

OFFICIAL REGISTER OF  
HARVARD UNIVERSITY

VOL. XXXIX FEBRUARY 25, 1942 NO. 5

ISSUE CONTAINING THE  
REPORT OF THE  
PRESIDENT OF HARVARD COLLEGE  
AND REPORTS OF DEPARTMENTS  
FOR 1940-41



CAMBRIDGE, MASSACHUSETTS  
PUBLISHED BY THE UNIVERSITY

*Harvard Forest*

TO THE PRESIDENT OF THE UNIVERSITY:

SIR, — The outstanding event of the past year was the dedication and opening of the new forestry buildings — Shaler Hall, the Fisher Museum, and a large garage. The buildings were dedicated on May 13th by President Conant in the presence of Members of the Corporation, the Board of Overseers, the Visiting Committee, the Administrator of Botanical Collections, and the staff of the Forest. On the following day over four hundred invited guests were present to inspect the buildings.

The benefits from this generous gift of a friend of the Forest already are abundantly in evidence. The greatly improved facilities have resulted in the better organization and conduct of our various activities. For the first time in the history of the Forest, there is adequate room in a modern fireproof building of our own for housing the materials needed for our work. Previously, valuable records were kept in Athol and Cambridge in order to avoid possible loss through fire. The presence of a fireproof structure also has resulted in important accessions to our library. About 1,800 bound volumes of forestry periodicals have been placed on deposit here by the Arnold Arboretum, and two private collections of forestry literature have been received as gifts, one from Irving T. Worthley, '05, and the other from the late Austin Cary, one of the earliest members of the Forest staff. Also, for the first time, visiting groups of forestry students have been provided with comfortable sleeping quarters. The large dormitory room in Shaler Hall, which will accommodate from thirty to forty persons, is adding much to the usefulness of the Forest.

The Fisher Museum of Forestry, which houses the famous forest models collection and other exhibits, has proved to be of great interest to the public as well as to forestry students and workers in related fields. Nearly 3,000 persons visited the Museum during the period from May 13th to October 31st. It has been found necessary to provide a special guide for week-ends and holidays. The value of the Museum in conveying to the people generally a better understanding of forestry, and the social benefits to be derived from its application can scarcely be overestimated. At the same time, the Forest is being strengthened by the interest and support

of new friends and by the opportunities to be of greater service.

I am pleased to report that good progress has been made in cleaning up the debris left by the destructive hurricane of September, 1938. An improved cordwood market, due to a threatened shortage of coal and oil, has made possible the sale of a large quantity of fuelwood which otherwise would have rotted on the ground. We have found, too, that wood is a satisfactory fuel for heating the new buildings, and thus a substantial saving in building maintenance has been effected. Most of the 7,000,000 board feet of white pine logs purchased by the Timber Salvage Administration of the Federal Government and stored in Harvard Pond have been removed. Two sawmills are now operating on its shores, and it is expected that by winter the Pond will again be open water.

New experiments were begun during the year. In coöperation with the Division of Forest Insect Investigations of the Federal Bureau of Entomology and Plant Quarantine an attempt will be made to grow high quality white pine, free from attack by the white weevil (*Pissodes strobi* Peck), through partial suppression beneath a hardwood overstory. This has been prompted by the continued difficulty and expense of growing pine free from the forks and crooks caused by weevil attack wherever this species is given freedom to grow. The great majority of white pine plantations in open fields and pastures have been failures on account of this insect. Although it is well known that "shade grown" white pine with slim leaders is not attacked by the weevil and will develop a straight bole with small branches, this method of growing high quality pine has never been tried out on an experimental basis. It frequently has been said that the high quality of white pine in the original forests was due to its having to compete with hardwoods and struggle along in a position of partial suppression for many years, finally breaking through the hardwood canopy and attaining a dominant position. Thus, this experiment is of special significance in that it attempts to duplicate those conditions found in nature which favored the development of the highest quality pine trees. The vast area of hurricane blowdown, now restocking naturally with white pine and hardwoods, will afford an excellent opportunity to apply silvicultural treatments designed to improve the future quality of white pine.

Another experiment being carried on jointly by the Forest and the Division of Forest Insect Investigations deals with increasing the durability of wood for fence posts by impregnating the living sapwood with a chemical preservative. This treatment was origin-

ally developed as a means of killing broods of bark beetles, in which case the chemical was introduced through a wound caused by girdling with an axe. In the current experiment, the tree, usually not over 7 inches in diameter, is cut during the height of the growing season and the cut end immediately placed in a tub of copper sulphate solution. Posts treated this summer have been set up side by side with untreated posts to determine the effectiveness of the preservative treatment. If this method can be successfully applied to such common species as white pine and red maple, which otherwise are practically worthless for fence posts, it will find great usefulness among farmers. The chemical costs about 5 cents per tree.

The gypsy moth studies are being continued. A report by a special investigating committee appointed by the Bureau of Entomology and Plant Quarantine to review the measures being employed to control the insect recommended a much wider application of so-called silvicultural control. This method has been advanced by the Forest. Experimental treatment plots are maintained in the forest in coöperation with the Division of Forest Insect Investigations, together with other sample plots in which ecological studies of the insect are being conducted. An expanding program of experimental work in both directions is anticipated.

In coöperation with the Division of Forest Pathology of the Federal Bureau of Plant Industry, an experiment in the improvement of hardwood stands of sprout origin was started. Because the common practice among woodland owners is to clear cut hardwood stands for fuelwood, there already is a large acreage of hardwood coppice which will be of little or no value for future timber crops unless given silvicultural treatment. And, if the anticipated shortage of coal and oil materializes, we may expect a greatly increased area of coppice within a few years. To duplicate the conditions found so frequently elsewhere, a small stand of middle-aged hardwoods in the Forest was clear cut in order to start a growth of stump sprouts. The pathologists will make a special study of butt rots associated with stems of this origin, and members of the Forest staff will apply various methods of stump sprout thinning in an effort to develop satisfactory sawtimber stems. The findings of this study should be useful in any program of forest rehabilitation in the northeastern states.

During the winter of 1940-41 the Division of Wildlife Research of the Fish and Wildlife Service of the Federal Government con-

ducted in the Forest a study of the ecology and control of the Canadian porcupine. The porcupine has so increased in numbers that a great deal of damage already has been done to certain species of trees, especially the larch.

Considerable importance is attached to this coöperation with public agencies working in forestry and related fields. It brings to the Forest the services of highly trained scientists which otherwise would not be available, and permits, especially, the undertaking of studies in the important field of forest protection.

A report of the work directed by Professor P. R. Gast and supported by the Maria Moors Cabot Foundation is given in some detail in the report of the Foundation. The discovery of marked differences in the growth rates of seedlings from various mother trees encourages the belief that elite strains can be developed for use under intensive forest cultivation. The possibility that faster seedling growth is due to the particular environment or health of the mother tree must be eliminated before it can be stated that seedling growth rates are surely the result of inheritance. Experiments to test this possibility indicate certain of the conditions under which the two accessory growth substances, vitamin B<sub>1</sub> and adenine, favorably affect the growth rates of pine seedlings. The results illuminate a debate current among plant physiologists. The beneficial effects of vitamin B<sub>1</sub> first observed by certain workers were not corroborated by other workers. Results such as these influence not only the conduct of the breeding trials but also the whole field of tree physiology basic to silviculture.

Mr. Jonathan Wright, a candidate for the doctorate, has observed in his studies of white ash that certain strains fail in the autumn to accommodate themselves to the onset of cold weather. The succulent tissues are susceptible to injury in the winter by freezing, and special methods of cultivation are required to protect the young plants. The differences among seedlings raised from seeds of trees adapted to various climates suggest the use of strains from more severe climates as one method of overcoming the hazard. It is possible that recognition of the factor responsible for the failure to terminate growth in the autumn may lead to physiological studies which, in turn, may suggest successful innovations in cultural methods.

In the report for 1939, mention was made of the Petersham conference of soil scientists and foresters organized by Professor Gast. One fruitful result of this meeting was a plan for the intensive map-

ping of the soils of experimental forests according to the system developed by the Division of Soil Survey of the U. S. Bureau of Plant Industry. This is a highly technical procedure. Only experts fully familiar with this system, such as the staff of the Survey itself, can undertake the preparation of such maps. The maps for the Harvard Forest have been completed. They provide basic information for correlating studies in the Forest on the effect of forest vegetation on soil development with studies in other areas, and are extremely useful in the determination of the growth capacity of soils and hence in the determination of the proper silvicultural policies.

There were five candidates for the Master in Forestry degree. Messrs. Gordon M. Chute and Ernest M. Gould, Jr., working under the joint direction of the Department of Economics, the Graduate School of Public Administration, and the Harvard Forest, undertook a study of certain aspects of the agricultural-forestry land use problem in Worcester County. Case studies of selected farms were made to determine the correlation of the management of woodland and agricultural land. A budgetary analysis, on an input-output basis, showed the net result of different types of woodland management in combination with agricultural practices recommended by agricultural economists and technicians.

Messrs. Ralph W. Brake and Howard A. Post made an analysis of the natural restocking of a large number of "old field" white pine blow downs in northern Worcester County. White pine stands in particular were completely blown down by the hurricane of 1938. By tallying the young seedlings and sprouts according to kind, condition and prospective place in the developing stand, it was possible to predict to what degree forest renewal would take place voluntarily and to what extent supplementary stocking, through planting, would be needed.

Mr. E. Stanley Hurd made a survey of private forest ownership in the town of Petersham. By means of personal visits to residents, and questionnaires sent to non-residents, the coverage was unusually complete and thorough. Several types of owners, such as full- and part-time farmers, summer residents and industries, were recognized, and the data on their attitude toward forest ownership and forestry analyzed accordingly. The findings reveal the need for bringing about a greater degree of stability in the ownership of land and the production and marketing of the products of the land.

A new policy has been adopted for the management of the Black Brook Plantations at Hamilton, Massachusetts. Instead of attempting to carry on demonstrations of silviculture in stands which are made up chiefly of exotic species ill-adapted to timber production, the plantations will be developed chiefly along the lines of an arboretum. Tree labels already have been affixed to typical specimens of the various kinds of trees found on Block A and on portions of Block D. Cultural treatments will be limited to keeping the stands in a healthy condition. An effort is now being made to find a market for trees which should be removed in thinnings this winter.

For the Pisgah Mountain "Old Growth Forest," at Winchester, New Hampshire, the policy of "letting nature take her course" is being strictly followed. Nearly all of the old trees were blown down by the hurricane of three years ago. They will not be salvaged. In their prostrate form these veteran trees are still an impressive sight and an object of great interest to students of forest ecology. The Forest plans to carry on studies of the succeeding vegetation during years to come. The trail leading to this tract is being maintained in good condition, and this year's students have laid out a trail through the blowdown itself.

For its financial support the Forest continues to be dependent to a considerable extent upon the generosity of its friends. The donor of the new buildings was extremely generous in his gifts for furnishings, laboratory equipment, the improvement of roads and grounds and for general purposes. The organization known as the Friends of the Harvard Forest was formed in 1940 for the purpose of raising additional funds. It now has eighty-eight members, and the total amount of contributions has reached a little over \$2,100. The first annual Field Day of the "Friends" was held on the 6th of September, with an attendance of sixty-five persons. In order that more people may know about the work of the Forest and the existence of the organization of the "Friends," a small leaflet is now being prepared for free distribution in the Fisher Museum. This will reach several thousand persons during the course of a year.

