

REPORT ON THE HARVARD FOREST

The Harvard Forest has had a prolific year, and its service as a forest experiment station and research laboratory has been widely recognized. It continues to be much visited by foresters and persons concerned in timber land operation, not only from New England, but from more distant parts as well. That the knowledge and experience accumulating in its management are being drawn upon for the solution of professional and public problems is indicated by the following list of committees upon which the director is serving: Committee on the Scope and Character of Research in Schools of Forestry, Society of American Foresters (Chairman); Committee on the Standardization of Forest Sites, Society of American Foresters; New England Section of the Society of American Foresters (Chairman); Sub-Committee on Silviculture of the National Research Council; Special Committee appointed by the Massachusetts Forestry Association to Draft a Law for Forest Taxation; Committee on the Expenditure of the Parkman Fund, Sub-Committee on Trees (Chairman); Forestry Committee of the Boston Chamber of Commerce.

In addition, the Town of Petersham has voted to convert the woodland on its Poor Farm into a town forest, and to ask the Director of the Harvard Forest to advise as to its management.

Since the last Report, a substantial amount of research has been completed. In coöperation with the Massachusetts State Forester, a handbook of tables for the measurement of logs, trees and the growth of stands has been prepared. This was entitled "Forest Mensuration," and published as a Bulletin of the Commonwealth. In the series of Bulletins of the Harvard Forest, begun a year ago, two more numbers have been issued, — one on the "Life History and Control of the Pales Weevil," by H. B. Peirson; the other, on the "Management of the Harvard Forest from 1909-1919," by R. T. Fisher. Now in press is a "Study of the Growth and Yield of Red Oak and White Ash," by R. T. Patton. Completed and ready for printing are the following: "The Control of the White Pine Weevil by Forest Management," by H. B. Peirson (in collaboration with the State Forester); "Quality Increment in Second Growth White Pine," by A. F. Allen. These studies, mainly the fruits of research by graduate students, embody material and conclusions which are largely new to the science of forest management.

R. T. FISHER, *Director.*

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see last Report

REPORT ON THE HARVARD FOREST 9/1/21

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During the past year, the public relations of the Harvard Forest have been considerably widened. More than fifty persons, mostly foresters and lumbermen, have visited Petersham to study the methods and results of applied forestry. The Director is serving with the following outside organizations: Chairman of the Committee on Research of the National Conference of Forest Schools; Committee of the New England Section of the Society of American Foresters on methods of Growth Measurement for the Forests of New England; Chairman of Sub-Committee on Trees of Mayor Peters' Committee on the Expenditure of the Parkman Fund; Committee on Forestry of the Boston Chamber of Commerce; in charge for the U.S. Forest Service of permanent sample plots at South Lancaster, Mass. In addition to these general enterprises, an arrangement has been made with the State Forester of Massachusetts, Mr. William A. L. Bazely for a cooperative study of the white pine weevil in relation to forest management. In spite of the wide prevalence of this insect, especially on plantations,

there is little exact information, either as to the ultimate damage it produces in a timber crop, its distribution as affected by the composition of the forest, and other natural factors, or any silvicultural measures, by which its degradations may be controlled or minimized. It is possible that the damage to the final yield in timber has been overestimated; possibly, too, the spread of the beetle can be checked by regulation of the species represented in the stand. To investigate these questions, Mr. H. B. Peirson, a forest entomologist, now working on the Harvard Forest, has been appointed by the State Forester, a Collaborator of the Division of Forestry. He will carry on a considerable part of the work at Petersham, but the State Forester has provided means for him to visit also a large number of localities throughout the state, so that the infestations of the weevil can be studied under all conditions. In view of the large program of reforestation which the state is undertaking, it is highly important to find out in advance to what extent planting plans and methods of treating exist-

ing young woods can, or should be, modified to meet so apparently destructive a pest. Other new po

Other new projects now being carried on by research students at the forest are the following: The mound building ant as affecting coniferous plantations; the yield of red oak and white ash under intensive management; quality increment in white pine as related to utilization and market value. "The Life History and Control of the Pales Weevil", by H.B. Peirson, is now in press; "A Growth Study and Normal Yield Tables for Mixed Hardwoods in Central New England", by J.N. Spaeth, was published in November of the present year. These and subsequent publications are being brought out through the University Press as bulletins of the Harvard Forest.

The physical development of the forest and its display of varied phases of applied silviculture have now reached the point of warranting an adequate description in print. With the figures and results now available from the remeasurement of the volume and growth of the forest, completed in 1919 and summarized in the last report, a booklet

is being prepared on the history of management for the first ten years. With maps and photographs, this will serve also as a guide to all phases of technical forestry which are being conducted on the forest.

