

BIBLIOGRAPHY OF RESEARCH AT THE HARVARD FOREST

Harvard University
Petersham, Massachusetts

1907-1936

October 1936

MANAGEMENT OF HARVARD FOREST

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✓
Kimball, George W., and Carter, E. E. 1913

Influence of shade and other factors on plantations.

Forest. Quart. 11: 176-184.

1912 plant. 3A. PH III

1912 Brooks plantation - New SC VI

Summer of 1912 very droughty.

1911 WP seedlings disappeared in open

Survival in ^{medium} shade best

Fisher, R. T. 1928

Pine plantations and New England forestry.

Jour. Forest. 26: 790-793.

As alternatives to the pine planting policy — perhaps they should be called complements — three principal aims stand out

- ① Mixed stands with mixtures of hardwood or mixed softwood + hardwood.
- ② Development of the natural forest
- ③ economic solutions, such as coupe selling, forest owner assoc., forest taxation, and market improvement.

✓ Fisher, R. T. 1931

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Quarterly Jour. Forest. (Gt. Brit.) April. 12 pp.,
illus.

✓ Curtis, J. D. 1936

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Forest. Chron. 12(3): 291-299.

WP

cut collar

✓ Curtis, J. D. 1937

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Forest Chron. 13(2): 380-395.

✓ Gast, P. R. 1937 ✓

✓ Contrast between the soil profiles developed under pines
and under hardwoods.

Jour. Forest. 35(1): 11-16.

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Some interrelations of wildlife management and forest management.

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HARVARD FOREST

Manuscripts Ready for Publication

- | | |
|--|---|
| Branch, W. C.
Daley, R. K.
Lotti, Thomas | Life History of the Climax Forest
on the Pisgah Tract, Winchester,
New Hampshire. 1930. |
| Breckenridge, C. G. | Growth and Condition of the Conif-
erous Plantations on the Harvard
Forest, 1909-1928. 1931. |
| Cline, A. C. | Representative Cases in Silviculture,
1933. |
| Holsoe, Torkel | Management of Red Oak and White Ash
with Special Reference to Thinning.
1933. |
| Steed, A. V. | Reproduction Resulting from the Group
Selection Method in White Pine on
Light Soil. 1933. |
| Cummings, W. H. | Preliminary Study of Phosphorus,
Nitrogen, Potassium, and Moisture
Content of Foliage of Northern
White Pine in Weeviled Plantations.
1934. |
| Curtis, J. D. | A Study of Artificial Pruning in White
Pine Plantations. 1934. |
| Duffield, J. W.
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Method Applied to White Pine - Hemlock
Mixtures. 1935 |
| Johnston, J. W. Jr. | I. Statistical Analysis of the Distribu-
tion of Soil Fauna in the Soil Profile
and Their Effect on the Decomposition
of Organic Matter. II. The Influence
of Temperature upon Respiration of the
larvae of <i>Chrysopilus quadratus</i> . 1935. |
| Turberville, H. W. | Some Winter Relations of the Ruffed
Grouse in Petersham. 1936. |
| Goodell, B. C. | A Study of Spring Flood Factors as
Influenced by Certain Forest Cover
Types. 1937. |
| Gould, E. W. | Wildlife Food Production of Pine and
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- Gould, E. W.
- Life History of the Climax Forest on the Pisgah Tract, Winchester, New Hampshire. 1930.
- Growth and Condition of the Coniferous Plantations on the Harvard Forest, 1909-1928. 1931.
- Representative Cases in Silviculture, 1933.
- Management of Red Oak and White Ash with Special Reference to Thinning. 1933.
- Reproduction Resulting from the Group Selection Method in White Pine on Light Soil. 1933.
- Preliminary Study of Phosphorus, Nitrogen, Potassium, and Moisture Content of Foliage of Northern White Pine in Weeviled Plantations. 1934.
- A Study of Artificial Pruning in White Pine Plantations. 1934.
- Results of the Uniform Shelterwood Method Applied to White Pine - Hemlock Mixtures. 1935
- I. Statistical Analysis of the Distribution of Soil Fauna in the Soil Profile and Their Effect on the Decomposition of Organic Matter. II. The Influence of Temperature upon Respiration of the larvae of *Chrysopilus quadratus*. 1935.
- Some Winter Relations of the Ruffed Grouse in Petersham. 1936.
- A Study of Spring Flood Factors as Influenced by Certain Forest Cover Types. 1937.
- Wildlife Food Production of Pine and Hardwood Stands in the Harvard Forest. 1937.

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J. W. Duffield and J. H. Kraemer, 1935. The Uniform Shelterwood Method in Pine-Hemlock Mixtures on Light Soil.

A study of the amount, distribution and condition of pine and hemlock reproduction on the 2-cut and 3-cut shelterwood areas on the Fay lot--ten years after the first cutting. A complete account of cutting and logging included.

An analysis of the various aspects of reproduction and the residual stands, including amounts, sizes, growth rates of both old trees and seedlings, soil conditions, seed fall, influence of slash burning, soil scarification, etc. ^{on} in seed bed condition. Conditions under the two different degrees of shelterwood cuttings compared with those in the clear-cut strips adjoining, especially as regards soil condition and vigor ^{of} reproduction.

Provides new knowledge on application of shelterwood cuttings to pine and hemlock stands, having thick organic layer--an unfavorable seed bed. A very timely study which could be made ready for publication at an early date.

A. V. Steed, 1933. Reproduction by the Group-Selection Method in White Pine on Light Soil.

Three cutting areas analyzed -- (1) northeastern part of the Fay Lot, (2) Baker Lot in Warwick (owned by New England Box Company, and (3) the Ella Streeter Lot in Baldwinsville (owned by E. Murdock Co.). In all three cases the marking for cutting was done by the Forest. Cuttings were made about 12 years ago.

Amount of pine reproduction was correlated with ground vegetation, size of openings made in cutting, and method of slash disposal.

Striking differences were found between the most and the least favorable pine ground cover types, e.g., hypnum moss and blueberry, but relationships were obscure in several cases of mixed ground vegetation. Results showed need for changing former policy of slash disposal. Reproduction is increased by lopping and scattering.

The study provides new knowledge on a promising method of partial cutting in white pine on light soil. Good records of the cuttings are available, and analyses of resulting reproduction were carefully made. Some further work needed on manuscript.

Branch, Daley and Lotti, 1930. Life History of the Pisgah Mt.
Old Growth Forest, Winchester, N. H.

An analysis of the composition of the present old growth types in relation to topography, exposure, fires, wind throw, etc.

By dividing the composition of the stand into three layers (overstory, middlestory, and small sapling growth) tendencies toward change were disclosed. Ages determined by studying cut-over old growth stands. Soundest part of the study is this detailed composition analysis of about 75 samples falling under six different old growth cover types. Life history is fairly clear for some types, obscure for others. A start was made in mapping both stands and topography for some 5000 acres around Pisgah Mt. If many of the old growth stands remaining in 1930 have by now been cut, it would be difficult to complete the mapping.

Some sort of a publication is due,-- to make good on the generous gifts of money made for the study by the Massachusetts Society for

the Promotion of Agriculture. Rather than wait until the histories of all the various old growth types can be worked out (if ever), a descriptive bulletin, well-illustrated with pictures and including the available factual information on composition, fires, blowdowns, etc., might be made ready for publication within a few months.

J. D. Curtis, 1934. Artificial Pruning in White Pine Plantations.

Numerous pruned plantations on the Forest, Choate Estate, Hamilton and elsewhere studied to determine rate and character of pruning wound occlusion as related to spacing of plantation, growth rate, size and condition of limbs, tools used, season of pruning, etc.

Most of the pruned trees were analyzed in situ; others were cut down, and pruned portions cross-sectioned for analysis indoors.

New means were devised for measuring rate of healing of cuts, and many new observations made in connection with condition of branch at time of pruning (live, dying or dead). Limited time and material (stands pruned some time ago) prevented getting thoroughly satisfactory quantitative relationships between the many factors studied. General trends were disclosed, and many new ideas gained. More time could well be given to building up ^glayer body of field measurements. However, plantations pruned with saws sufficiently long ago to have permitted complete healing are rare, and further delay in publishing may not be warranted. A conference with Curtis on this point would be desirable.

HARVARD FOREST PERSONNEL

November 30, 1944

<u>Person</u>	<u>Title</u>	<u>Salary</u>	<u>Remarks</u>
Stephen H. Spurr	Assistant to the Director	\$2,800.	
Karl A. Grossenbacher	Instructor in Forest Botany and Research Associate of the Cabot Foundation	500.	\$2,500 additional from Cabot
Elizabeth Carpenter	Business Secretary and Librarian	2,040.	
Louise Anderson	Cook	636.	Mr. and Mrs. Anderson also
Severin Anderson	Janitor	936.	receive an apartment with heat, light, water
Charles F. Upham	Foreman of Woods Crew	2,000.	
Charles E. Robinson	Woods laborer	1,800.	
Frank L. Robinson	Woods laborer-part time	75¢ per hr	
C. Thornton Brown, Jr.	Conscientious objector on detached service to H.F.	none	Receives subsistence allowance of \$45 per month.
Margot W. Brown	(wife of above)	50¢ per hr	for part time work in library
Eleanor C. Cairns	Member of Catalogue Dept. at Widener	1,800.	On loan to H.F.
Pasqual Maffeo	Laboratory helper	\$28. per wk	temporary worker-to leave before 12/31
Paul E. Bruns	Technical assistant	\$35 per wk.	also temp.
<u>On Leave without Pay</u>			
Albert C. Cline	Director	\$4,500.	Left for Wash. Jan. 1942
Russell J. Lutz	Assistant to the Director	2,200.	Left for Marine Corps Feb. 1942

P. R. Gast was appointed Assistant Professor of Forestry for three years from July 1, 1942. Since the summer of 1943, he has worked entirely at the Biological Laboratories.

Report on Forest Management and Research

Harvard Forest

May 1, 1936 - January 31, 1938

FOREST MANAGEMENT

Cuttings:

Substantial progress has been made in concentrating cutting in order to work toward systematic coverage by compartments and blocks. Beginning in 1936, compartments I, VII and VIII of the Prospect Hill Block were selected for treatment over definite, sizeable areas in order to clear out a number of low grade hardwood stands and scattered patches of white pine.

Approximately 650 cords of wood have been cut in two years from stands of too low grade to be held for sawtimber. A combined thinning and selection cutting was made in a stand of about two acres of 40-year hardwoods to improve the sawtimber quality and increase the growth rate.

The 1915 red pine plantation on Prospect Hill was entirely thinned, yielding 12 cords of wood, sold for \$36, and 1000 feet of sawlogs sold for \$16.50.

In 1936-37, 311,197 board feet, mainly of pine box board planks, were cut in scattered stands of poor quality in this Prospect Hill area.

In 1937-38, about 350,000 board feet of pine with a small quantity of hemlock and hardwood and about 100 cords of cordwood were cut in a systematic covering of compartments IV and VI of the

Slab City Block. This was in the form of a partial cutting salvaging weak and rot infected trees and laying the basis for experimental work to endeavor to obtain natural reproduction of pine, hemlock, and hardwood in mixture. About forty-six acres were covered by this treatment.

A number of cuttings were made to clean up unsightly spots and to improve the appearance of approaches to the Forest. A gypsy moth infested hardwood stand bordering Tom Swamp was cut, leaving a protective strip along the shore, which was given a cleaning. A ragged corner where the road enters south of Tom Swamp was cleaned up. The Tom Swamp picnic ground was thinned and pruned, and the undergrowth opened up. The Metropolitan Commission constructed a parking ground at the edge. A number of large trees along the right of way of the new highway adjacent to the Tom Swamp Block were saved by negotiation with the Commission. At the request of the Forest, the Commission purchased the Hathaway farm on the Barre Road to prevent threatened clear cutting to the edge of the road. On the Tom Swamp road an unsightly and gypsy moth infested patch of poplar was cut. On the Barre Road, in the present winter's operation, special attention was paid to improving the appearance of the stand where it borders on the road. The old pines on Sunset Lane were pruned and dead timber removed. The program of improving main entrances will be continued.

Prunings:

A crop tree pruning was made in seven acres of a mixed red pine and white spruce plantation east of the Forest headquarters.

Another covered two acres of Norway spruce and white pine in the Slab City Block. A second pruning was made on selected pines along the trail between the cabin and observation tower on the Schwarz lot. On Prospect Hill all except the control plot in the 1915 red pine plantation, all of the 1918 red pine plantation, and the red pine plantation near the French place were pruned. The total covered was just over fifteen acres.

Black Brook Thinnings:

An arrangement suggested by Dr. Merrill was made with the town of Hamilton to use relief help, without cost to the Forest, in doing the actual cutting in thinning these plantations given to the Forest by the late Nathan Matthews. Mace Raymond, under the supervision of W. W. Hosley, marked the plantations needing treatment over the whole property and the chopping crews completed the thinning of the block west of the railroad and part of the large block east of it. About fifty acres were covered. The work has now been resumed, to be paid for out of the income of the Matthews endowment. Whatever the ultimate disposition of these plantations, the University is under a moral obligation to keep them in good order so long as it retains title and so far as funds permit.

Plantings:

Sixteen plantations totaling about thirty-four acres were established. Several of these were a part of the hardwood experimental planting project being carried on with the help of Professor L. C. Swain of the University of New Hampshire.

Forest Reinventory:

The transit boundary and compartment boundary survey has been completed with corners marked by numbered brass caps on galvanized pipes and intermediate points marked by pipes. The inventory cruise has been completed in 28 of the 29 compartments. All of the cruise figures have been computed and checked. New compartment maps have been made for 13 of the 29 compartments. Compartment summary sheets have been completed for 5 compartments. The office work is going forward and should be completed this spring.

The survey and cruise, when completed, will supply the following information:

1. Definite, accurate location of the Forest boundaries
2. Accurate compartment boundaries
3. A definite system of reference points on which to base maps and records
4. The new inventory of the growing stock including
 - a. Species
 - b. Quality
 - c. Age
 - d. Density of stocking
 - e. Stand form
 - f. Volumes and sizes
 - g. Site classes
 - h. Present growth rates (ring widths for 10 yrs.)
 - i. Advance growth present
 - j. Ground cover present
 - k. Needed treatment
5. A check on the changes in the growing stock since the 1925 inventory
6. A systematic plan for all cultural operations

All the above data are to be combined into a Ten Year Management Plan. In this plan, special stress will be laid on

- (a) Priority of cultural operations, determined by urgency of need and laid out on a systematic time schedule.
- (b) Selective cutting instead of clear-cutting in order to improve the whole growing stock, to increase the increment, to reduce the expense and avoid the dangers of planting, and to lay the basis for a long range research attack on natural reproduction and the establishment of many-aged stands.
- (c) Systematic geographical concentration of cultural operations in stands of all ages to decrease costs of work, to bring about more homogeneity over large areas, and to give visitors the opportunity to see extensive contiguous treatments.

The Management Plan will also include a systematic road and trail and fire protection improvement plan.

Road Improvement Work:

In order to best protect the Prospect Hill Block from fire and to put our work into a road system under our control, a start was made on the interior roads. The one from the headquarters to the Locust Opening and the Bryant Road have been graveled so it can be used by passenger cars. The road along the Swift River and out to the state road at the upper end of the Slab City Block and the one west of the pond in the Tom Swamp Block have been similarly treated. The two other main internal north-south roads east of the pond have been patched up so they are passable also. The total mileage graveled is about two and the same length was patched.

Trails:

Several new trails were constructed in all of the blocks of the Forest to allow access to plantations and dense young hardwood stands. About $1\frac{1}{2}$ miles were completed.

RESEARCH

Permanent Sample Plot Work:

Work on sample plots during this period has been aimed at remeasurement of those needing it and establishment of new sets of plots to show results of treatment and growth in types having no plots.

In the oldest red pine plantation, established in 1915, a second thinning was made in the three treated plots (.47 acres) and all measurements for this and the control (.14 acres) brought up to date. Earlier thinning in this plantation has indicated that this work should be started early--at about the time the dead length is at a height of about four feet--to prevent abrupt growth stagnation.

In the second oldest red pine plantation, planted in 1918, crop trees were pruned through the plantation of 2.8 acres and a series of marked trees established to compare the results of pruning with and without cutting into the branch collar. Measurements and a record were started for seventeen marked trees.

No Norway spruce plots had ever been established in the Forest, so a set of three tenth-acre plots was laid out in the oldest plantation, which was 24 years old. One plot was pruned

and heavily thinned, another pruned and lightly thinned, and the third was left as a control. All trees were tagged and detailed measurements were made.

A study made by J. D. Curtis indicated that Norway spruce is the species most rapid in the healing of pruned cuts. As a check on these preliminary results, fifty-one trees were marked and pruned to varying lengths of green crown and by various methods to get the effect on growth and healing.

The set of spacing experiment plots in white pine back of the Fisher garage (four treated and four control plots) were all remeasured in detail. The wider spacings, 5 x 5 and 6 x 6 feet, were treated for the first time by pruning crop trees and girdling scrubby ones to favor them.

Forest Protection:

Because of the unstable conditions of the existing forest cover types, brought about through disruption of the balance in nature, the establishment of many artificial stands by planting, usually of a single species and often of exotics, and the continued introduction of insects and diseases, forest protection is of ever increasing moment. Thus far in New England more money has been spent on insect and disease control measures than on all other phases of forestry combined.