The Forest staff was strengthened by the addition of Mr. Stephen H. Spurr, a graduate of the Yale School of Forestry, as Instructor in Forestry.

The Director served as a member of a special committee on forestry appointed by Governor Saltonstall to study the problems of private forest ownership in the Commonwealth and to recommend

means of solving them. The Committee collaborated with the Massachusetts Forest and Park Association and other interested groups in drafting much-needed forestry legislation dealing with forest taxation, cutting practices, the distribution of forest planting stock and protection against forest fires.

A. C. CLINE, *Director*



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HARVARD UNIVERSITY

VOL. XLI SEPTEMBER 26, 1944 NO. 23

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FOR 1941-42



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*Harvard Forest*

TO THE PRESIDENT OF THE UNIVERSITY:

SIR, — During the past year further additions to the physical plant and financial support of the Harvard Forest have laid the foundation for an increased future productiveness and service in the field of forestry education.

Through the continued support of the friend of the Forest who so generously provided the new buildings, additions were made to the furnishings and equipment, especially by way of laboratory facilities for continuing the studies of forest soils and forest trees by chemical and physical methods. The installation in the basement of a photographic dark room, a special room for tools used in forest mensuration, separate storage compartments for various kinds of supplies and personal belongings, and a work room with a carpenter's bench and motor-driven tools, will contribute greatly to the orderly and efficient conduct of our work.

Further improvements were made in the displays in the Fisher Museum of Forestry. The staff of the Theodore B. Pitman Studio, which constructed the forest models, went over each model to increase the realism and to put on finishing touches. Progress was made in carrying out the plan for the exhibits in the gallery of the museum. The basis of the plan is to build upon the knowledge imparted by the models on the main floor by giving the visitor a further acquaintance with the technique and timing of essential silvicultural treatments and with the steps to be taken by a woodland owner in organizing his property for continuous forest production. Charts, photographs, sections of trees, and forestry tools are used to explain the silvicultural operations. The visitor will also see how losses from forest insect pests and diseases may be greatly reduced through a knowledge of natural control measures, and how fire hazard may be minimized by the application of cutting methods which leave little slash and keep the ground shaded and moist. A better understanding of the tree as a living organism is afforded by a series of exhibits on soils, nutrition, and growth. Additional displays will deal with the methods and objectives of forest management and with the many possibilities of present and future utilization of forest products.

Over 2000 visitors registered in the museum during the year. A small leaflet describing the Forest and its activities and con-

taining an application for membership in the Friends of the Harvard Forest was distributed free of charge. Sales to visitors of the 48-page special bulletin containing pictures and descriptions of the forest models amounted to approximately \$70.

A further strengthening of the foundation for the continued development of silviculture was provided by the completion of the study, "The History of Land Use in the Harvard Forest," by Professor Hugh M. Raup, of the staff of the Arnold Arboretum, and Mr. Reynold E. Carlson, a graduate student in the University. The forester in attempting to develop successfully a given forest stand has to take into account its past history and the successional changes in the vegetation, so far as he can ascertain them. The study of Professor Raup and Mr. Carlson enables us to understand better both the social changes and the vegetational transformations which have taken place since Petersham was settled. With the publication of this study as Bulletin 20 of the Harvard Forest, a new format for the bulletin series was adopted. The improved appearance of the bulletin and, at the same time, substantial savings in printing costs have amply justified making the change. Also completed during the year was the manuscript of "The Virgin Upland Forest of Central New England," a study based upon the analysis of a large number of remnants of old growth stands in the Pisgah Mountain section of southern New Hampshire, including the old growth tract owned by the University. Such studies as these are considered to be of inestimable value in guiding the future course of research and instruction in silviculture. The innumerable mistakes and failures associated with forestry as thus far applied in this country clearly demonstrate the necessity of first acquiring a firm knowledge of local forest history and ecology. It is fair to say that the Harvard Forest is outstanding among the pioneers in forestry education in the early recognition of this essential foundation for the teaching of silviculture.

A determined effort was made to clarify the policy and increase the effectiveness of instruction offered candidates for the Master in Forestry degree. In recognition of the special needs of professional practice, as compared with those of research or teaching, and the limited time available (ordinarily a single academic year), it was decided to offer on a trial basis two general methods of instruction, namely, the research project method and the so-called case method. In the past, the former method was used exclusively, with the result that those students desiring to fit themselves for

professional practice spent the major part of their time carrying through a research project and preparing a thesis. This procedure was not suitable for those students who were looking forward to a professional career, because the large amount of scientific technique which must be understood and used in research projects takes so much time to acquire that the student found it impossible to obtain more than a superficial acquaintance with the large body of knowledge in silviculture acquired through thirty years of experimentation and practice in the Forest itself. Moreover, he found it impossible to complete the assignment satisfactorily in the time available. The decision to offer the two methods of instruction was further influenced by the fact that students planning a career in professional practice do not continue their formal training beyond the Master's year; whereas those fitting themselves for a career in teaching or research have many inducements to continue on for the doctorate. Thus the work for the Master's degree often-times may be related advantageously to the program of study contemplated for the succeeding years.

Under the case method of instruction, representative stands which have been under treatment for a number of years are studied as illustrations of forest history and the results of silvicultural methods. The case method involves the study not only of a stand on the ground but also its history as recorded in the Harvard Forest files. The cases are taken up in the same order of presentation as is generally followed by standard text books of silviculture, that is, first, the several methods of securing tree reproduction by the application of harvest cuttings of various degrees, forms, and timing, then the numerous kinds of developmental treatments applied between the time of the establishment of a stand and its maturity. Each case is assigned first for reading, then is visited in the field and thoroughly and critically examined under the guidance of the instructor. Because of the unusual diversity of soil, topography, and stand history, and the comparatively long time during which intensive silvicultural treatments have been applied, the Harvard Forest is probably better fitted than any other school in the country to use this effective and realistic means of teaching silviculture. After studying cases, the student devotes a period of some two or three months at the end of the academic year to the analysis of a tract of forest which he has not previously studied and to the preparation of a written report setting forth the conditions found therein and recommending appropriate meth-

ods of treatment and management. This report takes the place of the thesis required under the research method of instruction.

Another innovation on a trial basis was to start instruction on August 15, about five weeks earlier than the official opening of the University. The purpose of beginning early was to extend the field season and to afford an opportunity for those students taking course work in Cambridge to benefit from the general instruction in forestry offered at the beginning of the first term.

The first year's trial of the case method of instruction and of the lengthened academic year apparently brought very satisfactory results.

Eight students were granted the Master in Forestry degree. Two of these had followed the program of work in forest economics, under the joint direction of the Department of Economics, the Graduate School of Public Administration, and the Harvard Forest. The completion of their theses, however, was necessarily carried over into a second year, because of concentration on course work the first year. Mr. Jonathan W. Wright, who carried on a considerable part of his work on the taxonomic and genetic characteristics of the ash tree at the Harvard Forest, was granted the degree of Doctor of Philosophy.

A separate report on the work of the Maria Moors Cabot Foundation for Botanical Research gives in detail the projects supported in part at the Forest under the supervision of Professor P. R. Gast. The study of the inherited differences in growth rate in white pine is one of the principal studies, and the past year witnessed the transfer to plantations of some forty apparently superior strains chosen from 165 collections. These plantations will serve as sources of material for further study. By still further selection and vegetative propagation, we hope to learn to recognize and turn to account the differences in inner characteristics which are responsible in part for the thriftiness and output of forest stands. More precise studies of tree nutrition are being continued with the use of salt solutions as sources of the necessary fertilizer elements. Additional variations included the use of organic compounds of possible importance in the chemistry of tree metabolism. Such studies are a desirable supplement to the nursery and plantation trials.

Besides the experimentation in silviculture which is being carried on year after year by members of the staff in a large number of intensively treated stands, the Forest continued its coöperation in research with the Division of Forest Insects of the Bureau of

Entomology and Plant Quarantine on various aspects of the problems of controlling the gypsy moth and the white pine weevil, and on the further improvement of the method described in the report of last year for increasing the durability of wood for fence posts by impregnating the living sapwood with a chemical preservative. Another coöperative experiment was undertaken with the Bureau during the year, namely, a study of the forest tent caterpillar and its relation to the decline of black cherry, one of the most valuable species in the region.

Also continued were the joint research projects with the Division of Forest Pathology of the Bureau of Plant Industry. Of special interest at the present time, in view of the excessive cutting of young hardwood stands for fuelwood, is the study of methods of improving young stands originating as stump sprouts after clear cuttings. Any program of forest rehabilitation in New England after the war must deal with this condition.

Coöperation was extended to the U. S. Forest Service and the Massachusetts Department of Conservation in the supervision of one of the forestry projects undertaken by Public Service Camp No. 2 for conscientious objectors, located in Petersham. This project combined fuelwood procurement and forest rehabilitation on lands which supported stands of timber prior to the hurricane. About 350 cords of wood were removed from seven areas laid out especially for their demonstrational value to local woodland owners, and appropriate improvement treatments applied to the remaining growing stock.

The last of the "hurricane" logs which were sold to the Northeastern Timber Salvage Administration in 1939 were removed from Harvard Pond. As noted in the report for 1938-39, this was the first pond leased in Massachusetts to the Federal Government for the storage of logs, such water storage serving to prevent the loss or deterioration of several million board feet of timber felled by the hurricane.

The production of cordwood from hardwood trees blown down or broken by the hurricane still goes on. Approximately 500 cords were cut and sold during the year. This wood was of help locally in alleviating the shortage in other fuels. At the same time, the residual growing stocks are being steadily improved and conditions made more favorable for the establishment of desirable natural regeneration.

Unfortunately a fire of unknown origin destroyed ten acres of

planted exotic conifers in the Harvard Forest's Black Brook Plantations at Hamilton, Massachusetts. Efforts are being made to dispose of the dead trees for fuelwood.

Because of the restrictions placed on motor travel by the necessities of war, this year's Field Day for the Friends of the Harvard Forest was designed especially for local members and their guests. On the afternoon of September 5th, some twenty persons assembled at the Forest headquarters, where Professor P. R. Gast described the projects being undertaken in the fields of forest soils and forest tree physiology, supported by the Maria Moors Cabot Foundation for Botanical Research. Thence the party went to the Forest's Nichewaug Nursery, where such matters as the growth rate of trees in early life, vegetative propagation by cuttings from spruce and pine, and the function of mycorrhizae were discussed. The great interest shown by the Sponsors of the Friends of the Harvard Forest in holding the Field Day despite the difficulties of travel is deeply appreciated.

During the brief time which this organization has been in existence, 153 persons have expressed their desire to become members, and a total amount of \$4,185 has been contributed towards the maintenance of the activities of the Forest. The Harvard Forest owes a great deal to its friends, many of whom have contributed liberally towards its support over a period of years. The staff of the Forest is most grateful for this indispensable aid and encouragement.

