growth, increment fell off abruptly at about this age. Although some of this decline was undoubtedly due to overdensity and resulting crown abrasion, it was generally associated with a gradual shrinkage of top soil, retarded decomposition of leaf litter, increasing raw humus, and the beginnings of a podsolized profile. Older stands, especially those on moister situations, were frequently infected with so-called

red rot (Trametes pini), sometimes causing defect in as much as ten per cent of the volume. In the absence of any cutting or other disturbance of the canopy, practically no advance reproduction of pine developed on the ground. On the other hand, because of the usual admixture of scattered hardwoods, such as red oak, white ash, chestnut (now practically eliminated as a commercial species by the disease Diaporthe parasitica), sugar and red maple, often left over from the previous pasture period, and the consequent dispersal of seed by rodents and other agents, there almost always appeared, beginning about the fiftieth year, a heavy undergrowth of hardwood, sometimes amounting on the better sites to as many as ten thousand stems per acre. When the pine stands were cut, the land was promptly restocked with this hardwood mixture, supplemented by additional seedling reproduction of such inferior species as gray birch, poplar (aspen and large-toothed), pin cherry, etc. Even when, as happened periodically, a pine stand was cut immediately after a fall of seed, the resulting reproduction was almost always eliminated by the faster growing hardwood, except in small patches where the soil was comparatively dry or the hardwoods scanty.

Aside from these general silvical tendencies there have been several other factors which in extreme cases and particularly in recent years have gone far to destroy the value of pure pine as a timber crop. Young stands are almost always attacked by the white pine weevil (Pissodes strobi), which kills the terminal shoot and sometimes even the previous one or two years' growth as well. This causes crooks or multiple stems and greatly reduces the ultimate timber value of the tree. The damage is considerably reduced in mixed stands or stands of high density; but with the preponderance of young white pine on abandoned farms, together with increasing

planting of pure stands, the insect has become so abundant as almost to discourage the growing of the species. Still another pest is the pales weevil (Hylobius pales). This beetle is very abundant during the first two years after the cutting of a pine stand. Feeding on the bark of small stems and twigs, it sometimes completely destroys any but very plentiful reproduction. A third menace is the European blister rust (Cronartium ribicola), already locally destructive in parts of New England and now pretty well distributed within the ranges of all three North American five-needled pines. In the case of the white pine, protection from this disease seems to be practicable, at least inlocalities where the wild ribes is not too abundant. Finally, the old field pine type, at least as a natural phase of succession, is encountering enormously greater competition from inferior species of hardwood and woody undergrowth than was present at the time of most rapid farm abandonment. In those times available seed sources consisted mainly of virgin forest or older second growth in which the longer-lived hardwood together with hemlock and pine predominated. As a consequence of increasing neglect of land, destructive logging, and forest fires, the light-seeded and short-lived species, such as gray birch, poplar, and pin cherry, together with aggressive species like red maple, have multiplied many fold. Thus, at present even where pine seed trees are abundant, abandoned fields and cleared areas are more apt to become reforested with an irregular stand of poor hardwoods and misshapen pine than with the heavy uniform stands so common a generation ago.

These conditions, as may be imagined, have had a controlling influence on the development of silviculture on the Harvard Forest. A wide variety of reproduction cuttings have been tried ranging from a conservative shelterwood with two or three successive cuts during a period of ten years to cleared strips or groups and scattered seed

trees. In general it can be said that in stands where deciduous advance growth is not well established and where a shelterwood sufficient to keep down herbaceous and weed growth can be left, reproduction is successful;but with any practice which exposes areas of more than a few square rods, the woody and herbaceous vegetation develops so strongly as to exclude any useful reproduction of pine.