Since the Forest staff does not include either an entomologist or a pathologist, it has been necessary to develop cooperative studies of insects and fungi on the Forest itself.

Gypsy Moth Studies:

In 1936 the study of the distribution and feeding habits of the gypsy moth in Petersham, begun the previous year with the Division of Forest Insects, Bureau of Entomology and Plant Quarantine, was continued and enlarged. Results of the 1935 study, by W. L. Baker and A. G. Cline, were published during 1936, and a bulletin on "Silvicultural Control of the Gypsy Moth," by C. E. Behre, of the Northeastern Forest Experiment Station, A. G. Cline, and W. L. Baker, was published by the Massachusetts Forest and Park Association. This study of the feeding habits of the insect in relation to forest types, initiated by Cline in 1934, already has resulted in greatly increased interest and action in silvicultural control measures, as contrasted with the costly direct methods of crosscutting and spraying so commonly used for the past thirty years or more. For it was shown that heavy defoliation takes place only where the highly favored food species, gray birch, aspen, and oak, comprise more than 50 per cent of the stand; and that, since gray birch and aspen are weed species and much of the oak too coarse and crooked to make good crop trees, improvement cuttings and gypsy moth control might be advantageously combined and protection afforded at little or no extra cost.

In order to follow more closely the feeding habits of the insect in varying mixtures of hardwoods, six plots were established in 1936 in Compartment I of the Fox Swamp Block. Records are being taken each year of defoliation by species.

In 1937 cooperative studies were further extended through the assignment of Dr. H. M. Bess of the Division of Forest Insects

to establish additional plots in the Harvard Forest for the intensive ecological study of the gypsy moth over a period of at least ten years. The periodic natural rise and fall of local moth colonies, and the current rate of feeding and mortality as influenced by weather conditions, parasitic and predacious insects, birds, bacteria, etc., will be followed by means of ground trays to catch the droppings (a measure of feeding rate) and dead caterpillars, counts of egg masses and hatches, and quantitative analyses of the effect of all organisms playing a part in the natural control of the insect. Self-recording meteorological instruments have been installed. Four sample plots were established; two in oak stands in Tom Swamp, Compartment VII, and two in aspen in Tom Swamp, Compartment VIII. Special significance attaches to this project, since it is believed that similar ecological studies must be made for all major insect pests before any scientifically sound and economically practicable methods of control can be developed.

Partial analysis of the data collected during the feeding season of 1937 shows certain extremes of weather conditions to cause high mortality of the caterpillars. Parasitic insects also were much more effective than previously supposed, particularly in the pupal stage.

Decay Hazards in Hardwood Sprouts:

By virtue of repeated clear-cuttings, the present forests of central New England are more than ever before composed of stump sprouts. There are tens of thousands of acres of hardwood coppice

which will require improvement, if anything better than cordwood is to be produced. While it is known that stump sprouts are specially subject to decay and therefore risky to hold for saw-timber, too little has been known as to the action of fungi in relation to species, size of stump, position of sprouts on the stump, or to the cut stubs left in sprout clump thinning.

The Forest staff has been aware of the need for studies of this subject, and in 1937 arranged with the Division of Forest Pathology of the Bureau of Plant Industry to assign a member of its staff to work on decay hazards in the more important New England hardwoods. During the field season of 1937, Dr. W. A. Campbell in cooperation with A. C. Gline undertook the dissection and analysis of paper birch and white ash sprouts on the Harvard Forest and elsewhere in the region where stands suitable for study were available. Sample areas supporting sprout growth of several different ages were clear-cut, and the stems cross-sectioned and examined for the presence of decay organisms and their means of entrance. In the case of paper birch, sufficient data were collected to justify preliminary recommendations for sprout treatment. In general, decay hazards are much greater in this species than in oak or ash.

The dissection of white ash sprouts showed this species to be highly resistant to decay, even for old trees which originated from very large stumps. In a 70-80-year-old stand in Compartment IV twenty-two ash sprout clumps were cut close to the ground and stumps and stems carefully examined. Although decay was present in 65 per cent of the stems, which had entered chiefly through open wounds in

the parent stump, it extended up the stem only three feet as an average.

This finding will modify the former policy of limiting choice of ash crop trees in young stands of sprout origin to those from stumps less than three inches in diameter. The safe use of sprouts from larger stumps greatly increases the opportunity to develop good sawtimber stands on many cutover areas.

Forest Influences:

Although it is generally recognized that forest cover retards run-off and promotes equable stream flow, there has been little research of such character as to permit concrete evaluation of these influences for a given forest region or type. It is obvious that not all forest types possess the same water-conserving powers; and that, even within a given type, density, age, and other factors affect the water-holding capacity.

Mr. B. C. Goodell, a graduate student working under the direction of Dr. Gast and Mr. Cline, studied the influence of four contrasting types of vegetative cover on run-off during winter and spring (1936-37), the seasons during which floods commonly occur in New England. Four cover types desirable for study were found on adjoining areas having essentially uniform elevation, slope, aspect, soil, and drainage. They were (1) a 70-year-old white pine stand, (2) a 35-year-old mixed hardwood stand, (3) a 20-year-old red pine plantation, and (4) an open abandoned field. In each of these types, systematic records were kept of air temperature, soil temperature (at varying depths from the surface down to two feet), snow depth, frost depth, permeability of frozen

soil to surface water, and the moisture content of frozen soil. Considerable time was devoted to the development of suitable instruments. Insulation of the soil thermometers was accomplished by the use of heavy, waterproofed cardboard tubes. A soil borer of original design was used to extract small cores of frozen soil. An improved method of extracting a sample of frozen soil and testing its permeability was developed.

Weather conditions during the period of field tests chanced to be very unusual, with much rain, very little snow, and higher than normal temperature average.

The results of the investigation may be summarized as follows:

1. Air temperatures were found to average higher under the hardwood than under the white or red pine.
2. After freezing, soil temperatures were generally higher in the hardwoods and in the open field than in the two pine types.
3. The two pine covers were better conservers of snow than the hardwoods or the open field.
4. The least frost and earliest thawing occurred under the hardwoods; the deepest freezing and the latest thawing under the red pine plantation.
5. No percolation in perceptible quantities took place through duff, humus, or mineral soil when these layers were frozen.
6. High percentages of gravitational water were held as ice in all cases. The greatest amounts were held by the hardwood and white pine soils. The water so held in the organic layers of the soil apparently largely reduced the insulating value of these layers against loss of soil heat.

With the prevalent light snowfall, heavy rain, and cold weather attending the experiment, the depth and duration of freezing the soil were apparently the most important factors affecting run-off. Since insolation is the chief deterrent to soil freezing and the principal aid to early soil thawing under such conditions, the hardwoods, because of their open canopy, appear to provide a better cover than conifers in retarding run-off. With heavy snows, however, conifers may be more favorable than hardwoods. Conifers intercept considerable snow and better conserve what snow reaches the forest floor, thus giving more protection to the soil against freezing and rapid melting, thus retarding run-off. Thus, coniferous forests may in general be best-suited to amelioration of flood factors in the north, where snow is deep, and the hardwood forests may best serve these same ends in southern New England, where snow is largely replaced by rain. The primeval distribution of the New England forests--spruce and fir predominating in the north, and oak, chestnut, and hickory in the south--may afford the best control of winter and spring run-off.

Silvicultural Management Plans for Farm Woodlands:

As a means of training for government service in improving farm woodland management, three graduate students, under Mr. Gline's supervision, have been studying silvicultural conditions in the town of Hardwick and making detailed silvicultural management plans for about forty-five farm woodlots. This study is also a contribution to the Worcester County Land Use Study, sponsored by the University in collaboration with a number of

federal and state agencies, in that it emphasizes silviculture as a part of the agricultural problem. The study includes an inventory of growing stocks, types of silvicultural treatment needed, determination of growth and yield, and detailed prescriptions of the kinds and quantity of timber to be removed and of that to be left. It is the most detailed analysis of growing stocks ever made in this region. Attention is also being given to present and potential marketing outlets in the adjacent region--a study that should help the Harvard Forest in its own marketing problem.

Game Management Research:

The work in game management has been aimed at the interrelations of forest animals and the forest. Ernest Gould completed a study of the production of low-growing wildlife food plants in the old field white pine-mixed hardwood succession of forest types. This study showed that from the time of old field abandonment production of wildlife foods increases to a peak about fifteen years later, goes to practically zero in pine 10-30 years old, rises again to a peak in pine at about 60 years, reaches the greatest peak of all after cutting of the pine, goes to another low as the hardwoods close in, and rises to a medium high peak in older hardwoods.

At present A. E. MacGregor is spending his second year toward a doctorate working on the habits of the red fox. So far, results indicate that in the Harvard Forest this animal is much more of a vegetarian than is generally supposed.

V. A. Gould, working for a master's degree, is studying the food habits and movements of the snowshoe hare in the spruce swamp on Prospect Hill. The requirements for this mammal are little known, although thousands of dollars are spent annually in attempts to stock new covers with it.

N. W. Hosley has completed his doctorate thesis on woody plants used as food by game birds and mammals in the north-eastern United States. It is hoped that this will be published as a book by the Paack Foundation.

Good ? New use

33-1 stab in
gang Ad TSI

42-1 BC

43-3 Pop

44-3 NS

45-2 DDT

46-4 EL

40-1 BD Regen

41-1 Coppice

41-2 Wpn Sup

44-8 Pam Sample

5

5

1

No good

Close out

43-2 climate

35-2 stool Ad

44-1 Plant.

41-5 paste

44-10 Gas Fern.

40-3 Ash

47-1 Gyp Meth
Wendell

3

4

Active Research

① W.P. Seed Source Experiment. Exp. '24-1. PHI.

Progeny experiment to test "somatic expression". Results largely effaced because of heavy weevil damage. Now classified as White Pine plantation, 24G. (Probably simply Planter 24-G)

② Exp. '30-1 (A) Reclamation of Weeviled White Pine.

Describes a pruning and girdling experiment conducted in plantation No. 19A in PHV, designed to bring some of the better formed members thru' as pruned crop trees. Results published in Bull. No. 152 of the Mass. Forestry Assoc. (1931?) and in Jour. For. Vol. XXXIII. No. 11, 1935.

Numbered trees - Check - New use? or Cont?

③ Exp. '30-1 (B) Reclamation of Weeviled Pine.

Similar in lay-out to 30-1 (A) but since reduced to naught by hurricane. (Gone)

④ Exp. '34-2. Plot A. Notes on the establishment of a scarified seed bed on the two-cut shelterwood of T.S. IX or Fay hot.

A plot 7'x20' est., duff and vegetation removed. Plot is marked on cloth map in 1938 Atlas of Tom Swamp. The last and only quantitative measure was taken in 1941 (J.W. Johnston Jr.). No further measurements have since been made. (Check - ^{or Cont?} New Use?)

⑤ Exp. '34-3. Shelterwood Reproduction.

Estab. by Duffield and Kramer to measure stocking of White Pine and Hemlock regeneration under shelterwood cuttings. In 1940, a relocation of the plot and a remeasurement were made. It was found impossible to compare these with the '34 results, so that the study becomes in effect a post-hurricane regeneration experiment. The plot, 150'x50', contains 75 10'x10'

Exp. No. 46-4.

(?)

European harch Seed Source Exp..

Again in connection with the Int. Union of For. Research Organizations. The seed samples obtained by the Harvard Forest are listed and the transplant beds in which they were raised (at the Shaker Hall) are noted. Where the transplants went subsequent to '46. is a mystery. Until this is known, no further work is possible.

Exp. 44-1

Plantation Study.

(N G)

A collection of plantation records taken out of the active research plantation record. There is nothing to tell us what the original exp. was set up to prove and it is quite unintelligible otherwise.

Exp. 43-3.

PH IV and PH III. Plots A & B resp.

(Check-Value?)

To test the value of poplar cuttings as planting stock. Both hybrid and native stock were used. Rootone was applied to some. Plots are not well described as to location. A was marked with chestnut stakes and could be found presumably. For this and remeasurement purposes, the assistance of K.A. Grossenbacher who estab. this exp. is almost essential. Measures have been made in '44 & '46. The last comments that the experiment should be carried on on observation basis only. (Poorly described)

Exp. 44-3.

PH III. Plantation '44B. N.S.

(Check - Well documented etc)

The effect of seed source and consequent genetic variation is to be measured in contiguous plots of Norway Spruce, the seed for which was obtained thru' H.I. Baldwin acting as distributor for the International Union of Forest Research, Commission on Tree Races and Tree Seeds. The plots of which there are 28 in an area 175' x 140', were estab. by Spurr, measured in '44 by C.T. Brown Jr., inspected for survival in 1944 by Maffeo and Muollo, and again by Rose, Campana, Johnson and Stevens in 1946. In 1947, (July), sections of the experiment were measured by the student body.

Exp. 45-2.

DDT spraying to control Gypsy moth.

(Check?)

Areas throughout the forest (see map in file) were sprayed using varying mixtures and concentrations of DDT. All plots were heavily infested at time of spraying. No subsequent measurements or observations have been made.

Co-Experiment 30-1. Prospect Hill V.

The reclamation of a severely weeviled white pine stand.

History.

The originators of the experiment, Dr.H.J.MacAloney and A.C.Cline, had in mind, in setting up this joint experiment, "the possibility of improving a severely weeviled white pine plantation by pruning and girdling". Observing that the better formed trees were in the co-dominant and intermediate crown classes, they advocated a method of treatment that favored such trees. By pruning to get clear length and by girdling overtopping dominants, they hoped to promote growth on the selected trees that were other than dominant in the plantation.

Apparently, the underlying idea was that an increase in quality yield could be obtained by pruning and gradually releasing the better formed trees in the intermediate size classes.

The following operations have been conducted in the experimental area to date:-

Planting of the white pine(19A)	1919
First pruning and girdling	1930
Second pruning	1932 & 1933
Third pruning and girdling	1936
Fourth pruning	1938
Hurricane salvage cut	1941
Thinning	1945

Originally there were 154 trees in the tenth acre sample plot established in the plantation in 1930. Of this number, 39 were pruned and numbered.

All the above operations, itemised above, covered the entire plantation and the sample plot established in it.

The information presently on record taken on the numbered trees comes under the following heads:-

Tree No.
Height(Presumed total height)
Crown class
Dead Length
Height of pruning
Average knot size
Diameter, breast height, outside bark
Extent of weevil damage
Remarks.

Present condition of the experimental area.

The following table will summarise the information concerning the numbered trees on the experimental tenth acre plot.

TABLE

Present Condition of the marked exp. plot - Exp. 30-1.

TREE NO.	D.B.H.	YEAR OF TREATMENT					COULD BE PRUNED FURTHER
		'30	'32	'33	'36	'38	
7A	3.8	*	*		*	*	YES
10A	6.8	*	*		*	*	YES
15A	NO TRACE					*	-
74	6.3					*	NO
77	7.5					*	NO
91	7.2	*	*		*		YES
93	5.4	*	*		*	*	NO
100	6.3				*	*	NO
101	8.5					*	YES
118	9.1	*	*		*		NO
119	7.1	*	*		*		NO
129	NO TRACE	*	*				-
133	6.4	*			*		NO
135	5.1	*	*		*	*	YES
139	NO TRACE		(*1934)		*	*	-
154	7.8	*	*		*		YES
157	6.8	*	*		*	*	YES
160	NO TRACE	*	*		*	*	-
163	6.6.	*	*				NO
176	5.8.	*	*		*	*	NO
180	NO TRACE	*	*		*	*	-
197	DEAD						-
204	NO TRACE	*	*				-
205	6.7			*	*	*	YES
208	8.8	*	*		*	*	YES
217	DEAD						-
221	6.3			*	*	*	NO
223	7.5	*	*		*	*	YES
225	8.5	*	*		*	*	YES
239	6.7	*	*		*	*	YES
244	8.3	*	*		*	*	NO
246	5.7	*	*		*	*	NO
259	NO TRACE	*	*		*	*	-
260	6.6	*	*		*	*	YES
265	NO TRACE	*	*				-
271	7.1	*	*				NO
272	10.4	*	*		*	*	YES
276	DEAD						-
277	8.0	*	*				NO
287	4.4	*	*				NO
288	8.6	*	*				NO
292	?	*	*		*	*	YES
304	NO TRACE	*	*				-
305	NO TRACE	*	*		*		-
311	8.5	*	*		*		NO
323	5.4	*	*			*	YES
329	9.1	*	*		*	*	YES
332	7.3					*	YES
350	11.2					*	YES
352	NO TRACE 4.4					*	NO
362	4.5					*	YES

The plot has been relocated on the ground and all numerals, legible at the time of this inspection, were re-painted.

The following is the situation then with regard to the sample plot:-

Total number of trees 68
Total number of numbered trees 38
Total number of numbered trees which
could be pruned again with advantage. 18

The number of trees on the plot has been reduced over the past 25 years, by girdling, salvage cutting and thinning, from 154 to 68. Today, 35 of the 68 trees on the plot are numbered. If my interpretation of the original purpose of the experiment is correct, the latter represent the final crop trees on the experimental plot area.

Future Plans and Treatment for the experiment.