The Harvard Forest has freely offered its services in connection with the prosecution of the war. The Director was granted leave of absence early in the year to work with the Lumber Branch of the Office of Price Administration in Washington. Members of the staff remaining in Petersham have been active in many ways. Under the general guidance of the Camouflage Committee of the U. S. Department of Agriculture and the Camouflage Section of the Corps of Engineers of the U. S. Army, members of the staff are planning to conduct experiments in the treatment of vegetation for concealment purposes.

The woods crew of the Forest has done a highly commendable job in contributing to the production of cordwood from trees damaged by the hurricane, thereby substantially increasing the quantity of fuel available locally for use this winter. Members of the Harvard Forest have used the Forest trucks to help the citizens of Petersham in their collection of scrap metal. During the first

scrap drive, Petersham collected over twelve times its assigned quota.

Because of the steady drafting of young men, the staff of the Forest has decided not to accept any students during the coming academic year. The staff, meanwhile, will carry on the continuing research projects and do everything possible to aid in the war effort.

A. C. CLINE, *Director*



## *Harvard Forest*

### TO THE PRESIDENT OF THE UNIVERSITY:

SIR, — The activities of the Harvard Forest during the past year have been dictated largely by wartime conditions. No graduate instruction in forestry was offered, since acceptable candidates for advanced degrees were lacking. Recent graduates of undergraduate forestry schools, from which the Harvard Forest draws its candidates for the degree of Master in Forestry, have been few, and for the most part have entered the armed services.

Our own staff suffered the loss of Mr. Russell J. Lutz, Assistant to the Director and Instructor in Forestry, who was granted leave of absence in February to accept a commission in the Marine Corps. Also, Mr. Stephen Spurr, Instructor in Forestry, was granted leave of absence for the second half of the year to serve as Assistant Professor of Silviculture at West Virginia University, where teaching aid was urgently needed. The leave of absence of the Director was extended to permit further service with the Lumber and Lumber Products Division of the War Production Board in Washington. Mr. Spurr returned to the Forest in June, and has since supervised activities there under the guidance of the Director.

Members of the staff not on leave have concentrated on problems related to the war effort, especially camouflage research, and to maintaining existing long-term research projects.

Dr. P. R. Gast and his associate, Dr. James Vlamis, both working under the Maria Moors Cabot Foundation for Botanical Research, temporarily set aside their program of investigation in tree physiology and genetics to participate in camouflage research. During the latter part of the year, Dr. Gast's headquarters were moved from Petersham to the Biological Laboratories in Cambridge, although he is still carrying on certain research projects of the Cabot Foundation at the Harvard Forest. Dr. Vlamis joined the armed forces in June.

Dr. Ernest Ball was added to the staff in March as a joint employee of the Harvard Forest and the Cabot Foundation. After working six months on camouflage research at Petersham, he was transferred to the teaching staff of the Department of Biology at Cambridge and given the rank of instructor. At the same time, Dr. Karl Grossenbacher, a member of the Cabot Foundation group in Cambridge, was transferred to Petersham and given the title of Research Associate in the Cabot Foundation and Instructor in Forest Botany at the Harvard Forest.

Despite personnel losses, the Harvard Forest made a definite contribution to the advancement of science during the past year, not only in silvicultural research but also in the special field of natural camouflage.

Camouflage installations made of natural materials have been universally recognized as being greatly superior to those made of artificial materials. Nevertheless, the Army had little information on the selection, care, and handling of vegetation effective for military camouflage. To supply this information, the Harvard Camouflage Committee was organized in September 1942 with Dr. E. D. Merrill as chairman and Dr. Karl Grossenbacher as secretary. The committee is composed of botanists and foresters desiring to aid the war effort through investigations which utilize their special trainings. Much of the research work sponsored by this committee has been carried on at the Harvard Forest by members of the Harvard Forest staff and the Cabot Foundation.

The camouflage research program has been devoted to obtaining the maximum usefulness of cut foliage for military purposes. Three general lines have been followed. One has been to maintain the natural appearance of cut branches by the application of waxy dips and sprays. Considerable progress has been made along this line. Preparations have been developed which are superior to any now on the market; but additional work is needed before these can be recommended for military use.

To understand better the mechanics of the wilting and browning of cut foliage, investigations have been undertaken in the anatomy and physiology of water transport, water loss, leaf discoloration, and leaf dropping. These fundamental investigations by the staff of the Department of Biology not only pave the way for improved camouflage techniques but also add materially to our store of botanical knowledge. While the immediate aim of our camouflage program is to satisfy a military need of great importance, much of the information acquired will later be of value in peacetime pursuits.

The principal line of investigation, however, has been to determine, through extensive experiments, what kinds of foliage should be selected for camouflage purposes and how branches should be handled and used. The lasting qualities of foliage of the most important woody plants of the northeastern United States, of Europe, and of the tropics, have been studied in extensive field trials at the Harvard Forest, the Arnold Arboretum, and the U. S. Plant Introduction Garden at Coconut Grove, Florida. Emphasis was placed on developing simple procedures involving no special equipment or supplies, to enable the average soldier to choose the branches best suited for camouflage, and to maintain the



natural appearance of the cut foliage as long as practicable. Water supplied to cut stems was found to be especially effective in prolonging natural appearance.

An illustrated report on this phase of the work, entitled "Using Cut Foliage for Camouflage," was prepared by Mr. Spurr and Dr. Grossenbacher. Over four hundred mimeographed and lithoprinted copies have been distributed to camouflage officers throughout the armed forces. This report has everywhere received a favorable reception. Copies have been sent by the Office of the Chief of Engineers of the U. S. Army to all fighting fronts. The material has been incorporated into at least two forthcoming Army camouflage bulletins and is being taught in all Army camouflage schools, as well as in many independent Army, Navy, and Marine camouflage courses. Dr. Grossenbacher and Mr. Spurr have been lecturing at bi-weekly intervals to the Camouflage School of the First Service Command at Camp Edwards. Army authorities have been most coöperative in furthering the project and in making Army facilities available to members of the Harvard committee. Major Theodore B. Pitman, builder of the Harvard Forest models, Colonel John K. Howard, Mr. H. Wendell Endicott, and Captain Russell L. Gould, all of the First Service Command, have been particularly coöperative.

Despite the demands of camouflage research, progress has been made in the silvicultural research program of the Harvard Forest. All long-term experiments, many going back thirty years, have been maintained. These involve the periodic remeasurement of permanent sample plots, and periodic silvicultural treatment.

Several new projects have been initiated. As many of the stands established since the Forest was acquired by the University have reached the thinning stage, experimental cuttings have been undertaken to control density of stocking. When the size of the stand permits, different degrees and types of thinning are tried. In all cases, a portion of the area is left untreated for purposes of comparison.

To further our understanding of the factors influencing forest distribution, a series of weather stations has been set up to measure variations in local temperature. Each station now consists of a maximum and minimum recording thermometer housed in a small instrument shelter.

Harvard Forest Bulletin No. 21, *The Virgin Upland Forest of Central New England*, by A. C. Cline and S. H. Spurr, was favorably received. A number of leading American foresters have expressed their keen interest in the findings and their hope that more studies of this kind will be undertaken. Sir Roy L. Robinson, Chairman of the British

Forestry Commission, also concurred in the conclusions reached, pointing out that he had arrived at the same point by a different approach.

For a number of years the Harvard Forest has maintained coöperative research projects with other agencies, both to make fuller use of the forest itself as an experiment station and to benefit from association with scientists working in branches of forestry and biology not represented in the resident staff. This policy is bearing fruit in increasing abundance.

Members of the staff of the New Haven office of the Division of Forest Insect Investigations, U. S. Department of Agriculture, had an extremely active season at the Forest. Dr. Thaddeus Parr spent nearly five months in Petersham, while Mr. S. F. Potts, Dr. Henry A. Bess, and Mr. John V. Schaffner made frequent field trips here.

Particular emphasis has been placed on studying the life history, habits, and ecological status of the gypsy moth. By correlating a thorough knowledge of this insect pest with the conditions in the forests it infests, effective low-cost control methods based upon improved forest management practices may be developed. During the past season, detailed daily observations were made in a number of selected areas to determine the effect of forest composition and condition on the abundance of the moth. In addition, toxicity tests were made with a number of insecticides, and considerable trapping was carried out to test certain attractants and to locate new infestations.

Coöperative experiments to control the white pine weevil have followed two lines, silvicultural and chemical. Continuing experiments in the partial suppression of young pines by hardwoods indicate that silvicultural control is both effective and inexpensive. The weevil has also been successfully checked by a concentrated lead arsenate spray. Current observations at the Harvard Forest indicate that a similar spray may be very effective in controlling the pales weevil, a close relative of the white pine weevil that girdles seedlings.

A new coöperative experiment has been established to determine the relationship of the eastern tent caterpillar and other insects and diseases to the growth and survival of black cherry. Preliminary observations of treated and untreated sample plots indicate that this valuable tree species may be successfully grown if the tent caterpillar is controlled and the stand periodically weeded.

Because of urgent military needs for their technical services, members of the staff of the regional office of the Division of Forest Pathology have been unable to spend much time at Petersham since the start of the war. As previously reported, Dr. Perley Spaulding and Dr. J. R. Hansbrough worked with the Forest staff in establishing a long-term



experiment dealing with the improvement of young hardwood stands which have originated as stump sprouts after the clear-cutting of the parent stand. The Northeast contains millions of acres of sprout stands generally considered as having little or no prospective saw-timber value, but which probably are capable of being markedly improved.

By pooling the pathologist's knowledge of stump rots and the forester's knowledge of improving tree form and quality by silvicultural treatments, an attempt is being made to produce valuable timber from stump sprouts, instead of crooked and rotten stems good only for cordwood. This experiment is designed to be carried out over a period of some twenty years, a time sufficiently long to obtain a reliable measure of the improvement effected.

Since the hurricane of September 1938, cutting operations in the Forest have been largely concerned with salvaging all sawlog material before the down trees become riddled with borers and attacked by wood-destroying fungi, and with cleaning up the remainder of the dead, down, or leaning trees as time permits, utilizing the wood for fuel. The Forest woods crew has concentrated on the latter operation during the year, in all putting up 425 cords of wood. Part of this wood has been used to heat the Forest buildings and part sold to residents of Petersham and Athol. The shortage of coal and oil in New England has increased the demand for wood and has made a ready market for all the cordwood which could be spared for sale.

The three new buildings erected in 1941, Shaler Hall, Fisher Museum, and the large garage, are a continuing source of convenience. The efficiency of the Harvard Forest organization has been greatly increased by the acquisition of modern buildings and equipment.

The Harvard Forest Library continues to grow. Dr. E. D. Merrill, Administrator of Botanical Collections in the University, has transferred from the Arnold Arboretum Library several thousand volumes on forestry, including many early European works not available elsewhere in this country. Our library now ranks high among the best forestry libraries in the country.

On account of the restrictions on motor travel, the number of visitors to the Fisher Museum showed a decline during the year. Nevertheless, about five hundred persons viewed the forest models and the special exhibits in the gallery. The latter are being greatly improved under the direction of Mr. Spurr in accordance with a plan designed to show the woodland owner how to organize his property for scientific management and how to apply essential silvicultural treatments and protection measures.