Because of this tendency to revert to hardwood and because the virgin forest of the region had been chiefly a hardwood mixture with subordinate elements of pine and hemlock, it was decided as early as 1912 that the wise policy would be to build up a growing stock consisting of the better, more long-lived species of deciduous trees with as much pine as conditions of site and advance growth would permit. In working toward this objective some significant results have come to light. Broadly speaking, the conversion of pure pine stands has resulted either in pure hardwoods or hardwoods with a varying percentage of pine. On such areas there has taken place in from fifteen to twenty years a complete reversal of the tendencies in soil metabolism. Whereas the typical profile under the old field pine indicated a tendency to podsolization, under succeeding hardwood the accumulated raw humus disappears very rapidly and is often replaced, especially on the fresher sites, by a typical brown earth or mull, characterized by a deepening enriched layer, no raw humus, and a leaf litter containing no more than the fall of the current year. Quite plainly this transformation in soil was accompanied by a current increase in fertility and was reflected in the rapid growth and good form not only of the hardwood which formed the bulk of the stand but also in the pine. Natural pruning has been extremely rapid. At twenty-five years the dominant trees of white ash, white birch, and red oak show a maximum clear length of sixteen to twenty feet; the white pine has a potential knot size for the first log of half an inch or less and the prospect

of a high percentage of clear lumber at the end of the rotation. The general vigor of such stands, rapid growth, and favorable soil conditions seem so far to indicate a high resistance to insects, disease, and climatic injury.

This experience tends strongly to corroborate the original assumption that a mixed forest is the best objective for the region. To a certain degree it means a return to the composition of the virgin stands but with the elimination of certain less valuable species and of the irregular form which precluded uniform growth. It corroborates also the opinion widely held among lumbermen that the highest quality of timber is always found in mixtures. In practice, however, the ideal association of species cannot always be brought about in one rotation. In many pine stands desirable species of hardwood are scanty or lacking; in some the density is so low that woody underbrush takes the place of valuable advance growth; on very sandy sites, where hardwoods are at a disadvantage, pine often persists in a groupwise form which can apparently be maintained by periodic selective cutting. In central New England forests as a whole, the preponderance of inferior short-lived species of hardwood or of enfeebled defective coppice over the longer-lived more vigorous high forest has become enormous. It follows from this that for all our forests and for many years to come the greatest problem of silviculture will be the regulation of composition, particularly where it is most possible, in the younger age classes. This means a policy of "opportunism", of making the best of the existing growing stock but always with an eye to the ultimate and ideal composition.

The procedure on the Harvard Forest now is to adapt the method of securing reproduction to silvical conditions in the individual stand and to economies in time and cost. The pine element in the new stand may be secured by a reproduction cutting or by supplementary planting

after cutting, the latter, in many cases, the more cheap and effective. When the pine stand is ready for cutting at sixty to seventy years of age, all advance growth hardwood is mowed close to the ground. This has the advantage of making the logging cheaper and also of insuring a uniform even start of vigorous seedling sprouts in the new crop. All pine branches and unusable tops are burned in piles. Although it would be most desirable to do the necessary planting immediately, so as to gain an even start with the hardwood, experience has shown that this would result in the destruction of practically all the planted trees by the pales weevil. The planting is therefore done in the spring of the third year after cutting, when the beetles are no longer breeding in the stumps. Groupwise plantings are made with four-year-old trees, located as far as possible on the small elevations and drier spots or where hardwood is not so dense or vigorous, and in groups not less than three rods in diameter. In the cases where pine reproduction has been secured from natural seeding by previous thinning in the old stand, the reproduction tends best to survive the competition of hardwood on the drier areas. There follows the process of periodic weeding or cleaning, generally extending over a term of ten years. The heavier the soil, the more often must the weeding be done; but in general three operations suffice to regulate density and composition and establish in a dominant position the best species and the better stems in the new crop. The general objective in the weeding is to build up a stand in which the two elements, the hardwood and the pine, are more or less groupwise in distribution. Ten to twelve years after the logging of the pine the new stand is satisfactorily established and may be left to grow until thinnings are due.