It is suggested that a second thinning is now desirable. Many of the crop trees are now in a dominant position in the stand and require release. A number of dead and suppressed members also require removal. If a thinning is done, it is recommended that:-

(a) wherever possible, numbered trees should be retained as crop trees. Should a numbered tree have as its neighbour a straighter, better formed tree less severely damaged by weevils, then, at the discretion of the marker, such a tree may be selected as a crop tree. Note shall be kept of all numbered trees so removed.

(b) the data collected on the plot be organised under the previously listed heads, omitting 'dead length' and 'average knot size'.

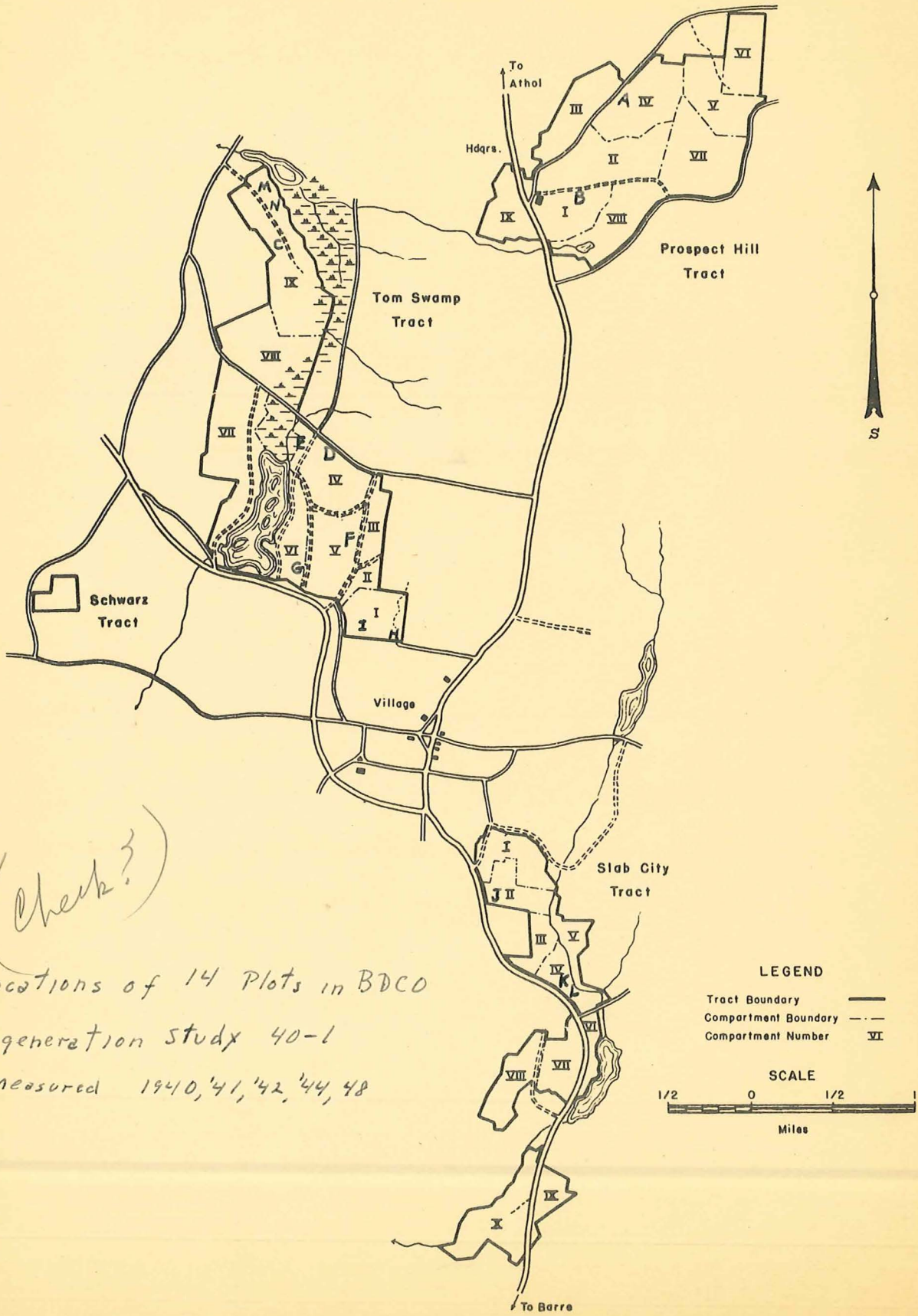
(c) the entire plantation be marked for a similar thinning at the same time. (total area - 0.5 acres).

(d) all limbs be removed on the selected crop trees to the live crown.

The experiment will presumably terminate with the harvest of the plantation. It is a considered necessity at this time to restate and amplify the original objective of the experiment.

OBJECTIVE. Evidence is being sought by this experiment to support the contention that it is more economical to select the better formed trees in a badly weeviled white pine plantation with a view to favoring them throughout the life of the stand by pruning and judicious release in order that, on conversion, these trees shall have greater value per unit of measure larger, malformed dominants not so treated. *Than*

P - normally the intermediate and co-dominant members.



(check?)

*Locations of 14 Plots in BDCO
Regeneration Study 40-1
measured 1940, '41, '42, '44, 48*



(final check & wind up)

Exp 40-3 Ash Provenance Test

4 plots 15'x50' to 40'x50' were laid out and planted white and green ash from various areas to test their survival.

Plot A - PHI

Plot C - PH IX

Plot B - PHI

Plot D - TS IV

The plots were checked for survival in 1941 but not afterward. All plots are marked w/ stakes and probably can be found again.

Probably this could be observed again & the original purpose would be served after 15 years if allowed for establishment.

(Check needs cut)

Coop-Exp 41-1 Coppice Conversion into Sawtimber

9 plots divided into 3 sets - 1 set control; 1 set drastic reduction at age 7-10 to 1 sprout/stem; 1 set for gradual conversion over 3 cuts at 5 yrs, 10 yrs, etc.

Plots to acre

Set up w/ Ray Hansborough

1st treatment gives gradual reduction group in 1946-47

Records include numbered tree measurements & stem maps.

Plots relocatable

Second cut past due for gradual area

Only cut for drastic area also past due.

Co-Exp 41-2 White Pine Partial Suppression (Check for new use)

Started in 9 year old Wpn Plantation w/ overtopping

RO RM & GB. To test effect of overtopping Almonds

on Weevil attack. 3 degrees of weeding set up

(41-2 cont) Weeded several times - last in 1948. Designed to ~~carry~~ ^{continue} until ~~the~~ 1st log is dead length. Stand now about 23 yrs old.

Original purpose may not be realized but perhaps plots could be ~~to~~ be turned to other account.

44-8 Sample Plots - Volunteer stands in PH

31 plots varying from 1/4 to 1/2 acre in size were set out in 1944. All trees 2" & over were measured in dbh by 1" classes and sample heights taken. No write up of purpose, method, marking etc is left. These should be checked to set up purpose & see if data are comparable.

Check for usefulness

44-10 Gas Generator

Little data - apparently finished

47-1 ~~see~~ Gypsy Moth. Plots in Wendell State Forest.

Plots treated w/ DDT by Brauer and egg cluster counts made. Planned to continue 5 yrs to check changes in ground cover etc. Apparently not run beyond 1947-48. File contains letters and ~~photos~~ ^{maps} of areas & plots. No tree or insect body data. Apparently completed or discontinued. This was a Cooperative Exp w/ Bur of Ent & Plant Quar.

NE

AC

6) Co-Exp. 35-2. Stool Heights. (Close out.³)
To determine whether the ht. of cut on companion stems will affect the incidence of heart rot in the selected stem following sprout reduction. Last measure 1940. Three 0.1 acre plots marked by orange colored pipes. (Check) (Tagged trees-³)

7) Exp. 33-1. T.S.I. Plots A, B, and C. (Check)
To follow the course of development (Goodlet's anathema!) resulting from a series of treatments aimed to produce high quality timber on a rotation of not more than 70 yrs.

Two plots A and B (for location see sketch map), each 0.25 acres, were thinned by Cline, Stolse and Steed in 1933. A control plot, C, 0.5 acres was established at the same time.

Subsequently, a student report in 1941, a measurement in 1947, and another thinning in 1948. This last operation thinned Plot C also; thus there is no longer a control.

8) Co-Exp. 41-5. No plots. P.H.I. (Check) Postb)
To test 3 methods of chemical impregnation known as "stepping", "collaring" and "capping" on local forest trees. Posts from treated trees inspected '42 and '53.

9) Exp. 43-2. Local Climate study. (Close out.³)
Little ^{date} of value. Racker's thesis probably has rendered such an experiment unnecessary. (Really outline of exp)

10) Co-Exp. 42-1. 4 plots. T.S.V. (Check + Write Shapler)

Black cherry perpetuation. 4 plots received different treatments:-

- A. Tent Caterpillar controlled. No silv. treat..
- B. No cat. control but weeded as
- C. " " " and weeded often as necessary.
- F. No treatment of any kind.

Measurements and inspections have been made in '42, '43, '44, '45, '46, '48, '50 and '51
Sketch map of plot locations in file (Total area involved 0.4 ac.)

H. H. Blanchet thinks that northern
provenance will solve first survival
of black walnut seedlings. Cornwall
and Brookline stocks are not
hardy enough for Petersham.

He uses hydrated lime to repel
gray squirrels

Sept. 19, 1941.

Memo. in **RE:** White Oak Propagation
Experiment.

Inspection of the three plots bordering the Lane Swamp Road showed that leaf fall had begun.

It was observed that some leafless seedlings appeared to be dead, since the bark was dark and very tight.

Therefore, when the annual inspection is made during the time of late frosts in the spring of 1942, separate records should be made of the number of seedlings which did not leaf out, as well as those whose foliage exhibits the characteristic

blackening following frosting.

Failure of the seedlings to leaf out in 1942 will prove that death occurred during the 1941 growing season. Possible causes are: summer drought (this has been a dry year; shock of transplanting - lateral roots may have been too few; or defoliation by an insect. ~~Evidence~~ Evidence of the latter factor has been noticed on quite a few young ash on various parts of the Forest.

J. W. Johnston, Jr.

Notes on Impressions of Prospect
Hill Block

1. Stands suitable for the initiation of the Selection System on Compts. II^{IV} and VI - mixed softwood - hardwood types.
2. Stands suitable for Improvement Cuttings.
Compt. VI, Hd-1 (4.4 ac.)
3. Stands suitable for Type Conversion into the gumprine, uncrenaged form in next generation
Compt. III, Hd-1 (34.1 ac.)
4. Stands in dire need of Weeding.
Compt. III, Mx. Sd.-1 (26.7 ac.)
5. Boundary^{stakes} missing and out of place - !

P.H. III, Hd-1 (34.1 ac.)

P.H. III, Mx. Sd-1 (26.7 ac.)

P.H. VI, Hd-1 (4.4 ac.)

5000

First field

Second field

Can make

Backbone Area

Outline for Experimental Treatment of Hardwood Stands
(Hd-1, Cd-1 & Hd-2, 1937) in P.H. VI.

1. Improvement Cutting.

Remove most of large old overstorey and thin out younger stand favoring oak ash and hard maple and hitting red maple heavily. 1st consideration will be to keep a closed canopy and improve quality and composition by present and future light operations.

Object: To keep a closed stand and develop present stock as well as possible.

2.a. Reproduction-Improvement Cutting.

Remove large old overstorey completely except for well formed seed trees of desirable species. Remove defective trees and poor species from understorey making openings up to 50' in diameter where necessary. In these openings mow out all advanced and shrubby growth.

Object: To wipe out undesirable and defective portion of stand and start new stand where necessary.

2.b. Same treatment but with heavy burning in the openings.

Object: To test the use of fire in preparing hardwood seedbed. Test use of fire in destroying advanced sprout growth and in destroying light seeded shrubby species which usually appear first and give all seeds, especially desirable ones, an equal chance so that subsequent seedlings will be able to leave a well stocked desirable young growth. *Fire to reduce unrotted duff resistance to seeding.*

3. No treatment.

Act as control. Let stand go and see how nature will take care of itself.

Method: Divide area up into 8 rectangular blocks. Mark boundaries of blocks and divide the four treatments up ~~1/4~~ among the 8 blocks at random in such a way that no two treatments are next to each other.

Make complete measurements as to amount of material taken off each block and make 100% cruise of all blocks for the purpose of subsequent progress determination.

CTB Jr 10/3/44

Discussion: Number 3 (control) might be abandoned. Consider #1 the control & #2a + 2 the experiment.

Research needed: Time of seed dispersal of desirable & undesirable species to determine the best time to burn.

Exp 45-1

140

Dendrometer Measurement of growth after thinning.

	Sp	Control plot	Thinned plot	Total
24. A.	Spruce	10 in control	10	20
24 C	Spruce	10	10 , 10	30
24 F	Spruce	10	10	20
16 E	Spruce	5	5, 5	15
19 C	Spruce	5	5, 5	15
				<hr/> 100

Guide to flowering time, seed ripening and seed dispersal time of trees, shrubs & woody plants of the Northeast.

For each species the following information

I. For four general Regions (Rhedley's Zones III, IV, V, VI)

Dates

1. Flowering
2. Seed ripening
3. Seed dispersal

II. Seed & Flower characteristics

1. Monoecious or dioecious
2. Location of flowers on plants
3. Abundance of seed production and viability of seed.
4. Preferred seed bed conditions
5. Occurrence of seed years & relative amounts of seed produced in in between years.

III. Seed distribution.

1. Physical description of seed.
2. Method of distribution of seed
3. Average distance of effective seed distribution from parent tree.
4. Age at which tree begins to produce seed.

The purpose of this guide is to provide a ready reference for determining the proper way to cut a stand and the time to do it in order to get the most desirable reproduction.

More study of this subject before reproduction operations are started might lead to less reproduction of undesirable species of trees, less competition from undesirable shrubs and, in general, greater manipulation of the composition of the young seedling stand than has hitherto been possible.

Sections II & III of the outline should provide good data for the selection and location of the seed source and the type of reproduction method best suited to attain a desired objective. Section IV should indicate the proper time to do this.

Most of the information called for should be available under many separate covers. Some field work would doubtless be called for. The preparation of this guide calls for assembling available material and making field observations when necessary.

Such a study may serve to broaden the field of applied silvicultural methods and make their foreign application easier.

CSB 978 10/3/44

Pines
wh. Pine
Red Pine
Pitch Pine

Spruce
Red
Black

Fir
Balsam

Hemlock

Arbovitae

White Cedar

Red cedar
Juniper

Willow
Black
pussy
Shining

Poplar
h. T.
Aspen
Cottonwood

Walnut
Black
Butternut

Hickory
Shag.
Bitternut
pignut

Birch
gray
paper
yellow
Black
Red

Carymus
Ostrya

Alder
Smooth

Beech

chestnut

Oak
white
Sw. white
Bur.
Post
chestnut
Red
black
Scarlet
Pin
Scrub

Elm
American
Slippery

Hackberry

Magnolia

tulip tree

Sassafras

Plane tree

Cherry
Pin
Fire
Choke
Mt. Ash

Hocunt

Horse chestnut

Maple
Sugar
Red
Silver
Mt.
Striped

Basswood

Black Gum

Ash
white
Black

Catalpa

American hach

Witch Hazel

Shad bush

Hawthorne

Ilex
opaca
Verticillata

Nemopanthen

Sumac
Smooth
stag horn
dwarf
poison

Dogwood

Yew

Myrica
Sweet fern
gale
Bayberry

Hazel nut

Spice bush

Rubus
black berry
dewberry

Spiraea
hardhack
meadow sp.

Kalmia

Huckleberry

Blueberry
High b.
Low.

Viburnum
acer.
ebriif.
cass.

THE CABOT FOUNDATION AT THE HARVARD FOREST

1943-44

During the fall and winter season, the Cabot Foundation aided in the extension of the work of the Camouflage Committee. A man was sent to the Plant Introduction Garden at Coconut Grove, Florida, where tests were carried out with tropical foliage. A supplement to the camouflage pamphlet was prepared and distributed to various organizations of the armed forces. It was warmly received.

As the work of the Camouflage Committee was brought to a close during the spring, attention was directed toward developing a peace time research program which could be integrated with the general program of the Harvard Forest, as well as with the other activities of the Cabot Foundation. This program centered around

1. Forest planting of cuttings and testing of various handling methods.
2. Development of an out-of-door sprinkler bed for the propagation of cuttings from various forest trees. Red maple and hemlock have been tentatively selected as the two species for concentrated work; although other species, including paper birch, sugar maple, red oak, white spruce, red pine, and white pine, are also being tested.