The drastic reduction in the Forest staff substantially lowered the budget for the past fiscal year, and lightened the yearly task of raising funds to supplement income from endowments too small to sustain the activities of the Forest. Through the husbanding of gifts made by numerous friends during the past few years and the sale of an unusually large amount of fuelwood, a small reserve has been accumulated, sufficient to support the activities of the Forest during the war without a deficit.

A generous gift of \$5,000 for general purposes was received during the year from the late James Richard Jewett, Professor of Arabic, Emeritus.

The Friends of the Harvard Forest, a group organized in 1940, is already an active force in promoting a better understanding among laymen of the principles and practices of forestry. Substantial aid has already been given by this group toward the work of the Forest. During the past three years the Friends have contributed a total of \$5,520, this sum representing gifts from 154 individuals, most of whom have made donations more than once. No special attempt is being made to enlarge the membership during the war, but efforts in this direction will be renewed afterwards.

Despite great transportation difficulties, over seventy people, many from other localities, attended the annual Field Day of the Friends of the Harvard Forest. The program emphasized war research by the Harvard Forest and other botanical units of the University, Dr. E. D. Merrill being the principal speaker.

A. C. CLINE, *Director*

# OFFICIAL REGISTER OF HARVARD UNIVERSITY

VOL. XLIV    JULY 7, 1947    NO. 20

ISSUE CONTAINING THE  
REPORT OF THE  
PRESIDENT OF HARVARD COLLEGE  
AND REPORTS OF DEPARTMENTS  
FOR 1943-44



PUBLISHED BY THE UNIVERSITY  
CAMBRIDGE, MASSACHUSETTS

*Harvard Forest*

## TO THE PRESIDENT OF THE UNIVERSITY:

SIR, — The activities of the Harvard Forest during the past year have continued to be dictated largely by war conditions. With several members of the staff on leave to participate in defense activities and with acceptable candidates for advanced degrees lacking, the policy of the Forest has been to bring long-term research projects up to date and to strengthen and reorganize its facilities so as to be in the best possible position for postwar expansion.

The leave of the Director was further extended to permit continued service as Chief of the Program Branch in the Lumber and Lumber Products Division of the War Production Board. Mr. Russell J. Lutz, Assistant to the Director, is still on leave of absence and is serving overseas as a Captain in the Marine Corps. Activities at Petersham are under the direction of Mr. Stephen H. Spurr, who is assisted by Dr. Karl A. Grossenbacher, a joint employee of the Maria Moors Cabot Foundation for Botanical Research and the Harvard Forest.

Despite the reduced staff, the long-term research projects have been maintained, all forest records reviewed and checked for completeness, certain new investigations undertaken, and needed cultural operations carried out in the forest.

The interdepartmental camouflage research program of the University was brought to a successful conclusion in January. Members of the Harvard Camouflage Committee stationed at the Harvard Forest continued their investigations on the use of cut foliage in military camouflage. Two mimeographed manuals on this subject, issued by the University, were widely distributed throughout the armed forces, and the material contained in them reissued in Army manuals. The favorable reception of this work is indicated by the following quotation from a letter written the Harvard Camouflage Committee by the Acting Commandant of the U. S. Army Armored School:

The problem of camouflage in armored units is best solved by the use of natural material because of the time element involved. . . . A knowledge of the life of such natural material as well as its selection is essential to proper application of camouflage to tank units. The (Harvard) manuals point out facts which not only have to do with selection of position and materials but also camouflage discipline, in that they stress the necessity for renewal of such materials. We would appreciate a dozen copies of each of these manuals for use of our instructors.



A press release on this work was issued in February by the University News Office, resulting in widespread publicity.

With the termination of the camouflage research program, members of the Harvard Forest staff turned their attention back to biological research of a non-military nature. During the winter of 1943-44, Mr. Spurr, assisted by Mr. C. T. Brown, Jr., reorganized the Harvard Forest record system and completed the long task of bringing these records up to date after the 1938 hurricane. The accumulated records of thirty-seven years' experience in silviculture and forest management constitute perhaps the greatest asset of the Forest. Research in forestry necessarily consists largely of long-term projects, because of the scores of years required by each generation of trees to reach maturity. A large share of essential information on tree growing can be obtained only by examining each stand carefully over a long period of years. The silvicultural records of the Harvard Forest go back the furthest and are the most comprehensive of any possessed by an experimental forest in North America.

Research in forest ecology has been continued. The major project in this field has been the study of the factors influencing forest composition in New England. Land use history, forest soils, and climatic factors are being studied in relation to the distribution and growth of the various tree species.

Of major interest among the research projects now under way are the experiments in the use of aerial photography in forestry as an aid in forest mapping, growing stock analysis, and the planning of management operations. These investigations are being carried on in coöperation with the United States Forest Service, the Fairchild Aerial Surveys, Inc., the Brown Company, the Polaroid Corporation, and other interested agencies. The Harvard Forest is one of the first research agencies in the country to undertake investigations in this field. The work thus far has consisted largely of photographing the Forest at different elevations with different filters and film emulsions; then analyzing each set of photographs carefully to evaluate their use for forest type mapping, timber cruising, and forest management. The Forest was especially well suited for these trials because of the large variety of forest conditions represented and the detailed information available concerning them.

Coöperative research between the Harvard Forest and the Maria Moors Cabot Foundation for Botanical Research has continued. A three-year study of the relation of seed weight and origin to seedling weight has been concluded and the results published by Mr. Spurr in

the *Journal of the Arnold Arboretum*. This relationship is important in connection with the analysis of tree seedlings to determine their response to varied environmental stimuli under controlled conditions. Dr. Grossenbacher has continued his research in the rooting of cuttings of forest trees, as a quick and positive means of propagating individual trees selected for superior qualities. He has developed a very promising propagating bed, automatically regulated, by which cuttings can be grown in full sunlight and yet kept from drying out. Field trials of promising poplar hybrids have been undertaken.

The Harvard Forest has continued its policy of carrying on coöperative experiments with forest entomologists and forest pathologists of the United States Department of Agriculture. All projects mentioned in previous reports have been carried on to the mutual advantage of all interested parties. During the last season, special emphasis has been placed on ecological studies of the gypsy moth. Dr. Henry Bess of the U. S. Bureau of Entomology and Plant Quarantine has made important contributions to our knowledge of the habits of this insect, based largely upon studies carried out in Petersham. Mr. Spurr spent some time in the field during the spring to investigate the possibilities of applying this information to practical forest management. His conclusions, which supplement the original theory of silvicultural control developed by Mr. Cline and others in 1935, are in process of publication.

In addition to research activities, considerable progress has been made along other lines during the past fiscal year. The Harvard Forest library, greatly augmented by deposits from the library of the Arnold Arboretum, is being more fully organized and catalogued by Miss Elizabeth Carpenter of the Harvard Forest staff and Miss Eleanor Cairns, who has been loaned by the Librarian of the University from the Catalogue Department of the Widener Library. It is expected that this work will be completed before the Harvard Forest resumes teaching activities.

Mr. Albert H. Upham, Superintendent of the Forest since 1910, was retired on June 30. For thirty-four years, he has capably supervised the work of the woods crew and handled hundreds of exacting and arduous woods operations, including logging and milling, cordwood cutting, nursery work and planting, other silvicultural treatments, and general maintenance and improvements. His shrewd judgment, unfailing interest, and unusual ability as a woodsman have made him a highly valued member of the Forest staff. His son, Charles F. Upham, has been appointed to succeed him as foreman of the woods crew.

The Harvard Forest continues to be a center of scientific meetings

where visiting scientists can see forestry practised in the woods and yet have comfortable buildings for indoor discussions. During the past season, the Harvard Forest has been host to the Massachusetts subsection of the Society of American Foresters, several conferences of forest entomologists, and the first American conference on forest aerial photography. In addition, the Forest held its annual field day for the Friends of the Harvard Forest, a day devoted to a non-technical discussion and inspection of the work of the institution. The continued interest and financial support of the Friends are a source of great satisfaction to the staff of the Forest.

While carrying on these many activities, both research and administrative, it is necessary not to lose sight of the position of the Harvard Forest in Harvard University and in American forestry. Along with many other institutions, the Forest has the difficult task of adjusting itself to the postwar world so as to be of maximum usefulness. With this in mind, the staff of the Harvard Forest has prepared a report entitled "Forestry at Harvard." This report is designed to summarize briefly the history of forestry at Harvard, to point out the value of continued research and instruction in this growing field, and to suggest a constructive program by which the facilities of the University can be more fully and efficiently utilized.

A. C. CLINE, *Director*

# OFFICIAL REGISTER OF HARVARD UNIVERSITY

VOL. XLV

MAY 20, 1948

NO. 12

ISSUE CONTAINING THE  
REPORT OF THE  
PRESIDENT OF HARVARD COLLEGE  
AND REPORTS OF DEPARTMENTS  
FOR 1945-46



PUBLISHED BY THE UNIVERSITY  
CAMBRIDGE, MASSACHUSETTS

*Harvard Forest*

## TO THE PROVOST OF THE UNIVERSITY:

SIR, — The year 1945-46 marks the close of a difficult period of war-time transition at the Harvard Forest. It has been possible to renew activities in various long-term research projects which have had to be somewhat curtailed during the war years, and to bring near conclusion a group of projects that grew out of the wartime activities of the staff. Owing to the fact that I became Director of the Forest only at the end of the year, most of the information contained in the following brief report on the year's activities has come from Mr. S. H. Spurr.

Mr. A. C. Cline, the Director, remained on leave until June as head of the Program Branch of the Lumber and Lumber Products Division of the War Production Board. He spent two months in Austria in the fall of 1945 studying forestry problems there at the request of the United States Army. In June he returned to Petersham to work with Mr. Russell J. Lutz on their report on the silvicultural history of the Harvard Forest. Mr. Cline resigned his position as Director of the Harvard Forest, effective June 30, 1946, to accept a position in the United States Forest Service.

Mr. Russell J. Lutz, Assistant to the Director, returned in March from service overseas as a Captain in the U. S. Marine Corps. During the remainder of the year, he worked for the Forest part time on the silvicultural history bulletin.

Dr. Karl A. Grossenbacher continued to be absent on leave throughout the year, working first for the National Defense Research Committee at the California Institute of Technology, and later for the U. S. Army Air Forces at the University of California. In June, he resigned his position in Harvard University to accept the position of Assistant Professor of Botany at the Santa Barbara branch of the University of California.

Mr. Stephen H. Spurr was the only regular staff member in residence for the entire year and was in charge of activities at the Harvard Forest. He was assisted by Mr. C. Thornton Brown, Jr., and after March by Mr. Richard C. Rose. The office and library were under the direction of Miss Elizabeth Carpenter and the woods crew under Mr. Charles F. Upham.

Mr. Albert H. Upham, for thirty-four years Superintendent of the

Harvard Forest woods crew, died in February. He retired from the University in 1944.

During the year, 10,600 board feet of white pine lumber and approximately 180 cords of fuelwood were cut in the Forest in the course of routine silvicultural operations. In addition, three large plantations, totaling sixty acres, were weeded thoroughly, bringing the silvicultural work on the Prospect Hill block up to date for the first time since the 1938 hurricane.