R. J. Fisher
Director

REPORT ON THE HARVARD FOREST

During the year 1921-22 the Harvard Forest has issued two more bulletins, numbers four and five in the series begun two years ago: "The Growth and Yield of Red Oak and White Ash," by Reuben T. Patton, and "The Control of the White Pine Weevil by Forest Management," by Henry B. Pierson. Three students received the degree of Master of Forestry at Commencement, all of whom secured positions through the aid of the Department. A field study involving a test of certain new methods of extensive cruising, and entitled "A Statistical Forest Survey," is completed and shortly to be published. A new and simplified forest-tax law, based mainly on experience gained in the management of the Forest, was passed by the Massachusetts Legislature last May. This law gives promise of being one of the most practicable reforms of its kind yet enacted in the United States.

Research and other work now in progress are engaging the resources of the Forest to the limit. Mr. J. Nelson Spaeth, Assistant to the Director and Instructor in Lumbering, has undertaken the compilation of a working plan document for the Forest. This will include all the data involved in the regulation of yield and will serve as the basis for future periodic assessments of the growing stock. Five students are registered in the Department of Silviculture and Forest Management. The projects under investigation are the following: Quality increment in second-growth white pine as related to associated species and density; the effect of crown friction upon volume growth in even-aged stands of white pine; the effect of light intensities upon certain phases of tree growth; a study involving management plans for lands of the New England Box Company. In the work upon light the Forest is coöperating with the Harvard Cancer Commission, and the apparatus for use in the woods is being perfected in the laboratory at the Huntington Hospital under the direction of Dr. Bovie. In addition to these special projects the New England Box Company has asked the Director to supervise the handling of a large area of its timberland in Petersham. The value of such a connection both to the advanced student and to the Forest is very great. It will furnish not only the best professional experience but also an opportunity for establishing improved methods of forest management in the practice of woodworking industries.

R. T. FISHER, *Director.*

REPORT ON THE HARVARD FOREST

Last spring the Harvard Forest received from an anonymous donor a gift of \$100,000. From the same donor, and at the same time, a similar gift was made to the School of Forestry at Yale. In both cases it was stipulated that the income of the endowment should be used for research in problems relating to silviculture and forest production in the northeast. At a time of greatly enlarged opportunity, this addition to income was peculiarly timely. The technical program is now organized under three heads: (1) continued development of the Forest as a unit of management illustrating all possible phases of proved and experimental silviculture; (2) establishment of coöperative studies with local woodworking industries; and (3) special investigative projects dealing with fundamental questions of growth and forest environment.

Under the first head, the Forest has been entirely remapped so as to show alterations in age and composition, the system of records and accounts has been improved, and a number of new silvicultural measures initiated. Under the second, experimental cuttings in coöperation both with the E. Murdoch Company and the New England Box Company, are in progress; and the latter company has loaned the Forest, for a term of years, a fine tract of softwood timber, two hundred and fifty acres in area, which will be used for joint tests in methods of reproduction. Special projects — the third type of work — now in progress, include: a study of the life history and commercial possibilities of mixed pine and hardwoods — an attempt to check the almost universal tendency of hardwoods to eliminate softwoods on the cut-over lands of New England; a study of the growth and management of Norway or red pine, a desirable alternative to white pine in reforestation; under the joint supervision of the Harvard Forest and Dr. W. T. Bovie of the Harvard Cancer Commission, an environmental investigation with special reference to the effect of varying light intensities and soil temperatures on tree seedlings. This general program, combining the fundamental and experimental work carried out on the Forest, with coöperative studies in the surrounding regions, seems calculated not only to help define the scientific foundations of forestry, but to enlist substantial interest in its practice.

The quality of the students resorting to Petersham for graduate work continues high. Of the three who took degrees last June, one is now employed by a combination of forest owners in Winchendon, including two woodenware factories, one is engaged in blister rust

control for the State of Maine, and a third is remaining for another year as research assistant on the Forest. Bulletin No. 7, "A Statistical Forest Survey of Seven Towns in North-Central Massachusetts," has been published by the Harvard University Press, and the manuscript of another, on quality increment in white pine, is ready for printing.

The Forest continues annually to attract many professional men, who come to see our methods and results; and the staff is more and more consulted by forest owners quite apart from the woodworking companies with whom we are actually coöperating. What with timber estimates, maps and boundary surveys, planting plans, advice for cutting operation, some two thousand acres have been in some degree prescribed for this year. Directly or indirectly, our precept and example have influenced the management of many thousands of acres of woodland. Thus the Harvard Forest is unmistakably promoting the practice as it is contributing to the technique of forestry in New England.