9/7/44

H. A. G.

I. Natural reproduction methods
(heavy soils)

1. Clear cutting of pine in a seed year, resulting in:
 - a. Mixed softwoods and hardwoods
T.S. III, P-Hd-4
T.S. IV, P-Hd-1
 - b. Mixed hardwoods
T.S. II, Hd-1
2. Clear cutting pine in a non-seed year, resulting in:
 - a. Mixed hardwoods
T.S. I, Hd-4 & 5
3. Shelterwood methods in pine, resulting in:
 - a. Mixed softwoods and hardwoods
T.S. V, P-Hd-3
S.C. II, P-Hd-1
S.C. III, P-6
 - b. Mixed hardwoods
T.S. I, P-Hd-3
4. Clear cutting mixed hardwoods, resulting in:
 - a. Mixed hardwoods
T.S. III, P-Hd-4 (swale portion)
T.S. IV, Hd-2
5. Clear cutting mixed hardwoods with seed trees, resulting in:
 - a. Mixed hardwoods
T.S. III, P-Hd-4 (south end)

II. Natural and artificial reproduction methods combined

1. Clear cutting pine with supplementary planting, resulting in:
 - a. Mixed softwoods and hardwoods
T.S. II, P-Hd-1
T.S. III, P-Hd-3
T.S. I, P-Hd-3 (north end)
T.S. I, P-Hd-5 (south end)
T.S. IV, P-Hd-1 (north end)
T.S. IV, P-Hd-2
T.S. V, P-Hd-6 (both conifers and softwoods)

b. Mixed hardwoods

T.S. I, P-Hd-3 (south end)

T.S. I, P-Hd-5 (north end)

2. Clear cutting of pine with seed trees and supplementary planting, resulting in:

a. Mixed softwoods and hardwoods

P.H. III, Mx-Sd-3

(Light soils)

III. Partial cuttings

1. Group selection

T.S. IX, P-2 and Hm-2

2. Uniform selection

T.S. IX, P-5

3. Two-cut shelterwood

T.S. IX, P-7

4. Three-cut shelterwood

T.S. IX, P-Hm-4

5. Alternate strip cutting

T.S. IX, P-9

IV. Artificial reproduction methodsPure stands

1. White pine

P.H. II, P-3

P.H. III, P-8 (spacing experiment)

T.S. VIII, P-4 (underplanting)

? P.H. I, P-1 (seed source)

2. Red pine

P.H. II, P-1

? T.S. IV, P-Hd-4

? T.S. V, P-1

T.S. VIII, P-2

3. Norway spruce

P.H. V, Sp-3

? T.S. III, Sp-1

S.C. VII, Sp-1

4. White spruce

P.H. I, Sp-1

T.S. V, Sp-1

T.S. VIII, Sp-3

5. European larch
P.H. VII, Lr-1
P.H. II, Lr-1
6. Scotch pine
? P.H. III
P. H. VII
? T.S. VIII, P-3
7. Japanese larch
P.H. I

Mixtures

- ? 1. Experimental mixture
White pine, Scotch pine, Douglas fir, Norway spruce
and western yellow pine
P.H. V, Mx-Sd-1
T.S. VIII, Mx-Sd-1
2. Red pine-European larch
T.S. VII, Mx-Sd-2
3. Red pine-Norway spruce
P.H. I, Mx-Sd-8
4. Red pine-white spruce
P.H. I, Mx-Sd-5
5. Red pine-white pine (alternate row)
P.H. VI, P-5
6. White pine-white spruce
P.H. II, Mx-Sd-3
- ? 7. White pine-Scotch pine
P.H. III, Mx-Sd-2
- ? 8. White spruce-Scotch pine
P.H. I, Mx-Sd-6
- (9. White and Japanese spruce) ?
P.H. I, Sp-1
10. Hemlock-European larch-Norway spruce
P.H. VII

Additional exotics

Western yellow pine
Jack pine
Japanese red pine
Japanese white pine
Douglas fir
Siberian larch
White ash
Tulip poplar
Oriental chestnut
Chamaecyparis

Cases in manuscript - Part I.

1. TSII Hd-1
2. TSV P-Hd-1
3. TSI Hd-5
4. TSI P-Hd-3 - South
5. TSV P-Hd-3
6. SCII P-Hd-1
7. —
8. SCV P-Hd-3
9. TSI P-Hd-3 North
10. TSV P-Hd-1 North
11. TSI P-Hd-5
12. TSV P-Hd-2
13. TSIX P-2
14. TSIII P-Hd-4 (Swab)
15. TSV Hd-2

Part II

16. TSIX P-7
17. TSIX P-Hm-4
- ✓ 18. TSIX Hem-2
- ✓ 19. TSV P-9

m Ho.

Plantation Cases
Supplemental Planting

- 13 TSV P-2
- 11 TSI P-Hd-5
- 4 10 TSI P-Hd-3 South end (white pine and spruce)
- 9 11 TSI P-Hd-3 North end (white pine)
- 10 12 TSV P-Hd-1 North end (red pine)
- 12 13 TSV P-Hd-2 Along road (white pine)
- 8 14 SCX P-3 (P-Hd-3 (pruning)

White pine on open land

- ✓ 22 PHI P-5
- ✓ 23 PH III P-8

WP on cutover sawtimber land

- ✓ 24 S.C. III P-6
- 25 S.C. III P-1
- ✓ 26 S.C. II Mx-Sd-1
- 27 T.S. IX Mx-Sd-2

WP on cutover coniferous land

- ✓ 28 PHI P-4 (no control)
- 29 PH VII Mx-Sd-2 (8' spacing with NS)
- 30 PH VIII Mx-Sd-1 South end

WP Undeveloped

- ✓ 31 TS VIII P-4

- | | |
|---------------|-------------------|
| ✓ PHI II, P-3 | ✓ PH VII, Mx-Sd-1 |
| ✓ PHI Sp-1 | ✓ PH V, Sp-3 |
| ✓ PHI P-1 | ✓ PHI, Mx-Sd-6 |
| ✓ PHI Mx-Sd-8 | |

Red pine on open land

✓ 32 PH VI P-6 (thinning)

RP on cut-over cordwood land

✓ 33 SC III P-5

34 TS. I P-Hd-5 South end

RP on cut-over cordwood land

✓ 35 PH II P-1

36 PH I P-7

37 PH II Mx-Sd-2

• Hemlock

✓ 38a PH I Mx-Sd-3

✓ 38b PH II Mx-Sd-4

39 White ash

40 Paper birch

✓ 41 PH V Sp-2 Norway spruce

✓ 42 white spruce

✓ 43 PH VI Lr-1 European larch

✓ 44 PH VII P-6 Scotch pine

✓ 45 PH I Japanese larch

✓ 46 PH I Mx-Sd-5

✓ 47 PH VII Mx-Sd-2

PH II Mx-Sd-3

48 PH III Mx-Sd-2

49 PH II Mx-Sd-4 and 5

50 PH I - Mx-Sd-4

SUMMARY OF RESEARCH AND OTHER ACTIVITIES AT THE HARVARD FOREST

Harvard University
Petersham, Massachusetts

1907-1936

October 1936

FOREST MANAGEMENT

As a demonstration of practical, sustained yield forest management, the Harvard Forest has been in existence for almost thirty years. Each year during that period there has been a cut of sawtimber and cordwood from about 250,000 to 400,000 board feet. Nevertheless there is more timber now than there was when the Forest was acquired and there is a better distribution of age-classes.

Starting with an estimated ten million board feet of timber, mainly pine and largely mature, the Forest has been built up to an estimated volume of twelve million board feet with an increasing percentage of hardwoods in its composition. From an initial annual growth rate estimated to be 250,000 board feet, there has been an increase to 400,000. During the same period the Forest has acquired a much better representation of young and middle-aged stands, so its production can be more uniformly maintained. A set of card records has been developed which summarizes the amount, quality, and condition of the timber in each of about 700 distinct stands on the Forest. A detailed record system has also been worked out for all silvicultural operations and cuttings, so that there exists a complete silvicultural history of the Forest, supplemented by several thousand photographs.

In the field of general forest management, the work has been mainly in studying successful forests on private lands and making the results available. In several cases, estimates have been made of the growing stock on private properties and recommendations laid down for management.

MANAGEMENT OF HARVARD FOREST

Fisher, R. T.
1911

An account of operations in the Harvard Forest, '08-'09. Harvard For. Club Bull. 1: 1-10.

Fisher, R. T.
1921

Management of the Harvard Forest.
Harvard For. Bull. 1.

FOREST MANAGEMENT

- Cary, Austin
1907
Practical forestry on a spruce tract in
Maine. U. S. F. S. Cir. 131.
- Cary, Austin
1908
Influence of lumbering upon forestry.
Proc. S. A. F. 3:67-81.
- Cline, A. C.
1930
The William H. Walker Forest.
Am. For. & For. Life, December.
- Cline, A. C.
1931
The William H. Walker Forest and wood-using
industry. Jour. For. 29:611-612. April.

SILVICULTURE

When the Forest was established in 1907, there were no examples of silvicultural practice in the region, except for a few coniferous plantations. In fact, to the lay mind forestry consisted almost wholly in planting pine seedlings on idle farm land. By contrast, at the present time, such treatments as weeding, thinning, pruning, and reproduction cutting have been applied to tens of thousands of acres of "natural" second growth forest, to say nothing of the continued practice of planting. To this truly remarkable development and application of the art of growing tree crops, the Forest has been fortunately able to contribute substantially. Under the guidance of the late Director, Richard T. Fisher, a soundly conceived philosophy of silviculture, based on a harmonization of man's efforts with natural tendencies, together with the accumulation of a large body of factual information resulting from both research and practice on the Forest, has now become thoroughly ingrained in New England forestry, and a part of the professional equipment of hundreds of practising foresters.

Nor has the influence of the Forest in the art of silviculture been limited to the New England region. The general conceptions of the superiority of mixed over pure stands of trees in their influence upon soil fertility and upon crop security and yield, the frequent admonitions concerning the indiscriminate planting of conifers and the failure to appreciate the timber crop potentialities of volunteer second growth, and the strong stand in favor of a policy of high quality wood crop production have substantially influenced silvicultural policies and practices throughout the country.

Perhaps the greatest single contribution to regional silviculture has been the development of a complete system for converting "old field" white pine, a temporary forest type inherently poor in quality and conducive to soil impoverishment, into a vastly more stable mixture of valuable native hardwoods or of hardwoods with pine, having singularly beneficial effects on soil fertility, affording a high degree of crop security, and promising attractive financial returns from a final crop of excellent quality. In the course of developing this system, the Forest became the leading exponent of the art of utilizing the existing volunteer growth on cutover lands for a future timber crop, more specifically; of the art of forest weeding, which has for its purpose the elimination of the bad elements in the stand and the preservation of the good. The former have enormously increased in numbers in recent years through the combined effects of farm abandonment, clear-cutting, and fires. The control of forest weeds in existing volunteer stands, rather than the planting of new stands on open land, has now come to be recognized as the most needed and profitable cultural treatment for New England forests and the principal weapon to prevent their further deterioration.

SILVICULTURE

- Carter, E. E.
1915 Notes on the relation of planting methods to survival. Proc. S.A.F. 10:9-17.
- Fisher, R. T.
1918 Silviculture for country roadsides. Mass. For. Ass. Bull. 123.
- Fisher, R. T.
1918 The yield of volunteer second growth as affected by improvement cutting and early weeding. Jour. For. 16:493-506. May.
- Fisher, R. T.
Terry, E. I.
1920 The management of second growth white pine in central New England. Jour. For. 18:358-366. April.
- Spaeth, J. N.
1922 Notes on the release of white pine in Harvard Forest, Petersham, Mass. Jour. For. 20:117-121. February.
- Cline, A. C.
1924 The group selection method with white pine. Jour. For. 22:128-134. February.
- Fisher, R. T.
1925 Note on Harvard Forest silviculture. Jour. For. 23:909-912. November.
- Powell, Grant
1925 Cases in the release of white pine from gray birch on old fields.
- Fisher, R. T.
1928 Pine plantations and New England forestry. Jour. For. 26:790-793. October.
- Cline, A. C.
Fletcher, E. D.
1928 Pruning for profit as applied to eastern white pine. Joint pub. of Harvard For. and Mass. For. Ass.
- Cline, A. C.
1929 Forest weeding. Joint pub. of Harvard For. and Mass. For. Ass.
- Cline, A. C.
1930 Conquering the forest weeds. The Empire Forester.
- Cline, A. C.
MacAloney, H. J.
1931 A method of reclaiming severely weeviled white pine plantations. Mass. For. Ass. Bull. 152.
- Cline, A. C.
MacAloney, H. J.
1933 The improvement of weeviled white pine plantations. Conn. For. & Park Ass. Pub. 24.

Silviculture (Cont.)

- Steed, A. V.
1933
Reproduction resulting from the group selection method in white pine.
- Curtis, J. D.
1934
A study of artificial forest pruning in white pine plantations.
- Cline, A. C.
MacAloney, H. J.
1935
Progress report of the reclamation of severely weeviled white pine plantations. Jour. For. 33:932-935. November.
- Duffield, J. W.
Kraemer, J. H.
1935
The uniform shelterwood method in pine and hemlock.
- Cline, A. C.
1936
Improvement cutting and thinning as applied to central New England hardwoods. Mass. For. & Park Ass. Bull. 155.

SILVICS

Silvics deals with the underlying principles which control the life of forest trees, thus furnishing the scientific bases on which the art of silviculture rests. In many instances, publications by the Harvard Forest unavoidably have contained a mixture of both the science and the art, for in the early developmental stages of silviculture an author can explain the outcome of silvicultural treatment and recommend a given practice only by frequent reference to the observed habits and behavior of trees in response to their environment.

By living continuously in close touch with the Forest itself, staff and students have been able to accumulate a body of silvical knowledge of local tree species and of the whole complex of climatic and biological factors operative in central New England forests which exceeds that available for any other forest region in the United States. And it is only by means of such painstaking observations over a period of many years that the Forest has contributed in such a significant way to the foundations of American silviculture.

The following list of titles is by no means inclusive of the work done in the field of silvics. Many other Forest publications, listed under related subjects, contain paragraphs or pages dealing essentially with the growth habits and behavior of the great variety of both coniferous and deciduous tree species which constitute the forest communities of the region.

SILVICS.

- Jack, John G.
1911
Trees and other woody plants found in the Harvard Forest, 1908-09. Harvard For. Club Bull. 1:10-26.
- Kimball, G. W.
Carter, E. E.
1913
Influence of shade and other factors on plantations. For. Quar. 11:176-184.
- Cline, A. C.
1924
Pure white pine versus pine in mixtures. Am. For. & For. Life 30:557-558.
- Tarbox, E. E.
1924
Quality and growth of white pine, as influenced by density, site, and associated species. Harvard For. Bull. 7.
- Cline, A. C.
Lockard, C. R.
1925
Mixed white pine and hardwood. Harvard For. Bull. 8.
- Altpeter, L. S.
1926
Growth and reproduction in slash on old field pine cuttings.
- Reed, Paul M.
1926
Red pine in central New England. Harvard For. Bull. 9.
- Hall, R. C.
1927
Pitch pine on Cape Cod.
- Hunt, Stuart S.
1931
European larch in the northeastern United States. A study of existing plantations. Harvard For. Bull. 16.
- MacKinnon, F. S.
Hyde, Gerald R.
Cline, A. C.
1935
The cutover old field pine lands of central New England: a study of the composition and stocking of the ensuing stands. Harvard For. Bull. 18.
- Hosley, N. W.
1936
Norway spruce in the northeastern United States: a study of existing plantations. Harvard For. Bull. 19.

FOREST ECOLOGY

Successful practice and teaching of silviculture at the Harvard Forest has been materially aided by a study of the line of descent of the local types of forest. Thus, the old field pine forests present problems quite different from those connected with forests originating on land which has never been cleared. These problems are most effectively comprehended when oriented in the scheme of dynamic changes shown by successive generations of forests.

The Pisgah Tract of original forest in New Hampshire, one of the few remnants of the primeval forest of the region, has furnished vital clues to the manner in which forests maintain themselves naturally. Their life histories can be read in the composition of the stands according to species, in the changing rates of growth of the individual trees, and in the character of the soil. Quite different types of forest may succeed each other as each reaches maturity. Each succeeding stand tends towards a higher proportion of shade-enduring species, such as hemlock and beech. But in the case of a catastrophe involving destruction of the stand and especially of the soil, the succession reverts to an earlier stage. From the forester's point of view there is sometimes an economic advantage in doing this, or in arresting the natural succession at a given point. Study of natural forest successions reveals the places where the forester is attempting "to go against nature", and the conditions under which he may intervene and return an area to a forest type characteristic of an early place in the series.

FOREST ECOLOGY

- Fisher, R. T.
1925
Descent of the white pine woodlot. Introduction to Harvard For. Bull. 8.
- Smith, Hollis A.
1928
Study of old growth sample plots on the Pisgah Tract, Winchester, New Hampshire.
- Branch, W. C.
Daley, R. K.
Lotti, Thomas
1930
Life history of the climax forest on the Pisgah Tract, Winchester, New Hampshire.
- Fisher, R. T.
1933
New England forests: biological factors. Am. Geo. Soc. Sp. Pub. 16.

SOILS, NUTRITION, AND LIGHT

To the knowledge of the changes in soils under the quite different influences of coniferous and broadleaf forests, the Forest has made a special contribution. It has been shown that the activity of earthworms and soil-inhabiting insects is favored by the hardwood leaves, which provide preferred food. The maceration of the debris is the first step in returning it to the soil. By mixing the organic and mineral material together, the earthworms produce the excellent tilth found in forest soils where they are abundant. The needles of conifers are fed upon to a smaller extent by the larger earth-working insects, and scarcely ever by earthworms. The soils under conifers, therefore, exhibit a quite different condition from that under hardwoods. In the absence of maceration and the admixture with mineral material, the decomposition of the needle debris depends upon fungal and bacterial action. The organic material is stratified on the top of the mineral soil, preventing its full use in maintaining the potential fertility of the soil because the chemical action is localized, as shown by a sterile zone formed in the top of the mineral soil. Evidences of this decreased soil fertility have been demonstrable very early in the life of pure coniferous stands in the Harvard Forest.