For such stands the rotation has been set provisionally at from seventy to eighty years; but as the indications are that even at this age a high quality of timber will have been produced with but little

slackening of increment, it is likely that some stands may profitably be held over for a longer period. The expectable final yield will range from twenty to thirty thousand board feet per acre (2800 to 4200 cu.ft.), the variation depending largely on how large a portion of the stand is made up of pine. The total cost of regeneration is difficult to set exactly. Some, if not all, of the expense of slash disposal is properly chargeable to protection. The amount of supplementary planting required is variable, as is the subsequent weeding. In general, twenty to thirty dollars an acre will cover the expenditure properly attributable to securing the new crop. In the present economic situation any estimate of final value for the mature stand is impossible; but unless the demand for timber of exceptional quality disappears, the stumpage price will certainly be from two to three times as much as can now be had for the low grade product of the pure pine type.

The experience of the Harvard Forest with white pine seems to show that apparently natural forest types, even if temporarily productive and valuable, cannot always be taken as models for silviculture. During most of the country's history enormous supplies of virgin timber made any interest in forest production all but impossible. Later when a use for low grade timber had developed in New England and prices had risen in consequence, the sudden and accidental supply of valuable second growth provided an incentive for forestry. It stimulated interest in timber as a profitable investment and brought about the widespread policy of planting vacant areas with pure stands of white pine. It also confirmed the popular delusion that nature in spite of man's mistakes would continue, as in the past, to produce valuable timber. The evidence of management is that, on the better sites, pure white pine is a phase of succession which leads only to deterioration and inevitable conversion to a different composition.

List of Species

White ash, Fraxinus americana

Gray birch, Betula populifolia

White birch, B. papyrifera

Pin cherry, Prunus pennsylvanicum

Chestnut, Castanea dendata

Hemlock, Tsuga canadensis

Red maple, Acer rubrum

Sugar maple, A. saccharum

Red oak, Quercus borealis

White pine, Pinus strobus

Aspen, Populus tremuloides

Large-toothed poplar, P. grandidentata.

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ABANDONED FARMS AND PINE WOODLOTS

It is a curious and little known fact that the rapid decline of farming during the latter half of the nineteenth century brought an amount of unexpected and gratuitous wealth to New England worth not less than $400,000,000. In 1830 the life of the inland towns from central New Hampshire to northern Connecticut was largely agricultural, and for the region as a whole, pasture and tillage covered from sixty to seventy per cent of the area. About 1850, with the opening of the West, the building of the railroads, and the expansion of manufacturing in the larger towns, the abandonment of the farms set in. This reached its peak between 1860 and 1880, and resulted in redud ng the land under cultivation by several million acres. A number of exceptional and temporary conditions made these old farms peculiarly favorable for the reseeding of white pine. At that time there was still much of the old mixed woodland interspersed with the fields, and most of the trees were of long-lived kinds, such as oaks, ash, maples, hemlock, and white pine. The shorter-lived species, so common today as forest weeds - gray birch, poplar, fire cherry, etc. - were scarce or absent, because they could not survive in the forest and were kept out of the fields by cultivation and grazing. For the white pine, with its heavy production of winged seed, old sod land and recently cultivated areas offered an ideal seed bed, which the heavier seeded trees could not so promptly reach and for which there was no such competition from inferior species as there is today. In consequence, thousands of acres of old fields grew up to almost solid stands of white pine.

Meanwhile manufacturing in the region was rapidly expanding and with it the business of making containers - boxes, box shooks -

as well as wooden ware, all of which were using pine. By 1895 the last of the original timber was almost used up, and the older of the field grown pine stands began to be large enough to cut. Very soon, with the development and spread of the portable sawmill, four-fifths of the pine used for New England boxes was coming from these recent and totally unexpected forests. In Massachusetts alone in 1907 these woodlots yielded two hundred million board feet, the peak of output for the state, and during the war the cut for the whole of New England reached over seven hundred million. Up to 1930 in round figures the abandoned farms had produced without plan or expense a crop of at least fifteen billion board feet of timber. This means in terms of manufactured products not less than four hundred millions of dollars, of which more than half went in the form of land or stumpage purchases, wages, and transportation, to the people of the neighborhoods where the trees were cut. Undoubtedly this virtually free gift of raw material has furnished a substantial part of the means of livelihood to hundreds of upland towns and has gone far to keep many shrinking farms alive.