RICHARD T. FISHER, *Director.*

Report on the Harvard Forest

During the year 1923-24 the Harvard Forest has been developing the program of research and cooperative experiment made possible under the Forest Production Research Fund. As an example of the successful practice of forestry, the Harvard Forest has already had a wide influence on the development of forest management in Central New England. With the resources of this new fund, its serviceability both to the advancement of technical knowledge and to the promotion of forestry is greatly enhanced. Since the last report a study of the Quality Increment of White Pine as Influenced by Density, Site and Associated Species, by E. E. Tarbox, with field assistance by P. M. Reed, has been published as Bulletin No. 7. Two other studies are completed and almost ready for the press: The Life History and Management of Mixed Pine and Hardwood by A. C. Cline and C. R. Lockard, and A Preliminary Investigation of the Growth and Yield of Red Pine by P. M. Reed. Last February and March in one of the factories of the New England Box Company, a study was made of the relation of grade or quality in lumber to the cost of manufacture, the result of which indicated the possibility of greatly improved utilization. Other investigations now in progress are (1) the silvical relations of certain mixtures of conifers, (2) the technique, cost and results of weeding and release cuttings, (3) logging costs as related to certain methods of partial cutting, and (4) the life history and reproductive phases of a specific hemlock forest. In addition to these experimental projects the fundamental research into the relation between seedling development and the factors of environment, particularly those of light and soil, has been continued. The apparatus and technique for recording data, developed by Mr. P. R. Gast under the supervision of Dr. W. T. Bovie, have been brought into effective operation. Meanwhile with the establishment of the Northeastern Forest Experiment Station of the United

States Forest Service at Amherst, a cooperative arrangement has been effected whereby this phase of silvical work is being conducted at the joint expense and control of the Government and the Harvard Forest.

In pursuance of the policy of establishing cooperative experiments or demonstrations with neighboring timber-owning companies, four different areas belonging to the E. Murdock Company of Winchendon have been cut under the direction of the Harvard Forest, with the purpose of acquiring specific data on growth and reproduction. Another most promising and extensive operation of this type is being carried out on the timber tract offered last year as a loan to the Forest by the New England Box Company. On this area of nearly 150 acres the Forest is conducting both an elaborate experiment in determining factors of reproduction and a test of certain new ways of utilization. The Company is paying the cost of the work and the results will be available not only for publication, but as a demonstration to other operators.

The public relations of the Forest continue to be active and serviceable. There are frequent visits of lumbermen and forest specialists to inspect out operations. In June the Forest acted as host to the joint field meeting of the New York and New England sections of the Society of American Foresters, said to be the largest turnout of its kind ever held in America. In August the annual outing of the members of the Worcester County Farm Bureau was held on the Forest, and in September the Research Council of the Northeastern Forest Experiment Station also met in Petersham. At these meetings the combined attendance of persons concerned or interested in the practice of forestry amounted to over 600.

In personnel there have been some changes. Mr. J. Nelson Spaeth has resigned as assistant to the Director to accept an appointment as Assistant Professor of Forest Research in the Department of Forestry at Cornell University. In his place, and with the title also of instructor, Mr. A. C. Cline has been appointed. Mr. P. R. Gast, besides serving as instructor, holds an

appointment from the United States Forest Service. At the last commencement three men received the degree of Master in Forestry. For the present year there are five graduate students registered at the Forest, all men with previous degrees in Forestry.

The Forest is represented through its Director in the following organizations: Forestry Committee of the Boston Chamber of Commerce, Executive Committee of the Research Council of the Northeastern Forest Experiment Station, Vice-President and member of the Executive Council of the Society of American Foresters.

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Report on the Harvard Forest

During the year 1924-25 no cutting, aside from cordwood, has been carried on on the Harvard Forest. This was primarily because of a very low market for native pine. Instead, the entire woods force and equipment spent the autumn and winter in a large experimental operation on the tract of forest recently loaned the Forest by the New England Box Company and known as the Tom Swamp Annex. This operation, which was paid for by the Company as in ordinary logging and sawing contracts, has resulted in some of the most striking and useful demonstrations of forestry that have been developed in the region. Different kinds of silvicultural treatment, or methods of cutting, were applied to a series of separate areas, each of which is clearly marked on the ground and also on an index map. The effects of these varying methods will be increasingly evident and instructive each year. The financial aspects of these experiments will be embodied in a paper on the effect of partial cuttings on the cost of logging by Mr. A. A. Davis.