For the study of forest soil fertility and the related factors of the environment, a continued project has been maintained at the Forest for fourteen years. The work started with the study of the effect of variation in light intensity on the growth of tree seedlings. At the time when the study was begun, the methods for the measurement of light were unsatisfactory. Work at the Forest contributed to the final form of the "pyrheliometer" which is now the standard instrument of the U.S. Weather Bureau for measuring solar radiation.

The interaction of radiation intensity and the supply of certain of the nutrients (nitrogen, potassium, phosphorus) have been studied in pot cultures under screens admitting various light intensities. Under these simplified conditions, regular relations have been discovered. They can be expressed in formulæ estimating within 2% the weights achieved by the seedlings under the various conditions. By the various fertilization of seedlings in nursery beds, both theoretical knowledge and practical information result. Further tests of the conclusions from the pot experiments are being made on a large scale at Enfield in a state nursery.

In nature, the conditions of tree nutrition are complicated by the kind of organic matter and the manner in which the nutrients are bound in the soil. Heath plants and trees exhibit a peculiar development of the fine roots caused by the invasion of the thread-like tissues of mushrooms. The "mycorrhizae" thus formed are a characteristic feature of the tree roots. There is an unsettled controversy as to the part they play in the nutrition of trees. Evidence from a series of experiments started at the Forest indicates that they are favorable under certain conditions, and probably exceedingly important in the initiation of natural forest reproduction.

SOILS NUTRITION AND LIGHT

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FOREST PROTECTION

Protection against such destructive agencies as fires, insects, and diseases constitutes an essential part of the administration of every organized forest, and requires a thoroughgoing knowledge of the factors involved, particularly so since protection costs must be kept within low bounds. The costly measures of direct control, such as may be employed in public parks or small private estates, are not available to managers of large tracts of commercial timber. The Forest has long appreciated the manifold advantages of indirect or silvicultural control through altering the character of the forest itself, and has taken a leading part in studying the habits of important insects and fungi in relation to environmental conditions. In several instances the highly destructive nature of forest pests was traced to the temporary and unstable composition of the existing volunteer stands on abandoned farms or cutover land, or to an unwise choice of species in the establishment of new stands by planting. Thus the seeding of old fields and pastures to pure white pine and the planting of additional thousands of acres to the same species brought about a concentration of food supply which resulted in enormously increased damage by the white pine weevil. A long series of studies led to the development of practicable measures of silvicultural control and important changes in former planting policies. Similarly, the early discovery of a member of the Forest staff of the destructive feeding by an insect (the Pales weevil) on coniferous seedlings planted on areas recently logged for pine gave rise to a new planting practice which prevented further losses.

FOREST PROTECTION

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MENSURATION - STUDIES IN GROWTH AND YIELD

The approach to the science of forest measurement in the Harvard Forest has been dynamic as contrasted with the common one of the analysis of measurements as such. Our studies have been largely correlated with silvicultural practice, aiming to interpret by means of mensuration methods the growth relations of trees throughout their lives. One of the main contributions has been in the little known field of the growing space needed by red oak and white ash at various ages for the best growth and the highest quality of timber. Another line of investigation has been with white pine, duplicating the growing space work and developing a method for determining the rate of taper of the stem from measurement taken from the ground of crown width and length of the bole on which branches were dead. Rate of taper is a very important factor in accurately determining the volume of standing trees, and accurate volume measurement is in turn essential to forest management. Tables of volumes were made up on this new basis.

It has been known for some time that hemlock would recover from suppression after being released, but it remained for Marshall to show that the growth rate of individuals long suppressed was fast enough to reach sizes at later ages that were greater than those of trees free to grow for the same length of time.

In 1930-31, the growth and development of each of the one hundred odd plantations on the Forest were measured. This information based on many species, some of which are exotic, and on varied soil and cultural conditions, has already been of great value. As the stands get older, this study if repeated will become increasingly valuable.

MENSURATION - STUDIES IN GROWTH AND YIELD

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ECONOMICS AND UTILIZATION

The science of forest economics permeates the whole structure of forest production and utilization, in the broadest meanings of these terms, controlling the extent to which they shall be brought to serve human needs at any given time or place, and governing the ebb and flow of the myriad of commercial transactions incident to the distribution and consumption of forest products.

To date the Forest has scarcely touched upon the broadest fields of economics; but it has made noteworthy contributions to the solution of a number of regional problems having to do with the manufacture and marketing of forest products, the future of the forests owned by wood-using industries, and the conservative use of land for the sustained production of wood crops. Several important surveys of wood-using industries have been conducted, which were of benefit not only in providing timber growers and lumber manufacturers with a better knowledge of consumer demands, but in bringing into sharp focus the many weaknesses of the lumber business in New England. Publications by the Forest were among the very first to point out the need for better sawing, grading, and seasoning of native lumber, for improved selling practices, for cutting only larger, older trees, for growing higher grade timber for the future, and for creating cooperative associations of timber growers. While many of the weaknesses in utilization and of the maladjustments between production and consumption still persist, they are now at least commonly recognized and means for their correction are gradually becoming available.

During the current year the Forest has assisted in formulating forestry practices for farm woodlands under the Agricultural Conservation Program of the Federal Government. It is believed that only through some form of public aid can the depleted and deteriorated farm woods of New England be restored to productiveness, and the Forest's long experience with regional conditions is proving to be of great usefulness in furthering this important program.

ECONOMICS AND UTILIZATION

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1927 Influence of land history and legislative
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- Bauer, Eitel
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Frost, L. M.
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WILDLIFE

The work with wildlife in the Harvard Forest has grown out of the obvious interdependence of forests and the animals living in them. Wildlife work has largely been developed either empirically by those who believed that simple measures such as restrictive legislation are all that are necessary for the production of abundant wildlife or by zoologists who were interested mainly in the animals as such and not particularly in their environment.

Of late years a newer conception of the problem has developed, the manipulation of the environment to provide the many necessities for the protection, nutrition, and reproduction of the animal species. It is along this line that the work at Petersham is being conducted. Many silvicultural practices can, by proper planning and arrangement, be made to favor wildlife. A start has been made toward evaluating these practices from the standpoint of wildlife production and toward determining the reverse effect of the animals on the woodlands. Studies have covered the use for food and cover of the various forest types by the white-tailed deer and the ruffed grouse. The production of wildlife foods in the various forest types according to age, density of stocking, and cultural treatment are being analyzed at the present time, and a two-year study of the red fox as a forest animal has been started.

WILDLIFE

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PROFESSIONAL AND PUBLIC EDUCATION

From 1907 to 1914, instruction in forestry consisted of a general professional training covering the requirements of a practising forester and leading to the degree of Master of Forestry. It became gradually apparent, however, that the Harvard Forest had unique facilities for advanced, specialized training and research which could in the long run make a far more important contribution to forest conservation than a continuance of general "practitioner" training, an already overcrowded field. In 1914, therefore, the general curriculum was abandoned, entrance was restricted to students already possessing the bachelor's degree in forestry, and instruction thenceforth took the form of advanced research projects in forestry or in contributory fields such as entomology, soils, and game management, leading to the master's or doctor's degree. The unique quality of forestry education at the Harvard Forest remains what it has always been - an overwhelming emphasis on learning in the woods rather than largely from lectures and books. The great and increasing range of silvicultural treatment and of research projects in forestry and contributory sciences gives an unrivalled collection of "cases" for this time-tested method of instruction. In all, 137 students have studied at the Harvard Forest.

The educational influence of the Forest has extended far beyond the training of its students. An average of about 300 visitors come to the Forest each year, and many thousands have already viewed the Forest models at Cambridge. Lectures, articles, and bulletins by members of the staff have reached in the aggregate a very large audience. Staff members have given technical advice to many forest land owners and in some cases have made and supervised the execution of detailed forest management plans for such owners. Training courses have been given at Petersham to many forestry foremen of the Civilian Conservation Corps in "stand improvement", and a member of the staff supervised the silvicultural work in 12 CCC camps for several months, thus greatly extending the practical application of silvicultural principles derived from the Harvard Forest.

PROFESSIONAL EDUCATION

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PUBLIC EDUCATION

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SAMPLE PLOT WORK IN THE HARVARD FOREST

Forestry is a young profession in America and many of the facts most needed for the intelligent management of our native timber species are still lacking. In addition many exotics are now being used and what they did in their native habitat is no criterion of what can be expected of them here. With a crop which matures as slowly as timber, it is necessary to lay out definite areas or "sample plots" and study the trees on them in detail over a long period to determine the best kind of silvicultural treatment.

Some of the ways in which permanent sample plots are most useful are in showing

1. The growth and yield of a given type of forest under a given set of conditions.
2. The effects of silvicultural treatment on survival, growth, form of the trees, and quality of the wood produced, and
3. Types of trees and growth rates resulting from seed of a given species from different sources.

Some of the more important plots now being studied in the Forest are:

1. Thinning and pruning in Norway spruce, P.H. V.

This set of plots was established in a twenty-four-year old plantation to determine the best method for thinning and whether pruning is advantageous or not. Two plots were pruned and given different grades of thinning and a third left untreated as a check. Detailed measurements were made for each tree.

2. Thinning in European larch, P.H. VII.

A plot was thinned in a plantation twenty years old and detailed records made. A remeasurement at twenty five-years showed the results in terms of increased growth.

3. Thinning and pruning in red pine, P.H. VI.

In the oldest red pine stand in the Forest, planted in 1915, a series of treated and untreated plots was started at the age of 19 years. Varying intensities of thinning are contrasted and crop trees have been pruned on some of the plots. Tree by tree records are being maintained on three treated plots and a control. A second thinning was carried out at an age of twenty-five years.

4. Spacing experiment, white pine, P.H. III.

In 1916 approximately half-acre contiguous areas on a uniform slope were planted with spacings of 3' X 3', 4' X 4', 5' X 5'

Sample plot work (Cont.)

and 6' X 6' by exact measurement. This experiment was made to determine the effect on tree form, quality of timber produced, and amount of white pine weevil damage in these various densities of planting. Thinnings and crop tree prunings were carried out in the two closer spacings at nineteen years of age and the treated plots were thinned and pruned in all spacings at twenty-four years. Detailed records are being kept on the eight treated and untreated plots.

5. Pruning, white pine, S.C. XI.

Two plots were pruned and an untreated area left for contrast when this densely stocked, natural stand was twenty-two years old. The pruning was extended up the trees in two later operations to a height of about seventeen feet at ages of twenty-five and twenty-seven years.

6. Growth of natural, managed hardwoods, T.S. II.

To show what can be expected in volume production and quality of timber in a managed, natural stand of hardwood containing an abundant stocking of sawtimber species, three plots, with untreated check plots, were established and measured in detail at the age of twenty-one years. The treated plots were thinned at twenty-six years and remeasured.

7. Reclamation of a severely weeviled white pine plantation, P.H. I.

This plot was established in a twenty-three-year old stand which appeared to be hopeless for sawtimber production as a result of weevil damage. Pruning of the best formed trees and girdling to kill the worst individuals was carried out and repeated at the ages of twenty-six and twenty-eight years.

8. Comparison of degrees of pruning, P.H. III.

To determine the effect on growth of removing varying amounts of green branches, four plots were treated when this 6' X 6' planting was twenty years old. Pruning varied in intensity from the removal of only dead branches to a very drastic removal of green ones.

9. Reproduction and growth of red spruce, P.H. II.

Two plots were established in 1913 to trace the development of the reproduction and sapling-size spruce occurring in a natural spruce swamp in a stand about forty years of age.

10. Seed source planting, white pine, F.H. I.

To determine the effect of the type of "mother tree" on the offspring, a plantation of 925 trees was established in 1924 with three-year seedlings. The seeds came from six trees ranging in form from the clear, tall, virgin forest type to the open grown, "scrub" in an open field. Yearly height growth measurements have been made.

In addition to these there are some twenty-five minor plots established for shorter periods and special objects such as seeding experiments with paper birch, a comparison of the results of different girdling methods in killing undesirable trees, etc. There are also six permanent plots in the Black Brook property of the Forest at Hamilton, Mass., to determine the effects of thinning in white and Scotch pine and in Japanese and European larch. There are also some half dozen plots established by the Forest on the property of others, mainly to determine the results of different treatments in given stands.

COOPERATIVE RESEARCH

For many years the Forest has cooperated with both public and private organizations in the conduct of research, particularly with the Northeastern Forest Experiment Station of the U.S. Forest Service, the Division of Forest Insects of the U.S. Bureau of Entomology and Plant Quarantine, and the Division of Forest Pathology of the U.S. Bureau of Plant Industry. Much has been gained thereby, for almost invariably neither party was equipped to attack the problem at hand effectively without the aid of the other. The Forest has benefited from the contributions of experts in the biological sciences, logging and lumbering, marketing and the like, while these specialists and the organizations they represent have profited by the knowledge possessed by members of the Forest staff in related forestry subjects. Furthermore, such joint conduct of research has given both parties a much better understanding and appreciation of one another's problems, of differing points of view and scientific disciplines, and has served to increase most substantially the reliability and usefulness of the results.

Out of the long list of cooperative undertakings, one might mention especially those dealing with the control of insect pests and diseases, the applicability of forestry practices to the holdings of certain commercial forest owners, the marketing of lumber in Massachusetts and in New Hampshire, weather conditions affecting the start and spread of forest fires, and the factors involved in underwriting forest fire insurance for New England forests.

MISCELLANEOUS.

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- Shepard, H. B.
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Harvard Forest, Petersham, Mass.

Summary of Investigative Work

Silviculture

Reproduction Cuttings

Project

To test the efficacy of various cutting methods for the reproduction of White Pine and chief associated species

Status

Annual cutting areas under observation and record since 1909. Systems employed, modifications of clear cutting and shelter-wood methods. Paper on the reproduction of White Pine in preparation.

Improvement Cutting

Experiments to determine method, costs, and possibilities of improving the composition and yield of mixed stands by early weeding.

Project

Relation of recovery of suppressed trees to ages, site, and extent of release.

Status

Not developed. Sample plots under observation.

Thinning.

Permanent sample plot in pure even-aged White Pine to accumulate data on the effect of periodic thinning upon yield, etc.

Plot established in 1912. Thinning and records made every five years.

Plantations

Permanent sample plot in plantation of White Pine to follow annual progress - height growth, establishment of cover, natural pruning, etc.

Established in 1909.

Plots in plantation of White Pine to determine effect of planting distance upon yield. Distances used three, four, five and six feet.

Established 1916.

Project

Plantations for test of species under various site conditions, in competition with natural reproduction on open and cut-over land, and under-planting. Comparative value of certain exotic species in reforestation.

Status

Approximately seventy acres planted from 1909 to 1919. Species used: White Pine, Norway Pine, Scotch Pine, Western Yellow Pine, Norway Spruce, European Larch, Japanese Larch, Douglas Fir.

Effect of planting method upon percentage of survival of various species.

Results published in paper by E. E. Carter Proceedings of Society of American Foresters, 1914.

Protection

Insect Damage

Study of injury to coniferous reproduction, especially White Pine, by the so-called "Snout Beetle".

Results in paper by E. E. Carter: "Hyllobius Poles as a Factor in the Reproduction of Conifers in New England", Proceedings of American Society of Foresters, 1916.

Lumbering

Project

Collection of cost data on operations in portable mill logging, sawing, etc.

Status

Records filed from classified time sheets. Publication planned.

Measurements

Mill tally volume tables for Beech, Yellow Birch, and Sugar Maple.

Published by I. W. Bailey and P. C. Heald, Forestry Quarterly, 1914.

Mill tally volume table for second growth chestnut.

Completed but not published.

HARVARD FOREST
Research Projects.