The growth and value of the white pine woodlot were remarkable and have not been equalled by any other type of timber in the history of New England. Most of the lots came to be cut when they were from fifty to seventy years old, the great majority, as would be expected from their history and the rise of the market, at about sixty years. At this age many stands yielded forty thousand board feet per acre, and volumes as high as fifty thousand were not uncommon. Between 1910 and the period of the war, ten dollars per thousand was a usual price for pine timber on the stump, and there were many instances where exceptional locations and quality brought prices as high as eighteen. This meant an actual stumpage value of from three hundred to six hundred dollars per acre.

These boom days for old field white pine coincided very closely with the beginnings of forestry in New England, the period when state departments, schools, and associations of forestry were being rapidly established. With such a model of natural forestry at hand and so large a part of the regional industries depending on it, it was no more than natural that white pine should be advertised and promoted as the ideal forest crop. The result was that many thousands of acres of vacant land were planted to pine, and in the minds of most of the general public, forestry came to mean planting rather than what it really is - the productive handling of natural forests.

In recent years market and economic conditions have profoundly altered, and scientific study and experience with the management of pine woodlots have brought out many facts about pure pine stands as a crop that were totally unsuspected in the early days of forestry. Today there is being used scarcely a third of the box lumber that was consumed in 1925. Some of this loss is due to the shrinkage in general business, but most of it to the development of pulp, fiber, and other materials for the making of containers. This leaves the market for native pine much restricted and the price correspondingly low. Nor is pine so successful a crop as the first generation seemed to be. Pure stands do not prune themselves rapidly and consequently produce relatively knotty, low grade timber, which is satisfactory for boxes but cannot easily compete with cheap and better lumber from the West and South. Twenty-five years of experience at the Harvard Forest have shown that pure pine forests tend to impoverish the soil, whereas mixed forests, containing a high percentage of hardwoods, tend to improve it. Moreover, pine growing in mixture with hardwoods not only maintains good growth to a greater age but produces a much higher quality of timber, owing to early and more rapid pruning of the branches.

Much of central New England is more suited by soil and climate to mixtures with a good percentage of hardwood - oaks, ash, maples, and white birch, which were characteristic of the original natural forests. This is further shown by the fact that almost all of the pine woodlots after reaching fifty years of age are found to be full of young hardwood seedlings and saplings, mostly carried in and planted by rodents, whereas in these stands little or no young pine germinates or survives. This is the reason why it is so commonly noticed that hardwood always follows pine after cutting and why so many thousands of acres of cut-over land are growing up to hardwood. To this invasion is added the enormous recent spread of forest weeds as compared to more valuable species. Fires, repeated cutting without regard to future crops, the widespread neglect of open land, have combined to multiply gray birch, red maple, and worthless sprouts to the point where many of the valuable species, especially pine, are killed off or suppressed in early youth. The outlook for the continuance of pine is still further clouded by increasing damage from blister rust and the pine weevil - both thriving where pure stands prevail. The truth is that on most of our upland soils pure pine is not a natural or permanent type of forest, and the peculiar conditions that for a generation have made it the leading native timber will probably never occur again.

There is still plenty of productiveness and prospective value in the potential mixed crops on thousands of acres of our so-called wild stands and cut-over lands. High grade timber, both pine and hardwood, is still in demand at good prices, and this can be very generally produced by the right treatment of young forest crops, whether on cut-over lands or old fields. Weeding is just as essential in forestry as in gardening - in the present state of our forests, more so. Worthless species and deformed and diseased stems should be cut out before they have time to suppress the better trees; and weeding applied in time can still convert many thousands of New England acres into stands more valuable and enduringly productive than can be created by planting.