The present situation in the lumber business has emphasized the fundamental importance of favorable marketing in the development of forestry. In the hope of defining marketing improvements, the Forest undertook last winter to analyze the consumption of lumber and wood products in the city of Springfield. With the active help and cooperation of Springfield business men, this canvass was completed in the late winter, and the results will shortly be published. In consequence of the facts brought out and the probable importance of more extensive studies, the New Hampshire Lumbermen's Association voted last July to ask the Harvard Forest to carry on a similar survey for the state of New Hampshire, and to defray a considerable portion of its cost. This study is now being very efficiently prosecuted by Mr. A. C. Cline, assistant to the Director.

Harvard Forest Bulletin No. 8, entitled "Mixed White Pine and Hardwood" by A. C. Cline and C. R. Lockard, has been completed and published. A study of the growth and yield of red pine by P. M. Reed is ready for the press. Another investigation undergoing final revision is "The Growth of Hemlock after Release" by Robert Marshall. A new volume table for native white pine by N. W. Hosley is nearing completion. Mr. Hosley has also finished a paper on the recent extensive damage to coniferous plantations by the red squirrel. To demonstrate concretely the possibilities of the practice of forestry, a series of representative cases in forest management is being prepared by Roger Gabriel.

The research into the relation between seedling development and the factors of environment, especially light and soil, has been continued by Mr. P. R. Gast, under the supervision of Dr. W. T. Bovie of the Huntington Hospital. The technique has been greatly improved, and one or more papers embodying the results are being prepared this winter.

Several cooperative investigations have been arranged between the Harvard Forest and the Northeastern Forest Experiment Station. Mr. L. S. Altpeter, one of our students, and Dr. Perley Spaulding of the U. S. Division of Forest Pathology are carrying on a study of the factors influencing the decay of pine slash. With a fund contributed by persons interested in New England forestry, an intensive study is being made, through Dr. F. C. Craighead of the Bureau of Entomology, of methods of controlling the white pine weevil. The work is in charge of Mr. Harvey J. MacAloney, assisted by Mr. Donald De Leon. They have had their headquarters and made most of their field observations and experiments at Petersham. Another of Dr. Craighead's men, Mr. James Beal, has spent some weeks on the Forest on a study of insects in relation to the decay of slash. Besides these, another cooperative project has been arranged at the suggestion of the Roosevelt Wild Life Experiment Station. The director, Dr. Charles C. Adams, has had a biologist, Mr. R. T. Hatt, in camp at the Forest for two months of the summer. Mr. Hatt is making a study of the habits and life history of the red squirrel in relation to forests, particularly seed dissemination and damage to young growth.

"The New England Homestead" in its campaign for the renaissance of rural New England has adopted farm forestry as one of the most practical means to that end. The editor, Mr. Herbert Myrick, spent a month in Petersham during the past summer. So impressed was he by the methods developed on the Harvard Forest that he has himself prepared, and is now publishing in "The Homestead", a series of illustrated articles about our handling of forest crops, which will make forestry unusually intelligible to woodlot owners.

The Forest has had frequent requests for photographs and technical information by other agencies concerned with forestry. The magazine, "Nature", detailed a man to visit Petersham and prepare an illustrated article. The extension branch of the United States Forest Service has had a large number of photographs taken on the Forest by a professional photographer. These will be made into lantern slides for the use of that department.

In personnel the only change for the present academic year has been the appointment of Mr. Neil W. Hosley as forest assistant in order to help keep up the necessary records of operations on the Forest and to assist in handling the growing amount of advisory work for other forest owners in the locality. There is always more demand for technical assistance, such as estimates of timber, planting plans, and recommendations for management, than the staff of the Forest is able to meet. Much of this kind of work was done during the past year, the largest single tract examined being that of the Northfield Seminary, Northfield, Mass.

The opportunities of the Harvard Forest as an experiment station and a demonstration of methods and practice of forestry are increasing every year. Our effectiveness in these fields has been multiplied many times by the resources of the Forest Production Research Fund. For this very reason the housing and physical equipment of our activities are already alarmingly inadequate. At present the laboratory and instrumental equipment, the entire

house furnishings, belongings of the staff and students, and most serious of all, the accumulated records, photographs, and maps acquired in seventeen years of work are all housed in an isolated wooden building with no protection at all from complete annihilation by fire except the vigilance of its inmates. Some form of fireproof housing, if only for essential records, is urgently needed.