1924

Completed

Project	Investigator
Relation of Planting Method to Survival	Staff
Forest Management for a Box Company	Cline & Foster
Second Growth Hardwood Growth Study and Yield Tables	Spaeth
Life History and Control of Pales Weevil	Peirson
Red Oak and White Ash Growth and Yield	Patton
Control of White Pine Weevil by Forest Mgt.	Peirson
A Statistical Forest Survey	Averill & Stevens
Quality Increment of White Pine	Tarbox

Under Way

Mgt. of Mixed Pine and Hardwood Type	Cline & Lockard
Silvical Relations of Light	Gast
Red Pine Growth and Yield	Reed
Effect of Thinnings (White Pine)	Staff
Effect of Thinnings (Spruce Swamp)	Staff
Spacing (White Pine Plantations)	Staff
Improvement Cuttings (Pine - Birch Type)	Staff
Grade and Utilization in Box Industry	Staff
Mixed Coniferous Plantations (Growth & Yield)	Staff

SUMMARY OF INVESTIGATIVE WORK

HARVARD FOREST

EXPERIMENTAL SILVICULTURE

FINAL CUTTINGS

Sawtimber

PINE			PINE&HARDWOOD			HARDWOOD		
Location	Date	Area	Location	Date	Area	Location	Date	Area
<u>Clear Cutting</u>								
T 1 B	10-11	.50	T 2 D	19-20	1.90	T 4 D	10-11	3.50
T 2 A	08-09	3.75	T 5	10-11	1.00			
T 2 A	09-10	1.50						
S 5 C	13-14	2.50						
S10 I	13-14	4.40						
Total Area		12.65	Total Area		2.90	Total Area		3.50
<u>Clear Cutting in Seed Year</u>								
T 3 B								
J	11-12	4.00						
F								
<u>Shelterwood (Two-Cut)</u>								
T 1 B	14-15	7.50						
T 1 B	16-17	13.00						
T 4 D	15-16	2.50						
T 4 C	17-18	5.00						
T 5 U	17-18	.25						
S 3 B	18-19	9.00						
Total Area		37.25						
<u>Clear Cutting with Reserved Trees or Groups</u>								
T 3 H	11-12	1.50				T 4 U	19-20	1.40
S 5 C	12-13	3.20						
Total Area		4.70						1.40

Selection and Small Group Cuttings

(Largely salvage cuttings culling dead or dying chestnut)

Forest Type:	Location:	Date:	Area:	Nature of Cutting
Transition	T 1	19-20		Culling chestnut
Transition	T 3	09-10		Selection of Ash
Transition	T 3	19-20		Culling chestnut groups
Transition	T 4	12-13	5.00	Culling chestnut
Pine-Trans	T 4	19-20		Culling Chestnut
Transition	T 4	15-16	.50	Group cutting chestnut
Pine-Trans	T 5	15-16		Culling Chestnut
Transition	T 5	19-20		Culling Chestnut
Transition	T 6 I	14-15	1.00	Culling Chestnut
P-H-T	S 3 A	18-19	1.00	Culling Chestnut
Transition	S 7	12-13		Culling Chestnut

Selection and Small Group Cuttings (Continued)

Transition	S 8	12-13		Culling Chestnut
Transition	S 8 D	20-21	5.90	Culling Chestnut
Pine-H-T	S 8 C	20-21		Salvage-windfall pined
Transition	S10 A	1919	1.50	Group Culling of chestnut
	M 5	09-10	6.00	Cleared groups
Pine	M.5	09-10	2.00	Selection

FINAL CUTTINGS

Cordwood

CLEAR CUTTING

Grey Birch			:	Maple Swamp			
Location	Date	Area	:	Location	Date	Area	Kind
P 1 M	15-16	.47		T 3	16-17	1.00	Coppice
P 1 D	19-20	1.40		T 3	17-18	1.00	Selection
P 1	'11	.50		T 3	18-19	.50	Coppice
P 1 G&B	21-22	2.00		T 3	20-21	2.50	"
P 2	16-17	1.00		T 4	18-19	.75	"
P 2 J	18-19	2.00		T 5	13-14	2.00	"
P 2 J	19-20	.23		T 5 C	14-15	2.00	"
P 2 H	12-13	.50		P 1 G	10-11	1.00	"
P 2 H	22-23	3.00		P 4 E	13-14	1.00	"
P 8 J	09-10	1.25		P 6 H	12-13	4.00	"
P 8 M	10-11	1.75		P 8 L	19-20	.25	"
P 8 Q	13-14	.75		P 8 G	21-22	1.00	"
				P 8 G	22-23	1.20	"
TOTAL AREA		14.85		TOTAL AREA		18.20	

Clear Cutting With Reserved Trees or Groups

S 2 B	10-11	2.00	Coppice with Standards
P 8 C	10-11	.66	"
TOTAL AREA		2.66	

THINNINGS

Forest Type	Location	Date	Area	Purpose of thinning
Pine	T 1 B	08-09	6.00	Shelterwood 1st Cutting
Pine	T 1 B	10-11	15.00	Shelterwood 1st Cutting
Pine	T 1 B	11-12	2.50	Shelterwood 1st Cutting
Pine - Trans	T 3BJF	11-12	5.00	Shelterwood 1st Cutting
Pine - Trans	T 4 D&C	11-12	6.50	Shelterwood 1st Cutting
Pine	T 5 E	11-12	3.00	Shelterwood 1st Cutting
Pine	T 6	08-09	.10	Stimulation of increment
Pine	S 2	11-12	.50	Increase increment
Pine	S 2	19-20	.50	
Pine	S 3BED	12-13	6.00	Shelterwood 1st Cutting
Pine	M 5	09-10	7.00	Salvage and Improvement
Total Area			52.10	

WEEDINGS

Forest Type	Location	Weeding	Area	Date	Cutting
<u>Logging Area Not Planted</u>					
Pine-Trans	T 2 A	1st	3.75	12-13	08-09
Pine-Trans	T 2 A	1st	1.00	13-14	09-10
Pine-Trans	T 2 A	2nd	3.75	15-16	08-09
Pine-Trans	T 2 A	3rd	3.75	19-20	08-09
Pine-Trans	T 3 D	1st	2.00	1914	10-11
Transition	T 4 D	1st	1.75	1920	10-11
Pine-Trans	T 5 U	1st	.25	1920	17-18
Total Area			16.25		

<u>Logging Area Planted</u>					
Pine-Trans	T 1 B	1st	3.50	1919	14-15
Pine-Trans	T 1 B	1st	10.00	1921	16-17
Pine-Trans	T 2 D	1st	1.90	1923	19-20
Pine-Trans	T 4 DC	1st	7.50	1920	15-16&17-18
Pine-Trans	T 4 C	1st	2.50	1921	17-18
Pine-Trans	S 3 B	1st	9.00	1923	18-19
Pine-Trans	S 5 C	1st	3.00	1919	12-13&13-14
Pine-Trans	S 5 C	2nd	5.70	1923	12-13&13-14
Pine	S 6 A	1st	2.00	1919	13-14
Pine-Trans	S10 I	1st	4.40	1920	13-14
Pine-Trans	S10I	2nd	4.40	1923	13-14
Total Area			53.90		

PLANTATIONS ON LOGGING AREAS

Species	Location	Area	Date	Cutting
S & R. Pine	T 1 B	1.00	1918	16-17
R & W. Pine	T 1 B	10.00	1919	16-17
Red Pine	T 2 D	1.90	1922	19-20
Red Pine	T 4 U	1.40	1921	19-20
Red Pine	T 4 C	2.00	1919	17-18
Red Pine	T 4 C	.75	1922	1 5-16 Burn
R & W. Pine	S 3 B	9.00	1921	18-19
N. Spr. & W.P.	S 5 C	5.70	1915	12-13&13-14
White Pine	S10 I	4.40	1915	13-14
White Pine	S 6 A	2.00	1915	13-14
Total Area		38.15		

IMPROVEMENT CUTTINGS

Forest Type	Location	Area	Date
Pine-Trans	T 1 AE	15.00	08-09
Pine-Birch	T 1	.50	08-09
Pine-Trans	T 2 GB	3.00	12-13
Pine	T 2 B	.75	1923
Pine-Birch	T 4 R	.25	08-09
Pine-Birch	T 5	.75	09-10
Pine-Birch	T 5 Q	.75	1923
Pine-Birch	T 6 N	1.50	09-10
Pine-Birch	T 6 NL	1.00	12-13
Pine-Birch	T 6 ENL	.50	13-14
Pine-Birch	T 6 A	1.25	1923
Pine-Birch	T 7CG&PP	4.00	14-15
Pine-Birch	S 2 C	2.00	09-10
Hwd Swamp	S 2 J	.25	09-10
Pine-Birch	S 2 H	.50	18-19
Pine-Trans	S 5 A	4.00	13-14
Pine-Birch	S 5 GD	1.50	12-13
Pine-Birch	P 1 HG	1.75	08-09
Pine-Birch	P 1 B	1.00	1912
Pine-Birch	P 1 B	1.50	1914
Pine-Birch	P 1 B	.75	1915
Pine-Birch	P 2	2.00	13-14
Pine-Birch	P 2 IE	3.00	11-12
Pine-Birch	P 3 A	.75	11-12
Pine-Birch	P 3 NG	.75	18-19
Pine-Birch	P 4 J	2.00	17-19
Pine-Birch	P 8 ATE	1.50	13-14
Pine-Birch	P 8 A	1.00	15-16
Pine-Birch	P 8 S	.50	08-09
Pine-Birch	P 8 I	1.00	11-12
Pine Birch	P 8 I	.65	15-16
Total Area		55.65	

(Status January, 1924)

Project: Artificial reproduction on clear cuttings.

Handled by Harvard - Staff

Scope. To determine species, age of stock, and spacing most suited to cut-over land.

Status. Each year a portion of the logging area of two years earlier is planted. There are now, on the Harvard Forest, 38.15 acres of plantation on logged over land. Plantations include the following species:- White, red and Scotch pine, and Norway spruce.

Plans. Additional logging areas to be planted each year. White spruce and hemlock to be added to the list of species.

MANAGEMENT.
(Status January, 1924.)

Project. White pine plantation spacing experiment.

Handled by Harvard Forest School

Scope. Determine time of closing of canopy, time of formation of forest floor, rate of natural pruning, cost and nature of silvicultural treatment, quality of stand, time of maturity.

Status. Work started May 1916 at Harvard Forest, Petersham, Massachusetts. White pine planted in open field, four spacings 3'x3', 4'x4', 5'x5', 6'x6'. Weeded of grey birch seedlings Oct. 1918. Four 1/5 acre plots established, one in each density.

Plan. Observations and records to be continued.

MANAGEMENT.
(Status January, 1924.)

Project. Method of Cutting.

Handled by Harvard - Staff;
Yale - R.C. Hawley.
Northeastern Forest Exp. Station - M. Westveld.

Scope. To determine the most desirable and effective silvi-cultural systems to be used in the different forest types of the various regions in order to secure natural reproduction in the shortest possible time and to determine the rate of growth of seed trees and advance growth left in logging.

Status. Harvard: White Pine. Shelterwood strip system. Begun in winter of 11-12 in Harvard Forest at Petersham. Preliminary thinning made in 1911, first strip clear cut and adjacent thinnings made in 1917; second strip clear cut and adjacent thinnings made in 1922; cleaning made on 1917 strip in 1920. Records kept on natural reproduction.

Final Cuttings - saw timber

Clear cutting: pine, 12.65 acres: pine and hardwood 2.9 acres: hardwood 3.5 acres.

Clear cutting in seed year: pine 4 acres.

Shelterwood (two cut): Pine 37.25 acres.

Clear cutting with reserved seed trees in groups:
Pine 4.7 acres: hardwood 1.4 acres.

Selection and small group cuttings: largely salvage cuttings, culling dead or dying chestnut in the transition type.

Clear cutting (Cordwood): gray birch 14.85 acre plot: maple swamp, coppice selection 18.2 acres.

Clear cutting with reserved trees or groups:
(Cordwood) -coppice with standards 2.66 acres.

Plans. Harvard: In shelterwood strip system additional strips to be cut from time to time.

MANAGEMENT.

(Status January, 1924.)

- Project. Thinnings and improvement cuttings.
- Handled by Conn. Agr. College, A. E. Moss;
Conn. Agr. Exp. Station. -H. W. Hicock, W.O. Filley;
Harvard Forest School
N. Hampshire Exp. Station - K. W. Woodward
New England Box Co. - G. C. Hawkins;
New York State Ranger School. -J. F. Dubuar;
Yale Forest School - J. W. Toumey; R. C. Hawley;
Cornell - C. H. Guise
- Scope. To determine effects of improvement cuttings, merits of different degrees, methods and frequencies of thinnings as affecting the growth of the maining trees in the forests of the various regions.
- Status. Conn. Agr. College. Mixed second growth hardwood thinning. Plan drawn up. Thinnings to be made in natural mixed second growth to encourage the desired species, such as ash, oak, and hickory; area involved 8-10 acres.
- Conn. Agr. Exp. Sta. Chestnut oak thinning. Work started in 1912 at Quassipug Lake, Woodbury, Conn. 2 plots, one thinned and one a check established originally by U. S. Forest Service in chestnut oak. Other plots were established but due to chestnut blight were abandoned. Plots remeasured at 5-year intervals. All trees numbered.
- Thinning in white pine. Work started in 1908 at Shaker Station, Enfield, Conn. 1/4 & 1/2 ~~acre~~ plots and strips involving area of 4 acres established. Three grades of thinnings with check plots - isolation strips. Remeasured in 1917 and 1923.
- Harvard. Red Spruce thinning experiment. Plan made, but work not yet under way.
- White pine release expt. in pine-grey birch type. Started in 1915 at Harvard Forest. Two plots a sample plot and a control, each 1/2 acre in area. Pines tallied in both plots all hardwoods (10 cords per acre) cut on one plot. Pines remeasured in 1921. Plots were seriously damaged by ice storm of 1921.
- White pine thinnings. Effect on yield.
Started in 1912 in northern Worcester Co., Mass. Five plots with controls established in pine stands of various ages and densities. Thinnings made in 1912 and 1920. Age of stands at first thinning 40 years and 22 years. Age

Age of plots not yet thinned, 13 and 16 years.

On demonstration areas Harvard is carrying on thinning on an extensive scale in pine, the purpose of the thinnings being for shelterwood 1st cutting, stimulation of increment, salvage, and improvement on 52.1 acres. Weedings are being conducted on logging areas in the pine-transition hardwood type on 16.25 acres where pine element of natural reproduction and 53.9 acres where pine has been planted, this includes two weedings on some areas. Improvement cuttings have been made in the pine-transition hardwood and the pine-grey birch types on 53.65 acres.

MENSURATION
(Status January, 1924)

Completed
Project.

Growth and yield in hardwood stands.

Handled by

HARVARD - (a) J. N. Spaeth; (b) R. T. Patton.

Scope.

To determine increment and yields of hardwood stands of various characters.

Status.

(1) a. Harvard: Started September 1919; completed June 1920; on Northern Worcester Co., Mass. 48 sample plots 1/4 - 1/2 acre in size on two site classes of Transition Hardwood type contained over 18,000 trees. Cutting and piling test carried out to prove applicability of red maple volume table to all species of second growth hardwoods.

(1) b. Harvard: Started September 1920; completed July 1 1921. Determination of interrelation of diameter, length of bole, size of crown from a study of the best formed individuals of oak and white ash. Yield tables for managed stands of oak and ash in mixture drawn up. Market study of relation of diameter of logs to sale value of timber.

Plans.

- (1a) Harvard. Results published in Harvard Forest Bulletin #2
(1b) Harvard. Results published in Harvard Forest Bulletin #4.

MENSURATION
(Status January, 1924)

Project. Rate of Growth in mixed stands of white pine and hardwoods.

Handled by N.H. Exp. Station - K.W. Woodward;
Harvard - A. C. Cline, C. R. Lockard.

Scope. To determine the increment of white pine when in mixture with hardwoods.

Status. N. H. Exp. Station. Started in 1913 at Durham, N. H. 18 plots, measured annually; white pine overshadowed. Completed, 1923.

Harvard. Started September 1923 in north central Mass., and New Hampshire. Measurements of single trees and groups of trees. Notes taken on determinable environmental factors. Chiefly even-aged stands.

Plan. N. H. Exp. Station: Manuscript at station, not published.
Harvard: To be completed in 1924. Scale studies to be carried on to correlate grades and conditions of growth.

MENSURATION.
(Status January, 1924)

Project. Growth and yields of red pine in natural stands.

Handled by Harvard, P.M. Reed; Cornell, B. A. Chandler.

Scope. To determine growth and yields of natural red pine stands.

Status. Harvard: Started September, 1923 in Central New England. Measurements of individual trees and plots; computation of volumes; reaction of trees to shading by hardwoods; comparative height and diameter with other conifers and hardwoods; reproduction methods on old fields and cutover land; character and use of red pine lumber.

Cornell: Started 1917 at Au Sable Forks, Clinton Co., New York; discontinued temporarily. Plots taken; description of work in Journal of Forestry, Vol. XVI, No. 3.

Plans. Harvard To be completed June, 1924 with subsequent publishing of results.

Cornell Report on first part of work in Journal of Forestry, Vol. XVI, No. 3.

HARVARD FOREST

Project Report 1923 -----Projects Planned.

1. Harvard Forest cooperating with New England Box Company
Factory study of relation between grade in white pine
box boards and utilization value: e.g., comparison of
waste, value of output, and return per board foot. Grade
based on form and life history of the timber.
2. Harvard Forest Staff
Red Spruce Thinning Experiment -To Increase Increment
Two 1/4 acre plots in even-aged spruce bog type to be
thinned in 1924
3. Harvard Forest Staff
Mixed Coniferous Plantations - Establishment and study
of life history and silviculture to be applied.

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
NORTHEASTERN FOREST EXPERIMENT STATION



ADDRESS REPLY TO
THE DIRECTOR
AND REFER TO
RS

Investigations
Census

Director, Harvard Forest,
Petersham, Mass.

AMHERST, MASS.

February 10, 1930

Dear Professor Fisher:

In 1924 this office at the suggestion of the Northeastern Forest Research Council compiled a statement of forest investigations under way by various agencies in New England and New York. A supplement was issued in 1925, which corrected and brought the original report up to date. No revision has been made since 1925. As a means of bringing our records up to date for a revised statement to be published this spring, it would be appreciated if you would correct and return the enclosed statements of projects credited to your organization. I should like to have a record of any publications which are based on these projects, and have provided a space for this on the project form. There are also enclosed project report forms for your use in reporting any studies not previously reported which are now under way or contemplated for 1930. Please use these forms also for reporting any projects started since 1925 and now completed.