An inspection of all plantings on the three Forest tracts in Petersham was completed. Based upon this inspection, all plantations were classified and a priority and schedule of treatment assigned to each area. The coöperative experiments with forest entomologists and forest pathologists of the U. S. Department of Agriculture have been continued.

No regular students were accepted during the year. However, a series of short courses in the forestry values of aerial photographs was offered from time to time. These courses were attended by professional foresters from as far away as Oregon, California, and Texas; representing industry, the United States government, state governments, consulting firms, and the faculties of universities interested in developing similar work in their own institutions. The courses were given by Mr. Spurr, Mr. Brown, Mr. Rose, and Mr. Edward S. Wood, Jr., of the Institute of Geographical Exploration. Special lecturers included Professor Earl Church of Syracuse University, Mr. Myles Standish of the Brown Company, Mr. M. A. Phillips of Fairchild Aerial Surveys, Inc., Mr. Earl J. Rogers of the U. S. Forest Service, and Professor H. H. Chapman of Yale University. Five regular courses, each of two weeks' duration, were given between October and June. A special course was given at the Harvard Forest by the U. S. Forest Service, the staff of the Harvard Forest participating.

In the field of research, routine measurements of existing experiments were made, and original research was carried on in the field of forest aerial photography. Aided by a Milton Fund grant, Mr. Spurr and Mr. Brown continued to develop instruments which they had previously devised for use with aerial photographs. With the completion of basic work in aerial photography and photogrammetric instruments, the staff of the Forest began to concentrate its efforts on the mathematical aspects of computing timber volume from measurements made on aerial photographs and supplemented by measurements made on the ground. Initial work in this field was carried out in the town

of Petersham in cooperation with the Northeastern Forest Experiment Station of the U. S. Forest Service. Under a grant of \$5,000 for each of two years from the Research Corporation, this research project is being intensified.

The demonstration activities of the Forest were continued despite wartime conditions. Over 700 people visited the Fisher Museum of Forestry to see the Harvard Forest dioramas. A large number of professional foresters, photogrammetrists, and industrialists from all parts of the United States as well as from Canada, New Zealand, and Great Britain visited Petersham to confer with the resident staff on problems of forest aerial photography.

In May, the U. S. Forest Service held a two weeks' conference at the Harvard Forest to discuss forest survey techniques. This conference was attended by forty officials representing the various experiment stations and regional offices of the Forest Service, as well as the Washington office. In a consultative capacity, Mr. Spurr conferred with the National Advisory Committee on Aeronautics, and undertook an experimental analysis of aerial photographs, in conjunction with Mr. Brown and Professor H. H. Chapman of Yale, covering the lands of the Jackson Lumber Company in southern Alabama.

During the year, members of the staff published the following papers:

- CLINE, A. C. A brief view of forest conditions in Europe. *Journal of Forestry* 43(9):627-628, September 1945.
- CLINE, A. C. Forestry is big business in Austria. *American Forests* 52(2): 58-61, February 1946.
- SPURR, STEPHEN H. and BROWN, C. T., JR. The multiscope: A simple stereoscopic plotter. *Photogrammetric Engineering* 11:171-179.
- SPURR, STEPHEN H. Armchair forestry that pays. *American Forests* 51:486-488. Reprinted in *Forest Notes* 9:14-18.
- SPURR, STEPHEN H. The Navy Hypsometer. *Journal of Forestry* 43(7):517-518.
- SPURR, STEPHEN H. Preparation of maps with the multiscope and related instruments. Harvard Forest Miscellaneous Publication, 12 pp. offset.
- SPURR, STEPHEN H. Volume tables for use with aerial photographs. Harvard Forest Miscellaneous Publication, 16 pp. offset.
- SPURR, STEPHEN H. and BROWN, C. T., JR. Specifications for forest aerial photography. *Photogrammetric Engineering* 12:131-141.

HUGH M. RAUP, *Director*

## *Harvard Forest*

TO THE PROVOST OF THE UNIVERSITY:

SIR,—I wish in this letter to make a brief report on the affairs of the Harvard Forest during the fiscal year 1946-1947. This is the first year of my directorship at the Forest, and I have devoted it in large measure to a careful study of materials, problems, and objectives.

Ordinary operations at the Forest went on in the usual manner. During most of the year we employed two full-time men at woods work, and one man about half time. In the late spring one additional man was added to the woods crew. This work was in the able hands of Mr. Charles F. Upham. About 170 cords of wood were cut during the year, and about 36,000 board feet of pine lumber. The pine was from poor quality trees which escaped the hurricane, and was sold. The cordwood will be used entirely for fuel to heat the various buildings at the Forest. Most of the cordwood came from what we designate as salvage and improvement cuttings in our older hardwood stands, and from thinnings in younger hardwoods and coniferous plantations.

One of the most important functions of the Forest is the maintenance of its system of records of research and operations. These records have become of great value not only to our own institution but to outside agencies which need information on the time and cost involved in silvicultural work. We possess detailed information on the cost, in man-hours, of many types of forest operations, accumulated over the nearly forty years of the Forest's life. During the year we have instituted a complete reorganization of our record system. The system in use to date, based upon early surveys of the Forest, had become extremely cumbersome, laden with duplication, and difficult to use. We are now about two thirds through with the reorganization of the records. When it is finished, it will be possible to extract in a very short time all the knowledge we possess about any specific area of the Forest.

The last detailed type maps of the Forest tracts were made in 1937, just prior to the hurricane. New type maps of two of our three tracts were made during the current year, and the third tract was partially mapped. These maps, made with the aid of aerial photographs, are far more accurate in line and forest detail than any yet achieved here.

Research in the study of growth in our coniferous plantations was



continued throughout the year. These studies have been based upon the use of a recently devised instrument which measures the increment on the trunks of trees with great accuracy to the thousandth of an inch. It has great practical significance because it enables the forester to determine within a period of days or weeks the effects of his forest thinnings upon the growth of the remaining trees. With older methods it has been necessary to wait as long as five or ten years for such results.

Mr. Stephen H. Spurr continued, during the year, the accumulation of data for his research program in the use of aerial photographs in timber cruising. With the aid of student assistants employed during the summer of 1946, and of part-time assistance from members of the Forest staff, he began ground surveys in the southernmost of our three tracts for this purpose; and through collaboration with timber owners and operators in Maine and New Hampshire, he has secured data from carefully selected sample areas. To further this work during the coming year, we established during the spring two graduate scholarships for advanced students of forestry. These scholarships, to become effective in September, 1947, will be made up in part from Mr. Spurr's research funds and in part from our regular scholarship funds.

One staff appointment was made during the year, to become effective July 1, 1947. Dr. Scott S. Pauley was appointed Assistant Professor of Forestry for a term of five years. This appointment was made jointly with the Cabot Foundation, and Mr. Pauley will divide his time approximately in half, sharing the routine work of the Forest and engaging in its research program on the one hand, and serving in the research work of the Cabot Foundation on the other. The Cabot Foundation finds it necessary to expand its test plots, and a considerable part of this expansion will take place at the Forest. Mr. Pauley will live at Petersham.

Messrs. C. T. Brown, Jr., and R. C. Rose continued on our staff in a temporary capacity throughout most of the year. Mr. Rose continued through June 30, 1947, and Mr. Brown resigned in April to go into a forest consulting business.

Several changes were made during the year in our housing facilities. Through a generous gift from an anonymous friend of the Forest, it has been possible to renovate completely the old forest headquarters building. The entire third floor with its mansard roof was removed and replaced by a peaked roof following the lines of the original house. The long ell at the northeast corner was entirely removed. The house was then broken up into four separate housekeeping apartments, each of which is supplied with basic furniture and kitchen equipment. En-



tirely new heating and plumbing systems were installed. It is expected that we will use this house as a temporary residence for married graduate students, for visiting scientists, or for short-term instructors.

The household organization at Shaler Hall was reorganized during the spring to take care of an expected student group which would be there for the summer. Mr. and Mrs. Anderson, who had been with the Forest for many years as housekeeper and janitor, were retained in much the same capacity, but with altered status. In past years they have operated the kitchen and dining room on what has amounted to a concession basis. The operation of the dining room and dormitory were taken off this basis in May, 1947, and the Andersons' salary adjusted upward accordingly. The dining hall was then set up in a manner somewhat similar to that of the University dining halls in Cambridge. A food storage compartment was built in the basement, and an electric freezer installed.

One of the less desirable aspects of life in Shaler Hall has always been its acoustic properties. This difficulty was in large part corrected by soundproofing the common room, dining room, pantry, kitchen, the corridors, and lavatories. The Fisher Museum is still in need of this improvement.

With regard to instruction, we have spent a great deal of time during the past year in exploring the problem, and in attempting to define our position in the whole field of forestry instruction in this country. There were no graduate students during the war, and it seemed advisable to use this opportunity to examine carefully our objectives before entering upon the postwar period. The question of continuing to offer the degree of Master in Forestry, specialized as it has been in the field of silvicultural management, seemed especially worthy of study. To this end I had several conferences with representatives of the alumni of the Harvard Forest and of other forest schools. Out of these conferences grew a circular letter which I sent to all alumni of the Harvard Forest. As a result, we have arrived at the conclusion that our Master in Forestry degree should be continued, but that we should attempt to raise our standards in the selection of candidates for the degree. Furthermore, it seems wise, in view of our limited resources, to hold our student body to small numbers, perhaps not more than six or eight students per year.

The first postwar candidate for the Master in Forestry degree arrived at Petersham in February, 1947, and another came at the beginning of the summer term in mid-June. Three more are expected at the beginning of the fall term. We propose to handle the instruction of these

students by the same rather informal methods used successfully in past years, but with emphasis upon what might be termed a modification of the "case" system.

A serious difficulty connected with research and instruction at Petersham in past years has been the physical and intellectual isolation of the Forest staff and students from the University in Cambridge. The recent reorganization of botany at Harvard, and the administrative union within the area of experimental and applied botany, will do much to break down the barriers that have existed in the past. In an effort toward further integration, we offered in 1947 three regular University courses in botany at Petersham. One of these was a course in the study of vegetation that I have previously given in Cambridge, another was a new course called "An Introduction to Forestry," given by Mr. Spurr and myself, and the third was a course in elementary taxonomy of the flowering plants given by Professor I. M. Johnston. Professor Johnston came to the Forest for the summer to give this course. Fifteen students registered in June and were in residence at the Forest during the twelve weeks of the summer term.

Financially the Forest is far from secure. Income from endowment funds and from sales, rentals, etc. covers only about half the annual budget. The remainder must be made up principally from annual gifts. We have been very fortunate during the year in receiving a gift of \$25,000 from Mr. George Frederick Jewett, to be used for immediate needs. This gift is, of course, in addition to that received for the renovation of the old building. It will enable us to get on our feet following the difficult war years, and in the aftermath of the hurricane. The Forest has been dependent in no small measure throughout its existence upon the sale of wood products. This income was nearly eliminated by the hurricane. Such gifts as we have received during the past year are therefore of particular significance because they will help to tide us over a period of transition to new and undeveloped outlets for such wood products as we can produce.

Staff members of the Forest have published the papers listed below.