R. J. Fisher
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Report on the Harvard Forest
1925-26

The Harvard Forest has had a productive year. The study of lumber marketing and utilization undertaken for the New Hampshire Lumbermen's Association has been completed and published as Bulletin 10 of the Harvard Forest. In consequence of the apparent usefulness of this study, the same Association has voted to ask the New England Council to organize a survey of the wooden box industry and to assign the supervision of it to the Harvard Forest. This work has now been under way for several months, and will shortly be reported for action to the members of the industry. A third economic investigation, consisting of a survey of the wood working industries of Massachusetts, is also being conducted. In view of the present unfavorable condition of the markets for native timber, these studies are especially timely and calculated to have a useful effect on the progress of forestry.

Another project which has been completed and published as Bulletin No. 9 is entitled "Red Pine in Central New England". At the request of several local wood using companies, Mr. Hosley has completed an examination into the damage by beetles to piled lumber and possible methods of control. The recommendations arrived at are proving almost completely effective. Studies which are now almost ready for publication are "The Growth of Hemlock after Release" by Robert Marshall and "The Decomposition of Pine Slash in Relation to the Factors of Decay and to the Effect upon Reproduction" by L. S. Altpeter and Dr. Perley Spaulding of the U. S. Division of Forest Pathology. Mr. P. R. Gast has continued his researches into the physical factors affecting forest growth, and expects shortly to publish a paper embodying summaries of diurnal measurements of light.

A new cooperative study between the Northeastern Forest Experiment Station and the Harvard Forest has been going on during the past summer under the direction of Mr. Paul Stickel, a member of the Station staff. This study is concerned with the determination of moisture content in forest litter as related to atmospheric humidity and is proving useful for advance determination of periods of fire danger. The study of the life history and possible control of the white pine weevil undertaken a year ago has been continued under Mr. H. J. MacAloney, who represents the U. S. Bureau of Entomology as well as the Northeastern Forest Experiment Station. This study and the one dealing with duff humidity will be continued next year.

There are now six research students registered at the Forest. The problems which they are investigating are the following: the life history and production of pitch pine on Cape Cod; the suitability of European larch for forest planting in New England; a management plan for a group of Massachusetts state forests; methods of thinning in young stands of mixed hardwood; nitrogen content in forest soils as related both to the composition of leaf litter and conditions of exposure; a survey of the lumber markets of Massachusetts.

Beyond the usual activities of demonstration and investigative work, the most notable event to report is the acquisition, already assured and accepted by the Corporation, of an area of original pine forest in southern New Hampshire. This tract is located in the town of Winchester and is probably the last example of this kind of primeval forest left in New England. It has been largely through the efforts of Dr. John C. Phillips and a number of donors whom he has interested that the purchase has been made possible. If this tract is maintained exactly in its original condition, as is planned, it will have a double value. In the first place it will offer an authentic specimen of a

forest condition that has now practically vanished in central New England. In the second place, as a sample of natural conditions unaltered by human agency, it will furnish a valuable background for ecological studies.

Director of the Harvard Forest

Report on the Harvard Forest
1926-27

"The Harvard Forest at Petersham, Massachusetts, is a perfect forest laboratory, the most interesting in the United States." This is a quotation from "The Nature Magazine" for July 1927. That it may not be unduly extravagant one is encouraged to believe from the number and quality of the visitors who resort to the Forest. During the present year the Forest has been shown to more than 150 men, most of them scientific or professional, who came to Petersham to study the demonstrations of forestry in practice or the methods of research. Among them were the chief of the U.S. Forest Service with a party of supervisors of Eastern national forests, the State Foresters' Association, numbering sixty men from twenty states, the Director of the Forest Experiment Station of Sweden, together with a number of American forest research men who came to Petersham to meet him, and foresters from Finland, Germany, Denmark, Canada, and Japan.

The character of the students who come to the Forest for advanced work or research is also significant. Of the five who are registered for 1927-28, all are men from established positions in state or federal service, two from experiment stations and three from executive or extension departments. These five represent as many schools of forestry: California, Minnesota, Pennsylvania State, Syracuse, and Maine. At the last Commencement seven degrees were given, six masters in forestry and one doctor of science. These men also were from widely scattered localities and were in general capable of doing productive advanced work.