I should like to have an estimate of the expenditures for research in this region during 1930. A space has been provided on the forms for this, but should you prefer, a statement of the total amount to be expended by your organization will suffice. This information will be treated confidentially.

As complete a record as possible is desired of all research projects having to do with any phase of forestry, including investigations in what are often known as "allied fields;" for example, studies having to do with forest botany, forest entomology, forest pathology, forest zoology, logging, wood utilization, forest economics, and the relation of forests to climate, erosion, streamflow, recreation, and health should be included, just as much as studies having to do with fire control, silviculture, and forest management. It is also desired to interpret "research" rather broadly as including any studies, irrespective of whether they are primarily observational, experimental, or fundamental in character, which are being conducted with the definite purpose of throwing light on the forest problems of the region.

I should like to have this material returned before March 1. Your cooperation in this matter will be greatly appreciated.

Very sincerely yours,

E. Edward Behre

Director.

Enclosures.

Sent to Amherst March 17, 1930.

RESEARCH PROJECTS AT THE HARVARD FOREST

Project Source of seed.

Scope To determine influence of character of seed trees on growth of seedlings.

Status Work begun in September 1920 at Petersham, Mass. Cones collected from open and forest grown trees of varying age and crown form. Measurements of cones, weight of seeds, counts of seeds per cone, cones per bushel. Seeds planted in separate plots May, 1921. Seedlings planted in field May, 1924. Yearly growth measured 1929.

Plans Six plots totaling $\frac{1}{2}$ acre planted, each containing trees derived from single parent trees.

Agency Harvard Forest.

1930 Costs \$50.

Project Broadcasting seed during and after cutting operations.

Scope To determine the possible relation between soil disturbance incidental to logging and the success of artificial seeding. Species used, red pine and Scotch pine.

Status Sowing done in April 1925.

Plans Still under observation.

Agency: Harvard Forest - A. C. Cline

Project Experimental planting of mixed conifers.

Scope To determine the effect of mixtures and varying age on production, both in quantity and quality. Species used, white pine, red pine, Scotch pine, white spruce, Norway spruce, and hemlock.

Status Sites planted, old fields.

Plans: To be followed by regular observations and records.

Agency Harvard Forest.

Project: Best spacing for white pine.

Scope: To determine the effect of different spacings in a white pine plantation on such factors as time of closing of canopy, time of formation of forest floor, rate of natural pruning, cost and nature of silvicultural treatment, quality of stand, and time of maturity.

Status: Work started in May, 1919 at Petersham, Mass. White pine planted in open field with four spacings: 3' x 3', 4' x 4', 5' x 5', and 6' x 6'. Weeded of gray birch in October, 1918. Four 1/5 acre plots established, one in each density.

Plans: Observations and records to be continued.

Agency: Harvard Forest.

1930 Costs:

Publications: Harvard Forest Bulletin 13, Plots A-1,2,3, and 4.

Project: Planting in clear cuttings.

Scope: To determine species, age of stock, and spacing most suited for planting on cut-over land.

Status: Each year a portion of the logging area of two years earlier is planted. There are now on the Harvard Forest 135 acres of plantation on logged over land. Plantations include white, red, and Scotch pine, hemlock, Norway and white spruce, and European larch.

Plans: Additional logging areas to be planted each year.

Agency: Harvard Forest.

1930 Costs: \$500. (planting cost).

Project: The effect of liming soil on the composition and behavior of ground cover.

Scope: To determine to what extent the reduction of acidity may result in affecting reproduction.

Status: Plots treated in the autumn of 1924.

Plans: Conclusions to be drawn by Gast.

Agency: Harvard Forest - P. R. Gast.

Project: Mixed coniferous types.
 Scope: To determine the effect of certain mixtures and stand forms of New England conifers upon the quality and quantity of timber production.
 Status: Started 1924.
 Plans: To be revived if possible.
 Agency: Harvard Forest.

Project: Methods and results of early improvement.
 Scope: To demonstrate by analysis of specific cases the technique, costs, and results of weeding and release cuttings in mixed stands.
 Status:
 Plans: To be included in "Cases in Forest Management", 1930.
 Agency: Harvard Forest - A. C. Cline.
 1930 Costs: \$300.
 Publications: "Forest Weeding" by A. C. Cline, bulletin of the Massachusetts Forestry Association and the Harvard Forest.

Project: White pine, hemlock, and spruce.
 Scope: To determine by adjacent areas in similar stands the results of cutting by the group selection, shelterwood, and cleared strip methods. Types: white pine and hemlock, and pure hemlock with some spruce.
 Status: First cuttings carried out and records made on all areas during the winter of 1924-25.
 Plans: Observations to be continued and operations performed when due.
 Agency: Harvard Forest cooperating with New England Box Co.

- Project: The conversion of inferior hardwood types into softwood by planting.
- Scope: To determine the best methods, costs, and results of planting softwoods after cutting the cordwood types.
- Status: Experimental areas planted on various sites and with varying mixtures under observation since 1919.
- Plans: Additional plantations to be added.
- Agency: Harvard Forest.
- 1930 Costs: \$50. (planting)
- Publications: To be included in "Cases in Management", 1930.
-
- Project: Methods of cutting white pine.
- Scope: To determine the best silvicultural system to use in white pine to secure natural reproduction in the shortest possible time, and to determine the rate of growth of the residual stand.
- Status: Since 1911 experiments have been under way at Petersham, Mass. with the shelterwood system, clear cutting, clear cutting in a seed year, and clear cutting with seed trees in groups.
- Plans: To be continued.
- Agency: Harvard Forest
-
- Project: Methods of cutting hardwoods.
- Scope: To determine the best silvicultural system to use in hardwoods to secure natural reproduction in the shortest possible time, and to determine the rate of growth on the residual stand.
- Status: Methods used include clear cutting, clear cutting with reserved seed trees and groups, selection and small group cuttings (largely salvage cuttings culling dead or dying chestnut in transition type), simple coppice, and coppice with standards. The types involved include mixed hardwoods, gray birch, and swamp maple.
- Plans: To be continued.
- Agency: Harvard Forest

Project: Demonstration of thinnings in mixed hardwood type.
Scope: To demonstrate the effect of extra heavy thinning in an even-aged stand 25 years old.
Status: Thinning carried out in winter of 1923-24 under the supervision of C. H. Foster, forester for the E. Murdock Company, Winchendon, Mass.
Plans: Observations to be continued.
Agency: George C. Beals, Harvard Forest cooperating.

Project: Thinnings and reproduction cuttings by shelterwood and selection methods in white pine.
Scope: To demonstrate the value and effect of the above treatments in commercial timber.
Status: Operations carried on in winters of 1923-24 and 1924-25. Two separate areas thinned, one cut by selection method and one by shelterwood.
Plans: Records and observations to be continued by C. H. Foster, forester for the E. Murdock Company, Winchendon, Mass.
Agency: E. Murdock Company, Harvard Forest cooperating.

Project: Improvement cuttings in white pine.
Scope: To determine the effect of weeding, improvement, and release cuttings on the growth of white pine.
Status: Work includes (1) white pine release cuttings in gray birch type started in 1915. Two plots, a sample plot and control, each one-half acre in size. Plots were seriously damaged in the ice storm of 1921. (2) Weedings on logging areas in the pine-transition hardwood type on 16.25 acres coming in to natural white pine reproduction and on 135 acres where pine has been planted. This includes three weedings on some areas. Improvement cuttings have been made in the pine-transition hardwood and the pine-gray birch types on 53.65 acres.
Plans: Observations to be continued.
Agency: Harvard Forest.

1930 Costs: \$100.

Project: Thinnings in red spruce.
Scope: To determine the effects of various grades of thinnings in red spruce on the growth of the residual stand.
Status: Plans made, but work not yet under way.
Plans: To be started in future.
Agency: Harvard Forest.

Project: The effect of thinnings upon growth.
Scope: To determine the effect of both the French and German methods of thinning on even-aged white pine stands.
Status: Plots laid out and thinned in January 1925 in white pine stand 25 years old.
Plans: To be thinned and measured periodically.
Agency: Harvard Forest.
1930 Costs: \$50. (remeasurement).

Project: Thinnings in white pine.
Scope: To determine the effect of thinnings in various stands of various ages and densities on the yield of the residual stand, and also to determine the effect of thinnings being made for shelterwood first cutting and stimulation of growth.
Status: Started in 1912 in northern Worcester County, Mass. Five plots established in pine stands of various ages and densities. Thinnings made in 1912 and 1920. Pine thinnings are also being made on demonstration areas covering 52.1 acres for shelterwood first cutting, stimulation of increment, salvage, and improvement.
Plans: Additional plots to be established in 13 and 16 year old stands.
Agency: Harvard Forest.

Project: Squirrel damage in coniferous plantations.

Scope: To determine the importance and extent of winter feeding on buds of Scotch pine, Norway spruce, and white pine by red squirrels.

Status: Plantations on the Harvard Forest examined during the winter of 1925.

Plans: Completed.

Agency: Harvard Forest - Neil W. Hosley.

Publications: "Red Squirrel Damage to Coniferous Plantations" by Neil W. Hosley. Ecology 9(1): 43-48, 1928.

Project: Analysis of marketing factors for principal New England species.

Scope: To determine by statistical analysis of production and utilization the possibilities of improving marketing for second growth stands.

Status: A survey of the wood-using industries and dealers of Springfield, Mass., completed in February and March, 1925.

Plans: Completed.

Agency: Harvard Forest.

Publications: "Lumber Consumption in the Springfield District", Harvard Forest Circular, 1925.

SUMMARY OF PERMANENT SAMPLE PLOTS

Harvard Forest

1936

Spruce swamp plots:

P.H. II.

Established in 1913 in a natural spruce swamp to study the progress of reproduction.

Seed source plantation:

P.H. I.

Planted in 1924 to show the effect on growth rate and quality of timber in the offspring of the types of white pine "mother" trees.

Degree of pruning plots:

P.H. III.

Treated in 1926 to show the effect on growth and quality of timber produced of varying amounts of pruning in an 18-year-old white pine plantation.

Managed hardwood plots:

T.S. II.

Established in 1928 in a stand 20 years old to trace the development with treatment of a hardwood stand of sawtimber species which followed a pine cutting.

Reclamation plots:

P.H. V & VI.

Laid out in 1930 in a severely weeviled, 1911 white pine plantation to determine the feasibility of developing a sawtimber stand of good quality by pruning and girdling

White pine spacing experiment:

P.H. III.

Established in 1930 in a stand planted 1916 to give the effect on growth, form and quality of spacings varying from 3 X 3 ft. to 6 X 6 ft.

Red pine plots:

P.H. VI.

Established 1930 in oldest red pine plantation in the Forest (planted 1915) to show effect of various grades of thinning with or without pruning. There is a series of three treated plots and an untreated control.

Pruning of white pine:

S.C. XI.

Established 1930 in a 22-year stand to determine the results of pruning in a densely stocked, natural stand.

European larch thinning:

P.H. VII.

Carried out in 1931 to show the results of thinning in a stand of this exotic species. This plot will be used for growth and yield data also.

Paper birch seeding experiments:

P.H. III & VIII.

Established 1931 in an attempt to develop a means of successfully establishing this species on cuttings without planting nursery stock.

Hardwood thinning plots:

T.S. I.

Established in 1933 in a 17-year stand of natural origin to trace the development with treatment through the life of the stand.

Cartridge planting:

O.C. II.

Established in 1934 to test the method of planting young seedling conifers grown in tobacco stem cartridges.

Black Brook plots, Hamilton, Mass.

Laid out in 1934 with six plots illustrating various thinning methods in white pine, Japanese and European larch and Scotch pine.

Red pine pruning methods:

P.H. II.

Established in 1936 to show the effect of various methods of cutting dead branches on callus formation and rate of healing.

Norway spruce pruning methods:

P.H. V.

Established in 1936 to determine the effect of various amounts of live and dead branch pruning on growth and healing of cuts.

Norway spruce thinning and pruning:

P.H. V.

Laid out in 1936 to determine the effect of two grades of thinning and crop tree pruning in a 24-year-old plantation by comparing with an untreated check plot.

4.

Plantations, general:

Each of the 100 plus plantations in the Harvard Forest has its record as to history and condition of the site at the time of planting, a description of the stock planted with its amount, how it was planted, who planted it, how much it cost and what treatment has been given it. Each of these is accordingly, in a sense, a sample plot. A tenth-acre plot has been located and measured in detail in most of these plantations established prior to 1930.

Adams-Fay lot stands:

A series of cutting method plots were laid out during 1924-25 in this old pine-hemlock tract to determine the best methods of naturally reproducing the stands. Also, small quadrats were scarified by various methods to eliminate the unfavorable effect of the deep litter or else trenched to eliminate root competition.

KEY TO EXPERIMENTS

Number	Subject	Status
15-1	Alternate row planting, R and W pine, PH VI.	Plantation File
24-1	White pine seed source, PH I.	Current
28-1	Hardwood thinning, TS II	Current
30-1	Reclamation of weeviled white pine (Coop.)	
	Choate	Current
	PH V	Current
	PH I	Completed
	PH VI	Completed
	SC XI	Completed
31-1	Direct seeding of paper birch, PH VIII	Plantation file
32-1	White spruce -- soil inoculation, PH III	Plantation file
32-2	Planting white ash, SC II	Plantation file
33-1	Hardwood thinning, TS II	Current
33-2	Planting yellowpoplar and white ash, TS V ^{C.P.S. 1949}	Plantation file
34-1	Cartridge planting of white pine, various	Completed
35-1	Gypsy moth reconnaissance (Cooperative)	Completed
35-2	Stool heights (Cooperative), TS I	Completed
35-3	Planting red oak, SC II	Plantation file
36-1	Pruning norway spruce, PH V	Current
36-2	Fertilizer control of cytospora canker (Cooperative), PH V, (incorr. 36-3)	Current
36-3	Silvicultural control of gypsy moth (Cooperative), TS I, etc.	Current
36-4	Thinning norway spruce, PH V (Cooperative)	Current
36-5	Pruning red pine, PH II	Current

Key to experiments, 1944

37-1	Decay hazards in white ash (Coop), TS IV	Completed
37-2	Paper birch red heart (Coop.), TS I	Current
37-3	Inoculation of norway spruce with cytospora (Cooperative), PH V	Current
37-4	Gypsy moth ecology (Cooperative)	Current
38-1	Direct seeding of white pine, TS VII	Plantation file
38-2	Planting white ash and yellowpoplar, PH IX	Plantation file
38-3	Planting white cedar, PH VIII	Plantation file
39-1	Planting black walnut, PH IX	Plantation file
39-2	Concentrated arsenite spray (Cooperative)	Current
39-3	Log spraying (Cooperative)	Completed
39-4	Log spraying	Completed
39-5	Log end treatment	Completed
40-1	Post-hurricane regeneration, Various	Current
40-2	Concentrated arsenite spray (Cooperative)	Current
40-3	Ash provenance, Various	Current
41-1	Coppice conversion into sawtimber (Coop) PH VIII	Current
41-2	Partial suppression of white pine (Coop.) SC II	Current
41-3	Planting white ash, various	Plantation file
41-4	Planting black walnut, various	Plantation file
41-5	Field impregnation of entire trees (Coop)	Current
41-6	Seed weight experiment	Manuscript file
42-1	Black cherry perpetuation (Coop.), TS V	Current
42-2	Camouflage research	Special file
42-3	Propagation of white cedar, SC VII	Plantation file
43-1	Thinning of mixed plantation, PH II	Plantation file
43-2	Local climate study	Current
43-3	Poplar propagation by cuttings	Current

CURRENT RESEARCH

In Experimental File
March 15, 1944

Number	Subject	Stand (1937)
HARVARD FOREST STUDIES		
24-1	White pine seed source	PH I P-1
28-1	Hardwood thinning	TS II Hd-1
33-1	Hardwood thinning	TS I P-Hd-3
34-2	Scarification	TS IX P-7
34-3	Shelterwood reproduction	TS IX P-7
36-1	Norway spruce pruning	PH V Sp-3
36-5	Red pine pruning	PH II P-1
40-1	Post-hurricane regeneration	Plot A PH IV P-3
		B PH I P-5
		C TS IX P-Hm-3
		D TS IV Hd-1
		E TS IV P-Hm-Hd-3
		F TS V P-17
		G TS VI P-1
		H TS I P-1
		I TS I P-3
		J SC II P-8
		K SC IV P-2
		L SC IV P-2
		M TS IX P-2
		N TS IX P-2
O PH IX P-1		
40-3	Ash provenance	Plot A PH I P-5
		B PH I O-5
		C PH IX Hd-10
		D TS IV O-1
43-2	Local climate study	Various
43-3	Poplar propagation by cuttings	Plot A PH IV P-Cd-1