- Brown, C. T., Jr., Richard C. Rose, and Stephen H. Spurr. 1947. The dial gauge dendrometer as a tool in silvicultural research. *Journal of Forestry* 45:102-104.
- Raup, Hugh M. 1947. The botany of southwestern Mackenzie. *Sargentia* VI. 1-262.
- Spurr, Stephen H., and C. T. Brown, Jr. 1946. Tree height measurements from aerial photographs. *Journal of Forestry* 44:716-721.



Spurr, Stephen H., and C. T. Brown, Jr. 1946. Reply to comments on the multiscope. *Photogrammetric Engineering* 12:313-314.

The first part of the Thirty-Year Progress Report, prepared by Mr. Russell J. Lutz and Mr. A. C. Cline, has been finished and is in press. This report has been divided into three parts, the other two of which are still in preparation.

HUGH M. RAUP, *Director*

# OFFICIAL REGISTER OF HARVARD UNIVERSITY

VOL. XLVII

MAY 16, 1950

NO. 12

ISSUE CONTAINING THE  
REPORT OF THE  
PRESIDENT OF HARVARD COLLEGE  
AND REPORTS OF DEPARTMENTS  
FOR 1947-48



PUBLISHED BY THE UNIVERSITY  
CAMBRIDGE, MASSACHUSETTS

## *Harvard Forest*

TO THE PROVOST OF THE UNIVERSITY:

SIR,—The following is a brief report on the status and activities of the Harvard Forest during the year July 1, 1947, to June 30, 1948. During the year I remained in close contact with affairs at the Forest, living there most of the time but making frequent trips to Cambridge for my own research and for conferences with graduate students there. The only exception to this occurred in the spring of 1948, when I left the University on May 14 for a summer's field work in northwestern Canada. In my absence the Forest was in charge of Dr. Scott S. Pauley, Assistant Professor of Forestry, who carried on the work with efficiency and understanding.

In my report of last year, I mentioned the impending appointment on July 1, 1947 of Dr. Pauley to our staff. His position is supported jointly by the Harvard Forest and the Maria Moors Cabot Foundation, and he divides his time about equally between the research and instructional activities of the Forest and the research program of the Cabot Foundation. During the past year he has concentrated on collecting and propagating especially desirable strains of trees and has begun the establishment of tree nurseries and experimental plots at Petersham.

The technical staff was further increased during the year by the addition as technical associate of Mr. Earl P. Stephens, a graduate of West Virginia University and the Harvard Forest.

The Forest profited very greatly during the summer of 1947 from the services of Mr. Torkel Holsoe, an alumnus of the Harvard Forest, now Professor of Forestry at West Virginia University, and a recognized authority on the management of certain types of hardwood timber. Mr. Holsoe spent the month of August at Petersham, advising our staff on the thinning and improvement cutting of some of our managed forest areas.

Another visiting forester during the fall and winter was Dr. Helge Johnsson of the Swedish Forest Tree Breeding Institute. Dr. Johnsson, who is a forest geneticist, spent about half of the year 1947 in America collecting materials for experimental work in Sweden. From September to January he used the Harvard Forest as a base of operations, and collaborated actively with Dr. Pauley. Together these men made

extensive collecting trips through eastern Canada, the Mississippi states, and on the northwest coast. Dr. Johnsson's work was supported in part from Swedish sources and in part by the Cabot Foundation.

The renovation of our record system at the Forest, mentioned in my last year's report, was brought to completion during the year. The old system had become unwieldy and involved a large amount of duplication. Under our new plan it becomes possible to develop case histories of specific forest stands quickly and easily, greatly facilitating the use of the records in silvicultural planning. Mr. Stephens has had charge of the reorganization. He has also completed the new stand maps of the Forest. These stand maps, the first ones drawn since before the hurricane of 1938, have been made with the aid of aerial photographs, and are far more accurate and detailed than any we have had previously. Stand maps of the Forest have been assembled approximately every ten years since the institution was founded.

Mr. Stephen H. Spurr has devoted most of his time during the past year to his research project in the use of aerial photographs for cruising timber. During the two terms of the academic year, he had as part time assistants two graduate students who were chosen especially for this purpose. Also during the year he published a text book on the use of aerial photographs in forestry.

Woods operations during the year have consisted largely of thinning, salvage, and improvement cuttings in the hardwood stands of the Forest. During the summer and fall of 1947, some of our stands in Compartments I and II of the Tom Swamp Tract were thinned under the direction of Mr. Holsoe and the staff. These stands are of particular silvicultural interest because they have been under intensive management for longer periods than any other parts of the Forest. During the remainder of the year, operations were in older stands located in Compartment VII of the Prospect Hill Tract. Most of this timber is approximately 50 years old and was rather badly damaged by the hurricane of 1938. Like many other areas of the Forest, it has long been in need of treatment, and the operations consist of the salvage of damaged trees and the improvement of the remaining stands. The principal product resulting has been cordwood. During the past several years, the cordwood cut at the Forest has been barely enough for our own needs, but this year we have accumulated a considerable surplus for sale.

It is well to draw attention to the fact that the winter of 1947-48

was a difficult one because of heavy snow which came late in December and persisted through most of March. Our cutting program was almost completely suspended during this period. However, the mechanization of the operations in the spring so increased the rate of cutting that the loss was made up. Furthermore, the delay during the winter was not all loss, for it was possible to use our labor for a great many miscellaneous tasks about the Forest, and particularly for an extensive pruning operation in some of our coniferous plantations.

During 1947 we secured from the War Assets Administration through the University's Purchasing Department five pneumatic chain saws and an air compressor with which to operate them. Put into operation in March, they doubled our output of cordwood. Approximately 400 cords of wood were cut during the year. Woods work was further facilitated by the acquisition, also from War Surplus, of a 2½-ton Army truck. This truck has greatly speeded the transportation of equipment and cordwood to and from the woods.

Substantial gifts in the way of buildings and equipment have been made to the Forest during the year. From an anonymous donor who has been a long-time and loyal friend of the Forest we received a new sawmill, a new bulldozer, and funds for the construction of a house. Construction on this house, to be designated as the Director's residence, was begun in June, 1948. It is located on an open knoll just northwest of the headquarters.

Transportation to and from the Forest was hindered during the spring of 1948 by the relocation and resurfacing of the state highway between the village of Petersham and a point north of the headquarters building. The principal effect of this upon the Forest property has been immediately in front of the building, where the road was widened so that it damaged the appearance and situation of one of our staff residences known as Highway House. The State has made adequate reimbursement for this damage and has constructed an excellent retaining wall between the house and the road.

Visitors to the Forest are numerous and range from casual travelers who stop to see the museum, to serious students who come to see the results of our research and current operations. The Forest holds interest for students in several fields other than silviculture. During the autumn of 1947, for instance, Professor John D. Black of the Department of Economics brought his land-use seminar group to the Forest for a week end. In June of 1948 a soils conference lasting two days was held at the Forest. Our records of silvicultural operations cover a longer period of time and are more complete than are to be



found anywhere else in America, and they are proving of great value to all those interested in wood-using industries as well as in New England land management, for they contain data from which it is possible to compute cost.

With regard to instruction, we had five regular students in residence during the year. They were candidates for the master's degree in forestry. The University courses in biology offered at the Forest during the summer of 1947 proved to be highly successful. No plans were made to repeat them in the summer of 1948, however, because the reestablishment of the Harvard Summer School made it impossible to offer these courses then; but we fully expect to offer them in future years.

In September of 1947, Mr. George F. Jewett of Spokane, Washington, repeated his splendid gift of \$25,000 made during the preceding year. This gift, like the former one, was designated for immediate expenditure. It is of great significance to the welfare of the Forest, not only because of its generous proportions, but also because it comes at a time when we are in serious need of such immediately usable funds to continue and develop the long-term research program for which our institution is widely known and which is a major part of its reason for being. Of similar nature are gifts made by the Friends of the Harvard Forest. This is an organization sponsored by a small group of persons, most of whom are summer residents of Petersham. It responded handsomely to an appeal sent out in the fall of 1947, with gifts totaling \$3,010.

HUGH M. RAUP, *Director*

## *Harvard Forest*

### TO THE PROVOST OF THE UNIVERSITY:

SIR,— The following is a brief report of activities and developments at the Harvard Forest from July 1, 1948, to June 30, 1949. During the year the Forest continued its instruction and research, and considerably increased the tempo of its woods operations.

### *Staff*

The staff of the Harvard Forest continued unchanged from last year. In addition to myself, Mr. Stephen H. Spurr and Dr. Scott S. Pauley have served as assistant professors of forestry, and Mr. Earl P. Stephens has been technical assistant. Mr. Spurr was away on leave of absence during most of the year, pursuing studies for his doctor's degree at the Yale School of Forestry. He left the Forest in September 1948 and returned early in June 1949. Upon his return, he renewed his investigations, begun some years ago, on the use of aerial photographs in the cruising of timber.

Dr. Pauley was in residence at the Forest throughout the year except for a collection trip in January 1949. He has continued the study and expansion of the Cabot Foundation experiments on the selection and development of rapidly growing trees. Through agreement with the Metropolitan District Water Supply Commission he has secured the use of several tracts of land in the Quabbin Reservoir Reservation, and in the spring of 1949 planted there the first of his expanded test plots of hybrid poplars. His trip in January extended through the southern Appalachians and the lower Mississippi and Ohio Valleys. It was primarily for the collection of ecotypes of native cottonwoods, and seedlings of hemlock, white pine, and red spruce. He was aided throughout this work by excellent coöperative arrangements with state and federal agencies. About 200 clones of cottonwood were collected. The plants are being propagated at the Bussey Institution and at the Weston estates of the Arnold Arboretum.

Mr. Earl P. Stephens gave splendid service to the Forest throughout the year. He superintended the woods operations, supervised much of the work of the students, and had most of the responsibility for the routine research records of the Forest. In addition to these things he made a careful survey of the past research activities at the Forest. He

has found no less than 563 research papers in the files of the institution. A great many of these exist as student theses and miscellaneous research reports of staff members. Only 114 of them have been published.

At the beginning of the year, I was away from the Forest as a member of the Andover-Harvard Yukon Expedition of 1948, and returned to Petersham in the latter part of September. Owing to the fact that I gave a course at the University in Cambridge during the fall term, I was able to be at Petersham for only about half my time during that term. Although I made frequent trips to Cambridge during the late winter and spring, I was in residence at the Forest throughout the remainder of the year except for a month's trip to Cuba and Honduras in February and March. On this trip I visited the Atkins Garden and Research Laboratory in Cuba, and toured the United Fruit Company's reforestation project in Honduras.

### *Instruction*

Five graduate students in forestry were in residence at Petersham during the academic year. They proved to be of unusually high quality and did excellent work. They represented three United States universities and one Canadian. The instructional program is divided into two parts. In the first term the students are assigned a series of cases which are constructed primarily for the purpose of acquainting the men with the institution, its resources, and its research program. The men are encouraged to visit the laboratories and libraries in Cambridge whenever the need arises and to go there for the advice of individuals in the Department of Biology, the Department of Economics, and the Graduate School of Business Administration. The whole instructional program is informal, and stresses individual initiative on the part of the students. In the second term each student prepares a thesis based upon some original research work.