Since the last report a number of new publications have been issued. They are as follows: Harvard Forest Bulletins Nos. 10, 11 and 12, "The Marketing of Lumber in New Hampshire" by A. C. Cline, "The Growth of Hemlock before and after Release from Suppression" by Robert Marshall, and "The Wood-Using Industries of Massachusetts" by J. B. Downs, with field

assistance by C. B. Gutchess. Each of these embodies the result of research work by students. Three shorter papers from the Harvard Forest are to appear in the January number of "Ecology": "Soil Changes and Silviculture on the Harvard Forest" by R. T. Fisher, "Red Squirrel Damage to Coniferous Plantations and Its Relation to Changes in Food Habits" by N.W. Hosley, and "The Relation between Subcortical Temperature and the Size of White Pine Slash" by A. W. Gottlieb. A number of other manuscripts are in process of preparation for the press: Dr. Gast's thesis, "The Development of the Thermopile and Its Use in Silvical Studies", "The Decomposition of Pine Slash and Its Effect upon Reproduction" by L. S. Altpeter, and four projects for which the field work was completed last year: pitch pine on Cape Cod, the relation of hardwood tree form to density, plantations of European larch in the Northeast, and the management of certain state forests in Massachusetts. The thermopile developed by Dr. Gast has proved so efficient that it is likely to have a commercial use in the equipment of biological research.

Another project which has been completed during the past year is the survey of the wooden box industry of New England, which was conducted at the request of the New England Council. The data gathered in this investigation were summarized and analyzed by the Harvard Bureau of Business Research. The report has been presented by the Council to representatives of the industry and will probably form the basis of important reorganization.

There are a number of new or continuing projects. Mr. Stickel and Mr. Gottlieb, representing the Northeastern Forest Experiment Station, with the assistance of Dr. Gast, are making seasonal studies of humidity in forest litter as related to weather conditions. Similar studies are being conducted by the Forest Service in other parts of the country in order to provide a more reliable basis for predicting periods of fire danger. Mr. Cline, in cooperation with the Massachusetts Forestry Association, is carrying on a study of the value and method of pruning stands of pine timber so as to produce a higher grade of lumber.

The newly acquired primeval forest at Winchester, New Hampshire, will form the basis of a study supervised by Dr. Gast in which the relation will be sought between the life history of virgin forests and certain factors of soil.

In respect to physical equipment, the Forest has received from a number of landowners in Petersham a gift of a portable gasoline pumping engine with nearly half a mile of hose. This will facilitate the control of possible forest fires and may prove helpful in the protection of our buildings.

The latter still represent the most deplorable deficiency in our equipment. They are neither safe nor convenient, and the consequent risk to equipment and records of unique value ought not to continue.

Director

Comparison of Growing Stock 1908, 1919 and 1926

	1908	1919	1926
Area forested (acres)	1775	1775	1743*
Total volume (board feet)	10,500,000		12,550,920
		12,435,200	
Total volume, pine	10,000,000		8,721,150
		11,061,700	
Mean annual increment b.f.	250,000		456,220
		380,090	
Volume reserved	?	?	387,510
Acres planted	--	57.4	180

Sawtimber cut, 1908-1926	3,942,470 b.f.
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* Two years' sawtimber cuttings waiting to be planted.

Report on the Harvard Forest

With 1927-28 the Harvard Forest completes its twentieth year of management by the University. As no other forest in America has been under similarly intensive treatment for so long, the accumulated results are of peculiar interest both to professional foresters and timberland owners. A recent inventory shows that whereas the initial volume of sawtimber was ten and a half million board feet, it now stands at approximately twelve million; and that an annual growth of two hundred fifty thousand board feet has now risen to about four hundred thousand, which is the amount of the present annual cut. To date four million board feet have been marketed. Cut-over areas have been satisfactorily restocked, unproductive land to the amount of one hundred eighty acres has been reforested, and a large area of inferior forest types has been converted into types valuable for sawtimber. Thus the Forest capital has increased about twelve and one half per cent and the interest or rate of production has risen nearly sixty per cent. Meanwhile the Forest has paid a net return ranging from fifty cents to one dollar an acre per annum. Incidental to this development, the most desirable forest types or combinations of species have been determined and methods defined for their maintenance and reproduction. This represents the nearest approach to a proven system of regional silviculture so far developed in the country. A report is being prepared to summarize the significant facts of this first twenty years of management.

Although the Forest itself in respect to physical and biological changes is its own chief contribution to forest science, both the lessons of management and the outcome of research projects must be made available through publications. During the past year the following articles or bulletins have been published by members of the staff: Pruning for Profit