COOPERATIVE STUDIES

30-1	Reclamation of weeviled white pine	PH V Ghoate Place	P-7
36-2	Fertilizer control of cytospora canker (Incorrectly also 36-3)	PH V PH V	Sp-3 Sp-2
36-3	Silvicultural control of gypsy moth	TS I	P-Hd-3
36-4	Thinning norway spruce to control cytospora	PH V	Sp-2
37-2	Paper birch red heart	TS I	P-Hd-3
37-3	Inoculation of healthy norway spruce with cytospora canker	PH V	Sp-3
37-4	Gypsy moth ecology	Various	
39-2	Concentrated arsenate spray	TS VII	O-1
40-2	Concentrated arsenate spray	SC II TS III	P-Hd-2
41-1	Coppice conversion into sawtimber	PH VIII	Hd-8
41-2	Partial suppression of white pine	SC II	P-13
41-5	Field impregnation of entire trees	Various	
42-1	Black cherry perpetuation	TS V	P-17

COMPLETED RESEARCH

In Experimental File
March 15, 1944

Year	Subject	Stand (1937)
1908	Thinning of old field white pine	TS VI P-1
1908	Releasing volunteer white pine	TS IV Hd-3
1910	Poplar root suckers	TS VIII Cd-1
1912	Thinning old field white pine	SC II P-7 (?)
1912	Growth of spruce in peat bog	PH II Sp-1
1914	Shading of gray birch to prevent sprouts	PH IV P-3
1915	Releasing volunteer white pine	TS II Hd-1
1916	White pine spacing (Plantation 16-C)	PH III P-8
1916	Pales weevil damage	TS IV P-Hd-1
1919	Releasing volunteer white pine	PH I ?
1923	Thinning volunteer white pine	Brown-Spooner Lot
1923-24	Thinning, releasing, etc.	Mass. -- N.H.
1924	Lumber grading	Winchester, N.H.
1926	Stump poisoning	PH I, O-12
1927	Scarification	TS IX
1929	Hardwood thinning (L-Plot)	TS II Hd-1
1930	Pruning volunteer white pine	TS IX P-2
1930	Thinning red pine (15-F3)	PH VI P-4, P-6
30-1	Reclamation of weeviled white pine (11-A) Abandoned plots	PH I P-5 (Vol.) SC XI P-23 (15-F1) PH VI P-1
30-1	Reclamation of weeviled white pine Temporary plots	Various
34-1	Cartridge planting of white pine	Various
35-1	Gypsy moth reconnaissance (Cooperative)	Various
35-2	Stool heights (Cooperative)	TS I P-Hd-5

37-1	Decay hazards in white ash (Cooperative)	TS IV	Hd-1
39-3	Log spraying (Cooperative) (formerly 39-2)	TS VII PH VIII	
39-4	Log spraying (Cooperative)	--	
39-5	Log end treatment (TS IV	

EXPERIMENTS TRANSFERRED TO
PLANTATION FILE, 1944

No.	Species	Subject	Plant.	Stand (1937)
15-1	Red pine White pine	Alternate rows	15-G	PH VI, P-5
31-1	Paper birch	Direct seeding	31-B	PH VIII, Mx-Sd-3
32-1	White spruce	Soil inoculation	32-E	PH III, Mx-Sd-1
32-2	White ash	Planting	32-C	SC II, Hd-5
33-2	Yellowpoplar	Planting	33-D	TS V, P-Hd-6
35-3	Red oak	Planting	35-B	SC II, Hd-3
38-1	White pine	Direct seeding	38-F	TS VII, P-Cd-5
38-2	White ash Yellowpoplar	Planting	38-H	PH IX, Hd-1
38-3	White cedar	Planting	38-D	PH VIII, O-1, Cd-2
39-1	Black walnut	Planting	Plot A, 39-A B 39-B C 39-C D 39-D E 39-E	PH IX, Hd-10 PH IX, Hd-7 PH IX, P-1 PH IX, Hd-1, Hd-5 PH IX, Hd-1
41-3	White ash	Planting	Plot A B C D E F G H I J K L	41-D PH I, Hd-1 41-E PH IX, Hd-10 41-F PH IX, Hd-7 41-G SC VIII, P-Cd-1 41-H TS IV, P-Hm-Hd-3 41-I TS IV, Cd-1 41-J TS VIII, Hd-2 41-K TS VII Hd-2 41-L TS VIII, Hd-1 41-M TS VIII, Hd-4 41-N PH II, P-1 41-O PH IX, Hd-1
41-4	Black walnut	Planting	Plot A B C	41-A PH III, P-Cd-3 41-B PH II, O-3 41-C PH II Cd-1
42-3	White cedar	Planting	42-A	SC VII P-2
43-1	White pine White spruce	Thinning	24-C	PH II, Mx-Sd-3

May, 1945

RESEARCH FILE

Year or Number	Subject, Location, Author	Status
1904	A comparison between the forest administration in British India and the United States of America. Louis Margolin.	Completed
1908	White pine thinning. TS VI, P-1, 1937	Completed
1908	Release of white pine. TS IV, Hd-3, 1937	Completed
1910	Forest resources of the world. George Y. Baker.	Completed
1910	Disposal of slash in relation to forest management. W. F. Hale.	Completed
1910	Poplar root suckers. TS VIII, Cd-1, 1937	Completed
1912	White pine thinning. SC II, P-7(?), 1937	Completed
1912	Growth of spruce in bog. PH II, Sp-1, 1937	Completed
1911	Forest resources of the United States. K. D. Swan.	Completed
1913	Hardwood lumbering in Potter County, Pennsylvania. Joseph Kittredge, Jr. and Ward Shepard.	Completed
1914	Shading of gray birch to prevent sprouting. PH IV, P-3	Completed
1915	Weeding volunteer white pine. TS II, Hd-1, 1937	Completed
15-1	Alternate row planting, Red and white pine. PH VI	Plantation file
1916	White pine spacing. PH III, P-8, 1937. 16-C	Completed
1916	Pales weevil damage. TS IV, P-Hd-1, 1937	Completed
1918	The regeneration of white pine in cutover land in central New England. E. I. Terry.	Completed
1919(?)	Releasing volunteer white pine. PH I	Completed
1920	A report on some of the forest plantations of Massachusetts. A. H. Richardson.	Completed
1921	Quality in the second-growth white pine of New England. A. F. Allen.	Completed

1921	Cuts used in H. F. Bul. 1, "The Management of the Harvard Forest". R. T. Fisher.	Completed
1921	Control of the white pine weevil by forest management. H. B. Pearson. Bul. 5	Completed
1922	A statistical forest survey of seven towns in central Massachusetts. R. W. Averill, W. B. Averill, and W. I. Stevens.	Completed
1922	Red oak and white ash: a study of growth and yield. R. T. Patton. Bul. 4	Completed
1923	Thesis in lumbering research. D. R. Rogers.	Completed
1923	Quality and growth of white pine, as influenced by density, site, and associated species. E. E. Tarbox.	Completed
1923	White pine thinning. Brown-Spooner lot.	Completed
1923-24	Various off-forest thinnings, etc.	Completed
24-1	White pine seed source, PH I, 24-B	Current
1924	Lumber grading. New England Box Company.	Completed
1924 (?)	The planting tool and planting basket used by the Harvard Forest. A. C. Gline.	Completed
1925	Studies in bole form of white pine: relation between form point and form class. W. A. Albright and N. W. Hosley.	Completed
1925	Mixed white pine and hardwood. A. C. Gline and C. R. Lockard. Bul. 5	Completed
1925	The marketing of lumber in New Hampshire. A. C. Gline. Bul. 10	Completed
1925	A preliminary study of borer damage in stacked white pine lumber. N. W. Hosley.	Completed
1925	Study of lumber consumption in the Springfield district. Harvard Forest staff.	Completed
1926	A study of the relation of white pine slash to the development of reproduction on clear-cut areas. L. S. Altpeter.	Completed
1926	The management of a small forest for sustained yield: The Petersham Town Forest. R. P. Gabriel.	Completed
1926	The wood-using industries of Massachusetts. J. B. Downs and C. B. Gutchess. Bul. 12	Completed

1934	A study of artificial forest pruning in white pine plantations. J. D. Curtis.	Completed
1934	The relation of the white-tailed deer to the forests in north central Massachusetts. N. W. Hosley and R. K. Ziebarth.	Completed
35-1	Gypsy moth reconnaissance (Cooperative)	Completed
35-2	Stool heights (Cooperative) TS I	Completed
35-3	Planting red oak. SC II	Plantation file
1935	Cutover and field pine lands in New England. F. S. McKinnon and G. R. Hyde. Bul. 18	Completed
36-1	Pruning Norway spruce. PH V	Completed
36-2	Fertilizer control of cytospora canker (Cooperative) PH V, 16-E, 19-C.	Current
36-3	Silvicultural control of gypsy moth (Cooperative) TS I	Current
36-4	Thinning Norway spruce (Cooperative) PH V	Current (under 36-2) Also Plantation file
36-5	Pruning red pine. PH II	Completed
1936	Norway spruce in the northeastern United States; a study of existing plantations. N. W. Hosley. Bul. 19	Completed
1936	Some winter relations of the ruffed grouse in Petersham, Massachusetts. H. W. Turberville.	Completed
37-1	Decay hazards in white ash (Coop.) TS IV	Completed
37-2	Paper birch red heart (Coop.) TSI	Completed
37-3	Inoculation of Norway spruce with cytospora (Coop.) PH V	Completed (under 36-2)
37-4	Gypsy moth ecology (Cooperative)	Current
1937-1940	Seed collections. Seed origin. P. R. Gast.	Completed
? 1937-1942	Miscellaneous Cabot Research. P. R. Gast.	Completed
1937	A study of spring flood factors as influenced by certain forest cover types. B. C. Goodell.	Completed
1937	A study of spring flood factors as influenced by forest cover types in central New England. B. C. Goodell.	Completed

1937 (?)	A history of the forests of Cape Cod. L. Stanford Altpeter.	Completed
1937 (?)	History of Cape Cod forests. L. S. Altpeter.	Completed
38-1	Direct seeding of white pine. TS VII	Plantation file
38-2	Planting white ash and yellow poplar. PH IX	Plantation file
38-3	Planting white cedar. PH VIII	Plantation file
1938	Doe Valley seed source experiment. P. R. Gast.	Completed
1938	International union scotch pine and Norway spruce seed source. P. R. Gast.	Completed
1938	The farm woodlands of the town of Hardwick, Massachusetts. R. J. Lutz and Mace E. Raymond.	Completed
39-1	Planting black walnut. PH IX	Plantation file
39-2	Concentrated arsenite spray (Cooperative)	Current
39-3	Log spraying (Cooperative)	Completed
39-4	Log spraying.	Completed
39-5	Log end treatment.	Completed
1939	Nichevaug nursery seed source experiment. P. R. Gast.	Completed
1939	Seed sorter. P. R. Gast.	Completed
1939	Reproduction systems in the pine-hardwood succession on old fields. E. Arnold Hanson.	Completed
1939	Hurricane study. Willett Rowlands.	Completed
1939	A study of white ash with particular reference to the habit of branching. Jonathan W. Wright.	Completed
1939	Cones and seed weight. J. W. Wright.	Completed
40-a	Technique of weighing white pine seed. Stephen H. Spurr.	Completed
40-1	Post-hurricane regeneration. Various.	Current
40-2	Concentrated arsenite spray (Cooperative)	Current
40-3	Ash provenance. Various.	Current
1940	Auxin pot cultures. First series. P. R. Gast and Stephen H. Spurr.	Completed
1941	Auxin pot cultures. Second series. P. R. Gast and Stephen H. Spurr.	Completed

1926	Red pine in central New England. A preliminary study with volume tables. Paul M. Reed. Bul. 9	Completed
1926	Stump poisoning. PH I, 0-12, 1937	Completed
1927-1942	Pisgah old growth study. A. C. Cline and S. H. Spurr	Completed
1927	Scarification. TS IX	Completed
1927	The occurrence of nitrogen in soil profiles under pine. A. W. Gottlieb.	Completed
1927	Influence of land history and legislative enactments on the character and condition of the state forests in Massachusetts. R. M. Hick.	Completed
1927	The growth of hemlock before and after release from suppression. Robert Marshall. Bul. 11.	Completed
28-1	Hardwood thinning. TS II, Hd-1, 1937	Current
1928	Form and development of white pine stands in relation to growing space. S. R. Gevorkiantz and N. W. Hosley. Bul. 13	Completed
1928	Red squirrel damage to coniferous plantations and its relation to changing food habits. N. W. Hosley	Completed
1929	Hardwood thinning. (L-Plot) TS II, Hd-1, 1937	Completed
1930	The evolution of soils as affected by the old field white pine-mixed hardwood succession in central New England. B. G. Griffith, E. W. Hartwell, and T. E. Shaw. Bul. 15	Completed
1930	Pruning volunteer white pine. TS IX, P-2, 1937	Completed
1930	Red pine thinning plots 15-F. PH VI, P-4, P-6, 1937	Completed
1930	Life history of the climax forest on the Pisgah tract, Winchester, N.H. W. C. Branch, R. K. Daley, and Thomas Lotti.	Completed
30-1	Reclamation of weeviled white pine (Coop.) Choate PH V, 19-A PH I, 11-A PH VI, 15-F SG XI	Current Current Completed Completed Completed
1930	The regrowth of hardwood sprouts resulting from repeated weedings. C. S. Herr.	Completed
31-1	Direct seeding of paper birch. PH VIII	Plantation file

1931	The physical properties of the cove soils on the Black Rock Forest. H. P. Scholz. Black Rock Forest Bul. 2,	Completed
1931	The economic possibilities of forestry for wood-using industries in central New England. Eitel Bauer.	Completed
32-1	White spruce--soil inoculation. PH III, 31-A	Plantation file
32-2	Planting white ash. SG II	Plantation file
1932	Growth and condition of the coniferous plantations on the Harvard Forest. C. G. Breckenridge and N. W. Hosley.	Completed
1932	Study of Harvard Forest Plantations. C. G. Breckenridge and N. W. Hosley.	Completed
1932	European larch in the northeastern United States. Stuart S. Hunt. Bul. 16.	Completed
1932, 1935	Miscellaneous material pertaining to his master's and doctor's theses. J. W. Johnston, Jr.	Completed
1932	Growth of Scots pine in sand cultures with varied radiation intensity and nitrogen supply. H. L. Mitchell.	Completed
1932	Weather and forest fire hazard with special reference to the white pine region of central New England. Paul W. Stickel.	Completed
33-1	Hardwood thinning. TS I, P-Hd-3, 1937	Current
33-2	Planting yellow poplar and white ash. TS VI	Plantation file
1933	Some factors underlying forest fire insurance in Massachusetts. C. C. Averill and L. M. Frost. Bul. 17.	Completed
1933	Management of red oak and white ash with special reference to thinning. Torkel ^H olsøe.	Completed
1933	A preliminary study of the effect of ground cover types on white pine reproduction in group selection cuttings. A. Steed.	Completed
34-1	Cartridge planting of white pine. Various.	Completed
34-2	Scarification plots. TS IX	Current
34-3	Shelterwood reproduction. TS IX	Current
1934	A study of artificial forest pruning. J. D. Curtin.	Completed

V EPS 1949-2/5

1941	Natural restocking of hurricane damaged (old field" white pine areas in north central Massachusetts. Ralph W. Brake and Howard A. Post.	Completed
1941	Field data, original tables, outline, and all computations for Natural Reproduction Study. Ralph W. Brake and Howard A. Post.	Completed
41-1	Coppice conversion into sawtimber (Coop.) PH VIII.	Current
41-2	Partial suppression of white pine (Coop.) SC II	Current
41-3	Planting white ash. Various.	Plantation file
41-4	Planting black walnut. Various.	Plantation file
41-5	Field impregnation of entire trees (Coop.)	Current
41-6	Seed weight experiment.	Completed
42-1	Black cherry perpetuation (Coop.) TS V	Current
42-2	Camouflage research	Completed
42-3	Propagation of white cedar. SC VII	Plantation file
1942	Economic possibilities of farm forestry. A case study to determine the potential contribution of farm woodlands to the economy of five representative farms in the town of Hardwick, Massachusetts. Gordon Libby Chute.	Completed
1942	A proposed plan of management for Tom Swamp Block, Compartment III. C. Edward Gill.	Completed
1942	Silvicultural management plan, Compartment III, Harvard Forest, Peter sham, Massachusetts. Robert W. Larson.	Completed
1942	Silvicultural study of Tom Swamp III, Harvard Forest, Peter sham, Massachusetts. Ray A. Yoder.	Completed
1942	Final student project. Tom Swamp.	Completed
43-1	Thinning of mixed plantation. PH II	Plantation file
43-2	Local climate study.	Current
43-3	Poplar propagation by cuttings.	Current
1943	Silvicultural study of Tom Swamp III. Louis Frahar.	Completed
1943	Thirty Year Report. R. J. Lutz and A. C. Cline.	Completed

44-1	Plantation study.	Current
44-2	Field propagation of cuttings.	Completed
44-3	Norway spruce - seed source.	Current
44-4	Standard height curves.	Current
44-5	Camouflage--infra-red.	Completed
44-6	Aerial photography	Current
44-7	Nursery bed propagation of cuttings.	Current
44-8	Permanent sample plots: Volunteer stands in Prospect Hill block.	Current
44-9	Gypsy moth study.	Current
1944	Nursery bed propagation, Root competition, Miscellaneous Gobot Research, K. A. Grossenbacher.	Completed
45-1	Dendrometer measurement of thinning effectiveness.	Current