Something of a new departure in the use of our instructional and research facilities developed from my trip to Honduras. It turned out that the United Fruit Company was in need of a man to initiate a research program in the management of their forest plantations and their naturally regenerated pine stands. It was proposed that they send a man to the Harvard Forest for a period of fifteen months for a program of training and apprenticeship which would enable him to set up such a research project. Pursuant to these plans, Mr. A. C. Chable arrived at Petersham in May 1949. He was given an appointment as research fellow in the University, without stipend, the United Fruit Company continuing his salary while he is in residence here.



### *Woods Operations*

Woods operations during the year consisted largely of salvage and improvement cuttings and thinnings in the Prospect Hill Tract. The principal product has been in the form of cordwood, although a few logs, both hardwood and softwood, have accrued. During the fall and early winter the operations of the preceding year in Compartment VII were continued into the eastern part of this compartment. In the winter and spring a salvage and improvement cutting was made in a hemlock stand in the eastern part of Compartment II.

The cordwood operation was greatly facilitated during the year by improvements in methods for handling the wood. A chain saw was utilized almost entirely, the logs being drawn from the woods to the roadside where they were sawn into four-foot lengths and placed directly on trucks. By this method two handlings of the wood were eliminated. In preceding years a cut of 250 cords was looked upon as a good year's work, and it commonly was not finished until midsummer. During the past year upwards of 300 cords were cut, and the work was finished before the beginning of summer.

### *Buildings*

No changes were made during the year in existing buildings except for necessary maintenance. However, a generous gift from a friend of the Forest made possible the construction of a new dwelling to be known as the Director's residence. This house was begun in June 1948 and finished in April 1949. It is an eight-room house, done in the colonial style characteristic of the region, and is situated near the administration building.

### *Visitors*

Visitors to the Forest, and especially to the Fisher Museum, are more numerous each year. About 1,220 signed the register during the past year, and an unknown number failed to do so. The improvement in the state road which passes the headquarters building, made during the summer of 1948, has contributed somewhat to the increasing numbers. On January 1, 1949, we began to keep a record of those visitors with whom one or more members of the staff devoted considerable time. Between the first of the year and June 30, this number totaled nearly 200. They consist of a great variety of persons, ranging from individuals who wish advice about forest management, to groups interested in various phases of conservation or student groups from other schools.

*Finances*

The Forest continues to depend to a large extent upon annual gifts for immediate expenditure. Endowment funds provided income to meet only about a third of the year's budget. Miscellaneous sales, rentals, etc. yielded approximately another third. Gifts from Friends totaled about \$7100. The balance was made up by drawing upon unexpended funds derived principally from gifts made in 1946 and 1947 by Mr. George F. Jewett. It is clear that additional funds should be secured, and it is hoped that an increase in endowment can be effected.

*General Considerations*

In my three years as Director of the Forest, I have devoted most of my efforts to getting woods operations and instruction under way after the lean years of the war. At the same time I have endeavored to maintain and improve the research program and its records. During these three years the position of the Harvard Forest in relation to American forestry as a whole has become increasingly clear.

Scientific forestry and forestry education began in America at about the beginning of the present century. They began in an atmosphere of forest abundance which had persisted from the colonization of the continent. Wood was not only abundant, but was a nuisance in many regions that were desirable for agriculture. American forestry began its scientific life based upon European ideas and techniques. These ideas were drawn principally from Germany, largely because of German proficiency in the handling of coniferous woods.

The field of forestry can be divided into two phases. One of these is the growth or production of trees, and is commonly designated as "silviculture." This phase is a biological one, and its basic problems are biological. The second phase involves the recovery of wood from the forests and its utilization. This might be called the engineering phase of the profession.

Throughout the history of American forest science and instruction, the greater emphasis has always been placed upon recovery and utilization. This appears to have been due to the superabundance of natural stands of wood, and to the lack of an economic necessity for silviculture. Western European nations long ago altered their emphasis from recovery to production, but in America this change has barely begun.

Natural stands of forest in America are rapidly disappearing, due not only to increased demands for lumber and pulpwood, but also to a great enlargement in the field of wood technology. The latter is lead-



ing to increased demands for wood to be used as fabricated building material and for chemicals. Recent estimates indicate that the nation is using lumber 50% faster than the wood is being produced by the land.

Modern trends in American forestry teaching and research are now heavily weighted in the direction of the protection of the forests that remain, and toward improved utilization with the elimination of waste. These trends represent only a palliative. Silviculture has not kept pace with them in the over-all development of forestry.

From the above considerations it seems evident that the most pressing need in American forestry is the rehabilitation of silviculture. It must cease to be a minor handmaiden to the profession, and must become a central theme. We do not yet know how to grow most of our common forest trees on a sustained yield basis. The groundwork for a revitalization of silviculture must be through research devoted to this field.

Harvard University is in an unusually favorable position for the development of silvicultural research. It has three prime assets upon which to build such work. First is the Harvard Forest, with its splendid physical equipment and its forty years of research history. Second is a close relationship with departments of the University in Cambridge, whose facilities are available for instruction and investigation. Third is a tradition of independence which loses nothing of importance by being intangible. It is a tradition that knows no barriers among the disciplines that can contribute to the solution of silvicultural problems, and it is a tradition which opens the way for the exploration of new avenues of approach to such problems.

The primary aim of the Harvard Forest, then, is to develop men who can and will initiate and carry out research in methods for the growth of wood—wood for all uses and wherever it is needed. The Harvard Forest itself should be maintained as an efficient productive institution, utilizing all its University relationships, and serving primarily as a training ground for research men. This training should not be limited to research in the growth of trees in New England, but should develop in students a philosophy of investigation which will be applicable in the South, the Pacific Northwest, the Tropics, or wherever the need arises.

HUGH M. RAUP, *Director*

## *Harvard Forest*

TO THE PROVOST OF THE UNIVERSITY:

SIR, — The following is a report on the Harvard Forest for the year ending June 30, 1950.

### *Staff*

Dr. Scott S. Pauley has been in residence more or less continuously, carrying on his research under the Cabot Foundation in the development of superior forest growing stock. He has increased the poplar plantations to a certain extent on land in the Quabbin Reservation just south of the Tom Swamp Tract. Dr. Stephen H. Spurr was likewise here during most of the year except for a rather extended trip to the Pacific Coast during the fall. He has nearly completed his research project on aerial cruising and has prepared a manuscript setting forth his results. During the spring he finished his thesis and received his doctor's degree from Yale.

Mr. Earl P. Stephens spent the academic year taking course work at the University in Cambridge, working toward his doctor's degree in biology. He returned to the Forest in June to continue his work as assistant. Mr. Earl E. Smith served as general assistant here during all of last year, and will go to Cambridge in September to continue his studies toward the doctor's degree.

I was at the Forest almost continuously during the year except for a five weeks' trip to Honduras in February and March. There I reviewed in somewhat more detail the United Fruit Company's reforestation project that I had seen in the preceding year.

Our woods crew has remained unchanged, and continues under the capable management of its superintendent, Mr. Charles F. Upham.

### *Buildings, Equipment, and Operations*

There have been no notable additions this year to our buildings or equipment, although we have made some improvements with paint and repairs.

Woods operations have consisted principally of salvage and improvement cuttings in hardwood and mixed stands that were more or less damaged by the hurricane. Last fall we cleaned up a considerable area around the southern base of Prospect Hill in Compartments V and VII.



This is in a stand of hemlock and hardwoods which is relatively inaccessible, and in which considerable openings had been made by the hurricane. We have removed dead and poorly formed trees and, as an experiment, have planted a few white pines in some of the openings. In the late winter we made a similar improvement cutting in the southern part of the Prospect Hill Tract in Compartment VIII where the primary growth is of hardwoods. During the spring the men carried on similar operations in Tom Swamp, Compartments III and IV. A small area in Tom Swamp III, in which there was almost no good growing stock, was clearcut. There we ran all of the slash through a wood chipper and then scattered the chips as evenly as possible over the ground in the clearcut area. They are now functioning as a mulch and give some evidence of speeding up the natural regeneration of hardwoods. Another experiment with the chipper was performed where we thinned a small pine plantation in the Prospect Hill Tract.

The sawmill has operated on a few occasions when logs were accumulated from our salvage operations. Most of the lumber produced is of inferior quality and will be used to build sheds for other lumber which will be sawn in the future. An important event occurred in this connection, however, when we sold a truck load of red oak planks that came from a few good trees. This, I believe, is the first time in many years that hardwood lumber has been sold from the Forest, and we believe it marks the beginning of the production of merchantable hardwood which should increase gradually as time goes on. A small quantity of birch was also sawn in the spring and will be sold this autumn.

### *Instruction and Special Research*

We began last year with six students. Two of them finished their work in February, and the other four during the spring and summer. One research fellow was in residence throughout the year. He was Mr. A. C. Chable from the United Fruit Company in Honduras. He will take up his duties with the Research and New Crops Department of the United Fruit Company in September, and will set up a research program in the silvicultural management of the Company's tree plantations and naturally regenerated forests.

During the past year the Forest has had a more or less steady stream of visitors. These include not only the usual visitors to the museum, but also people with whom the staff has spent a considerable amount of time. Most of them we have taken on trips around the Forest. Within



the year there have been no less than 23 groups ranging in numbers from 4 to 60. In these groups there were a total of about 455 people. In addition to the groups, there were about 40 persons who came as individuals or two or three together. Thus we have given personal demonstrations or personally conducted tours to about 500 persons during the year. Approximately 1744 have signed the guest book in the museum. These figures indicate that the demonstration of the Forest and its work to outsiders has become a major part of our instructional activities. I believe further that it is one of the most significant parts of these activities and is worthy of our best efforts.

Two special research projects were begun at the Forest in June. A year or two ago a research assistantship was established from Cabot funds to support a student of fungi, who would begin a long-term study of the fungi of the Harvard Forest. This we believe to be a necessity to the enlargement of our understanding of forest biology. It is particularly desirable to enlarge our knowledge of soil fungi and the part they play in the nutrition and growth of forest communities. Last fall this assistantship was given to Mr. Frank Raymond, who came to Cambridge as a graduate student in biology. He made collections of soil fungi at the Forest in October, and after studying in Cambridge during the academic year, came to the Forest in June to continue his work on the ground.

A second project, also set up with Cabot funds, was designed to test the efficacy of some of the new plant poisons that have been developed for the control of weeds and other undesirable elements in the natural flora. An assistantship for this purpose was given to Mr. David Hackett, a graduate student in plant physiology. He began his work at Petersham in late spring, and has been trying out several of the poisons, making careful records of the way in which they were applied and the kinds of plants treated. We are particularly interested in them as a means of controlling the development of hardwood stump sprouts, especially in hurricane blow-down areas. Upon the successful control of these sprouts will depend our ability to improve the growing stock in these young stands without having to go through a complete cordwood rotation.

### *Finances*

An event of far-reaching significance in the past year was the death, on December 16, of Dr. E. G. Stillman. Dr. Stillman has been for many years a generous benefactor to the Harvard Forest, as well as to

other departments of the University. At the Forest his gifts of buildings and equipment have brought us our excellent physical plant. In addition, he underwrote our publications and supplied funds for various worthy projects. Not the least of his benefactions came in the form of counsel and advice, for he was unusually astute in the planning and execution of experimental work.