by A. C. Cline and E. T. Fletcher, prepared in cooperation with the Massachusetts Forestry Association and published by them; Soil Changes and Silviculture on the Harvard Forest by R. T. Fisher, Ecology, January 1928; White Pine Plantations and New England Forestry by R. T. Fisher, Journal of Forestry, October 1928. Other papers now in press are as follows: Preliminary Study of Borer Damage in Stacked White Pine Plank by N. W. Hosley, to appear in the Journal of Forestry; Harvard Forest Bulletin No. 13, Form and Development of White Pine Stands as Influenced by Growing Space by S. R. Gevorkiantz and N. W. Hosley, Harvard University Press. Additional studies now practically ready for publication are Plantations of European Larch in Northeastern United States by Stuart S. Hunt; Pitch Pine on Cape Cod by R. C. Hall. Additional investigative projects now in progress include a study of the life history and origin of the virgin forest recently acquired by the University in Winchester, New Hampshire. A separate but closely related project deals with the evolution of forest soils as related both to types of virgin forest and to the principal phases of second growth which have followed its removal. This study was made possible by a generous gift from the Massachusetts Society for the Promotion of Agriculture. Mr. Cline is preparing a second bulletin in cooperation with the Massachusetts Forestry Association which is to deal with the methods of regulating the composition of young forests by early weeding. To illustrate in concrete form the exact procedure and results of forestry in practice a series of specific cases has been analyzed and described and will be published as a bulletin of the Forest.

The U. S. Forest Service is continuing at Petersham the cooperative projects which were begun last year and the year before. One of these is aimed at the development of universal taper and volume tables and involves incidentally a day-to-day determination of growth as affected by wind

stresses and exposure on selected trees. Another is the continuing accumulation of data on the relation of atmospheric humidity, temperature, rainfall, etc. to the moisture content and hence inflammability of forest litter, the results of which make it possible to predict periods of fire hazard.

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Report on the Harvard Forest

1928 - 1929

The Harvard Forest is in its twenty-first year as an experiment station and demonstration of the technique and business practice of forestry. This makes it the oldest scientifically managed forest in the United States. From the start it has paid a small profit on its operation while showing a substantially increased annual growth. It has reached a position of the first rank both on the score of its contributions to forest science and useful methods of forestry and as a place for the training of advanced students. Its income from invested funds is approximately \$7000. Other than this it has only the income from forest products and the tuition fees from research students, necessarily few in number. In the last five years the necessary expense of salaries, scientific work, maintenance of records, enlargements of equipment, upkeep of buildings, etc. has reached an amount which the income of the Forest cannot and should not be expected to meet. On the contrary it is felt by a large number of the scientific and business friends of the Forest that some of the area should be withdrawn from the necessity of periodic cutting because of its special and unique value, either as illustrating conditions that are vanishing or because of its use in demonstrating the results of certain treatment. At present, although the Forest is producing as great a revenue as ever, which it could continue to do in the future, there is an annual deficit which has been met by current gifts. If the fruits of twenty years of building are to be realized and secured for the future, the Forest must have a substantial increase in its endowment for unrestricted application to the maintenance of the plant - both forest and buildings - and of the organization for research and record at Petersham.

During the past year the Forest has had several important gifts and accessions. The executors of the late Nathan Matthews, in accordance with his will, have turned over to the University to be managed by the Harvard Forest his extensive coniferous plantations in Hamilton, which embody one of the earliest and most varied experiments with native and exotic softwoods yet made in the country. Accompanying this gift is an endowment for maintenance of \$10,000. Mr. G. Fred Schwarz of New York has given a fifty-acre tract of mixed woods in Petersham. This is to be managed for the purpose of demonstrating adaptations of forestry to landscape effect. To carry out the purposes of the gift, there is also an endowment of \$2500. The Massachusetts Society for the Promotion of Agriculture has made another grant to the Forest of \$1500, which is to be used for continuing the study of the life history and ways of origin of the primeval forest on the Pisgah Tract in Winchester, New Hampshire. Three research students are now engaged upon this investigation.

During the academic year the following publications have been issued: Harvard Forest Bulletin No. 13, Form and Development of White Pine Stands as Influenced by Growing Space, by S. R. Gevorkiantz and N. W. Hosley, Harvard University Press. Under an arrangement with the Massachusetts Forestry Association whereby the Forest is to prepare and the Association publish a series of pamphlets intended to make available in simple and practicable form results of useful research, Mr. A. C. Cline has written a bulletin entitled "Forest Weeding". This has proved so much in demand that several editions have been printed. Large numbers were bought and distributed by the forestry departments of eastern states. Two other publications are now in press and are shortly to appear. Harvard Forest Bulletin No. 14, A Thermoelectric Radiometer for Silvical Research, with preliminary results on the relation of insolation to the growth of white pine, is based upon a joint project by the Forest and the Northeastern Forest Experiment Station. Harvard

Forest Bulletin No. 15, The Evolution of Soils as Affected by the Old Field White Pine - Mixed Hardwood Succession in Central New England, was in part paid for by the grant of last year from the Massachusetts Society for the Promotion of Agriculture. Both these bulletins are being issued by the Harvard University Press.