Dr. Stillman's intentions with regard to the future of the Forest have been known to us for some years, and he was actively preparing their consummation at the time of his death. He had planned for many years to bequeath the Black Rock Forest in southern New York state to the University, and during the past two years he managed it in such a way that it could be taken over by us with the least possible difficulty. Before the war he had set up with the Treasurer of the University the Black Rock Forest Trust Fund, to which he added sums at various times. This was to become an endowment fund for the pursuit of forestry at Harvard.

As a consequence of these things, we now have the Black Rock Forest, containing about 3700 acres of woodland, and an endowment fund from Dr. Stillman totaling about \$1,152,000. His final instructions for the use of the income were that it was to be used first for the maintenance of the Black Rock Forest; second, for the maintenance of the Harvard Forest; and third, for any other forestry pursuit that the University should deem wise. He left us with almost complete discretion as to how the income was to be apportioned. From our many discussions with him, we know that he wished the center of Harvard's instruction and research in forestry to be at Petersham, and that the Black Rock Forest should be used as an extension of the Harvard Forest.

We took over the management of the Black Rock Forest on the first of January, and appointed Mr. Benjamin B. Stout as resident silviculturist in charge of maintenance and operations. Mr. Stout, who had finished his work here as a student in February, moved immediately thereafter to Cornwall and took over the management of the Forest.

These bequests have made large changes in the financial structure of the Harvard Forest. Although the new funds have greatly increased our resources, they have been accompanied by increased responsibilities. The total endowment available for the operation of the combined Harvard and Black Rock Forests is now about \$1,522,000, and the proposed total budget for the combined operation of the two institutions totals about \$80,000. Our total income, including what comes in



from miscellaneous sales, rentals, etc. will be about \$74,800. Thus we still have an operating deficit of between five and six thousand dollars. During the past few years we have received annually in gifts about \$7,000, which we hope will continue.

### *General Considerations*

Three events occurred during the year 1949-50 which I believe will affect greatly the future of the Harvard Forest. Their significance lies not only in the improvement of the physical well-being of the Forest, but also in the clarification and development of its functions as an educational institution.

During the summer of 1949, after three years of rather intensive study of the Forest, I ventured to draw up in written form a statement of what I conceived the Harvard Forest to be, and what I thought it could do with its resources in the future. The statement is called "A Plan for the Development of Silviculture at Harvard." The premises upon which it is based are, essentially, three in number. First is the commonly accepted fact that as a nation we are using wood more rapidly than we are producing it; second, that the largest single complex of problems in forestry in America lies in research which will show the way to a balanced forest budget; and third, that Harvard is peculiarly suited and equipped to attack these problems in silviculture.

The plan itself is a simple one. It involves first the continuity of the Harvard Forest as a relatively small but highly efficient institution for research and training in silviculture; and second, the use of the Forest and collaborating University agencies for the development of a reservoir of men trained to meet the world's needs in silvicultural research.

The staff of the Forest would be small and closely knit, in itself an example of collaborative techniques in research. Although made up of experts in various phases of silviculture, it would avoid extreme specialization. Its men would be chosen not only for their skill in dealing with the immediate problems at Petersham, but also for their alertness to research problems and methods in all the great forest regions of the world. They would be encouraged to travel. No attempt would be made to build at Petersham a staff varied enough to work in all the collateral fields that contribute to silviculture. Instead, staff and students would be encouraged to avail themselves of facilities in these disciplines in other parts of the University.

Instruction and demonstration could be expected to take two forms. A small, carefully selected group of students would be accepted each

year as candidates for a master's degree. They would be chosen not only upon the basis of academic standing, but upon the breadth of their previous training and experience. Their thesis investigations might likewise be centered at the Forest, but they would be encouraged to go farther afield. Liaison would be established with agencies in various parts of the world, particularly in the Americas. These agencies would be used by the students as bases from which to carry on research. Harvard's botanical station in Cuba, the Atkins Garden and Research Laboratory, would be used for this purpose. It would be particularly advantageous to have the cooperation of the great industries controlling forest lands, such as the lumber and pulp and paper companies, wherein students could come to grips with the practical application of theoretical silvicultural concepts. Especially valuable would be a system of apprenticeship by which students, after they had attained their degrees, could be placed with government agencies or industrial enterprises for periods of six months or a year.

Second, representatives of industry and of various government agencies would be encouraged to use the Forest and its facilities for training and research. Such a program could be financed either by the industries and agencies themselves, or by grants from foundations. There is ample precedent for this in the Harvard Business School's courses in advanced management, and in the seminars conducted by the Department of Economics and the Graduate School of Public Administration.

The plan alters current policy principally by the broadening of aims. It proposes the use of the Forest not merely for the demonstration of silvicultural research and techniques in New England, but as a medium for broad training in research philosophy and method which can be carried anywhere.

A tentative budget, based upon the plan as outlined, was drawn up. It totaled about \$85,000 per year. Taking into consideration miscellaneous income from sales, rentals, etc., this involved an increase in endowment great enough to bring the total to about \$1,568,000; or, in the event that such an endowment could not be raised, it was hoped that sufficient funds to meet the proposed budget might be acquired from gifts or grants for research. The proposal involved a substantial increase over the budget for the year 1949-50. This budget was approximately \$53,000, only about one-third of which was met by income from endowment.

Increases in the proposed budget over that of our current expenditures would be primarily in two areas. The first of these would be in



the stabilization of the Harvard Forest staff, and the second would be in scholarship grants to students. At present we have an income for the latter purpose of about \$1,000 per year. It was proposed to raise this to about \$8,000 a year, particularly to enable students to travel. Other lesser increases would be for publication and library maintenance.

Inherent in the proposed plan is a proposition that goes far beyond the mere maintenance of the Forest as a research and educational institution as operated at present. It involves something of a new departure in American research and instruction in forestry, for it asserts that the greatest need in forestry education is not merely technical training, but the development of young men who will carry on research in the fundamental biological and economic problems in the production of wood. In doing so it disregards much of the compartmentalization that plagues most forestry schools, and would define silviculture, not in the narrow terms of current forest practice, but in broad terms to include all of the productional aspects of forestry. It would attempt to accomplish its aims by the utilization of all the facilities of a great university rather than by the setting up of a separate forestry faculty.

The second event of far-reaching significance is the improvement in the Forest's financial position through the Stillman bequests. It should be said here that our new total income falls short of meeting the budget proposed in the plan for the development of silviculture at Harvard. With the new responsibilities at the Black Rock Forest, the total budget under that plan would be about \$104,000, and would necessitate additional endowment sufficient to yield about \$24,000 a year, or about \$571,400. It is not impossible that this additional income could be secured from grants, should it appear advisable to carry out to its fullest extent the proposed program.

The third event of the year which can be considered of great interest for the future of the Forest affects its relationship to American forestry education in general. The Harvard Forest was for many years one of those institutions which were accredited by the Society of American Foresters. It remained on the officially approved list from the beginning of the accrediting system to about 1942. It is rather peculiar that it remained on this list as long as it did, for technically it ceased to be a school of forestry about 1914 when it began its career as a graduate school attached to one or another of the departments of the University. It had gone far into the research field, laying increasing stress upon the development of research men in silviculture, and had long since ceased to be a complete school of forestry in any sense. Throughout most of

this period it reflected the extraordinary vision of Professor R. T. Fisher, who saw clearly, and far ahead of his contemporaries, the basic educational needs of the profession. This vision grew out of his broad interests as a naturalist coupled with the research developments at the Forest under his leadership. During the 1920's he began an educational diversion which has led inevitably away from the excessive standardization that has been manifest in most forestry schools.

All forestry schools in the country were reviewed for reaccreditation in the early years of the war, and the Harvard Forest was at that time reduced to a secondary category. There were no students here, and most of the staff had gone elsewhere or into war service. The Forest was merely "listed" as an approved school, but was not called "non-accredited." The accreditation of forestry schools is now being reconsidered by the Society of American Foresters, and the criteria for accreditation have been made known.

From a study of these criteria, it has become quite obvious that if the Harvard Forest were to make an effort to become accredited, it would have to change its policies completely. It would have to set up a separate school of forestry within the University and staff it with professional foresters. Reaccreditation would entail such involved commitments in the way of personnel and specialized equipment that the Forest's resources would be tied up in them for years to come. It would be so straitjacketed by these commitments that the possibility of utilizing the University's actual assets for the development of research and instruction in silviculture would be almost completely lost. It would be throwing to the winds one of the major assets it possesses—that of complete freedom and independence in the development of what we conceive to be its true function. In addition, it would be moving in a direction which would be directly opposed to much of the basic educational philosophy of Harvard University, and, specifically, of the Harvard Forest.

Consequently, a brief but clear statement of our aims and the means we propose to use in accomplishing them has been sent to the Chairman of the Society's Committee on Accreditation. The statement indicates that since it is obvious that there is no provision within the accrediting system at present for such an institution as the Harvard Forest, the decision on whether the Harvard Forest should be examined for accreditation rests entirely with the Society itself. It is stated clearly that the Harvard Forest will make no effort to be accredited by the Society of American Foresters, either by alterations in its policies or by the



reallocation of its resources, and that if the Society wishes to set up a category of approval for such an institution as ours, either now or in the future, it is at liberty to make the necessary examination.

This declaration leaves the Harvard Forest completely free of external entanglements in working out its own destiny. I believe that in making such a declaration we are merely carrying on logically with a course of development that was set many years ago when the Forest became an institution for graduate study, and when it turned its energies into the research field.

If we continue this course into the future, as I believe we should, we may find it advisable to modify our system of recruiting students and granting degrees. At present we require our incoming students to have a bachelor of science degree from an undergraduate school of forestry, or its equivalent, and we continue to give the degree of master in forestry. The conviction has been growing, in the last few years, that we could in many cases make better research men in silviculture out of students from arts colleges than from those from the standard forestry schools, particularly if the former were well grounded in the natural sciences. To do this, and continue to give a master's degree in one year or in 15 months, would require some careful planning, and some very fine informal teaching in the hands of a small staff of young men who would be thoroughly imbued with the possibilities of the method. What we call our degree would be of little consequences. It could as well, and perhaps better, be called a master of science in silviculture. We already have the mechanism for a more advanced degree in this field through the Department of Biology; or, if the students' interests lie in the direction of forest economics, through the Department of Economics.

Our "declaration of independence," as I have called it, leaves the way completely open for us to try this experiment or any other that we choose in the field of instruction. And it would be an experiment. Its success would be measured by the quality and usefulness of the product — men capable of advanced research in silviculture.

The three events enumerated, although they have occurred separately and without apparent connection with each other, are very closely related. The proposal of a plan for the development of silviculture at Harvard was outlined at a time when we were financially insecure, and when it could, for the time being, be nothing more than a guiding principle. Facing the problem of reaccreditation has served to crystallize our ideas and clarify our position in the field of forestry education as a whole. It has given us added confidence that such a plan for research

and instruction as we proposed is very badly needed indeed. The Stillman bequests have enlarged our physical plant, and set us upon a financial basis that makes possible at least the partial implementation of the plan.

HUGH M. RAUP, *Director*