Other projects now in progress or in preparation for printing are, besides the study of the Pisgah Forest, Plantations of European Larch in Northeastern United States, Growth and Management of Pitch Pine on Cape Cod, and an analysis, largely by serial pictures, of specific cases of forest management.

The U. S. Forest Service through the Northeastern Forest Experiment Station continues its use of the Forest as headquarters for cooperative research. The Station is continuing its regional study of the relation of atmospheric humidity to the inflammability of forest litter, from which it is expected that means will be found for predicting periods of extreme fire hazard. Also related to fire protection is an interesting experiment to determine whether applications of calcium chloride to roadside margins will prevent the starting of fires by passing traffic.

Members of the Forest staff are serving on various organizations concerned with economic or biological research. The Director is a member of an advisory research committee of the Social Science Research Council. Mr. Cline is secretary of the New England section of the Society of American Foresters and is serving also for the parent body on the committees on Forest Policy and on Field Methods.

Report on the Harvard Forest

1929 - 1930

It is a satisfaction to record that the needs of the Harvard Forest for endowment, as set forth in the last report, have been substantially met. Early last year the Charles Lathrop Pack Forestry Trust offered \$100,000., provided a like sum could be raised before July 1, 1930. With the generous aid of many friends of the Forest, this stipulation was met so that the income of \$200,000. is now available. This will be sufficient not only to pay the salaries of certain members of the Forest staff which have hitherto been precariously met by annual gifts, but also to provide modest allowances for janitor and commissary service at the headquarters building, for equipment and materials needed in research, and for meeting the cost of occasional reductions in the amount of the annual timber cut. In addition to the new endowment there was a welcome gift from the estate of the late George E. Henry - \$7,410.57 - contributed for the specific purpose of constructing in the headquarters building a fireproof vault for the safe keeping of the accumulating records - maps, photographs, etc. - which embody the history and development of all Forest operations both scientific and otherwise.

In a season of almost unprecedented fire hazard the various properties of the Forest have not been entirely unscathed. In April a fire on the Matthews Plantation at Hamilton, originating at the railroad right of way and immediately after the passage of a freight train, destroyed three acres of the most valuable and oldest portion of the plantations, mainly a series of experimental mixtures of coniferous trees which could not be matched anywhere in the United

States. Threatening fires occurred also in the neighborhood of the Pisgah Forest in New Hampshire, but none reached the Harvard tract. In Petersham although a number of fires broke out, it was possible, with the aid of the portable pumping engine given to the Forest two years ago and by having crews and equipment always ready, to prevent all fires from spreading beyond a very small area.

The research projects now going on at the Forest and the ways in which they are organized are significant of the growing fruitfulness of cooperation by experts in related fields of science. Six students are registered at the Forest: three connected with the U. S. Forest Service or its experiment stations, one with the U. S. Division of Forest Entomology, one with the Forestry Branch of the Province of Ontario, and one with the Cason J. Calloway Company of Georgia. Two of these men are making a study of the history of forest fire damage on a number of classes of forest property as a basis for the possible application of insurance against fires. In this work both the Harvard Business School and the National Fire Protection Association are contributing advice and supervision. The project is also contributory to the program of economic research now being undertaken by the U. S. Forest Service under the terms of the so-called McSweeney Bill. Another man is investigating the micro-fauna of forest soils and its effect upon the metabolisms which make for fertility. The entomological aspects of this work are being supervised by Professors Brues and Wheeler at the University Museum. A third project is ⁱⁿ the field of forest pathology. It concerns the life history, effects, and ecological controls of a serious disease of coniferous timber and is being carried on under the direction of Professor Faull of the Arnold Arboretum. The field work is being done in part in the forests of Ontario and in part at Petersham. A fourth undertaking, in charge of

Professor Gast, concerns a study of degraded forest soils on the Black Rock Forest at Cornwall, New York, belonging to Dr. E. G. Stillman. The last of the current investigations deals with the property of a wood-working industry in Winchendon, the purpose being to determine to what extent and by what modifications of management the forest area can supply the annual requirements of the factory for timber. The combinations of knowledge and point of view represented by the persons involved in these studies are at once stimulating to the student and productive of additional significance in the results. Of the students engaged in these researches two are candidates for the doctorate and four for the master's degree.

The following publications from the Forest have been issued during the year by the Harvard University Press: Bulletin No. 14, A Thermoelectric Radiometer for Silvical Research, with preliminary results on the relation of insolation to the growth of white pine, by P. R. Gast; and Bulletin No. 15, The Evolution of Soils as Affected by the Old Field White Pine - Mixed Hardwood Succession in Central New England, by B. G. Griffith, E. W. Hartwell, and T. E. Shaw.