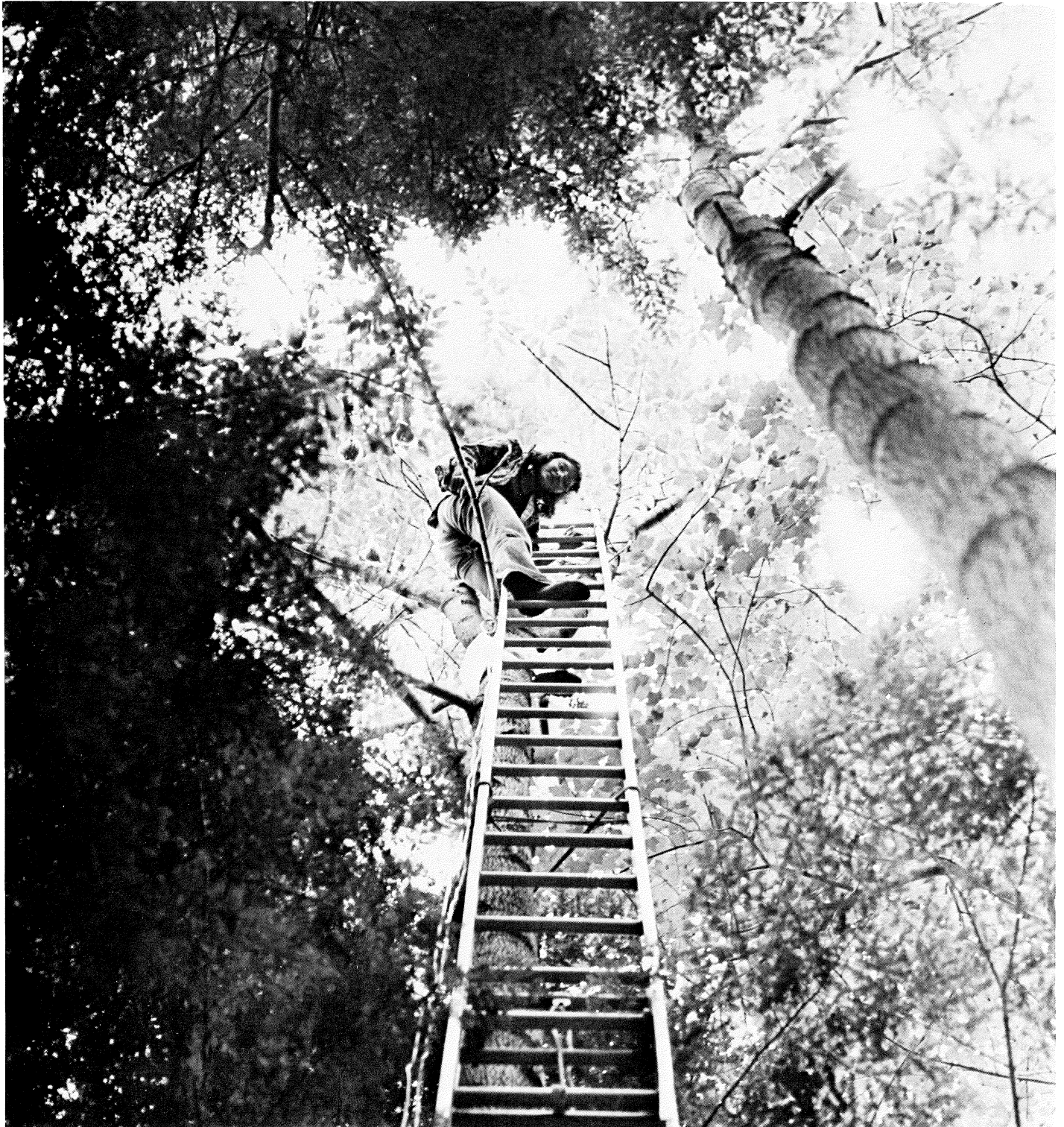


# THE HARVARD FOREST, 1974-75

Harvard University



Frontispiece: Elizabeth Gross (Radcliffe '76) on an ash tree where she adjusted a transducer while Dr. Susan Sovonick Dunford checked the recorder to see that the pen did not go off scale (see p. 15). (Photograph by Regula Zimmermann)

# ANNUAL REPORT OF HARVARD UNIVERSITY ACTIVITIES AT THE HARVARD FOREST 1974-75

## STAFF

The staff during the year 1974-75 consisted of the following persons:

Susan Sovonick Dunford, Cabot Research Fellow  
Ernest M. Gould, Jr., Forest Economist  
Henry Horn, Bullard Fellow (February 1 - June 15, 1975)  
Jack J. Karnig, Forest Manager  
James O. Klemmedson, Bullard Fellow  
Haviva Langenauer, Cabot Research Fellow (from September 1, 1974)  
D. Roger Lee, Cabot Research Fellow (from May 19, 1975)  
Walter H. Lyford, Soil Scientist  
John A. Milburn, Bullard Fellow (until September 26, 1974)  
William Newcomb, Cabot Research Fellow (until June 15, 1975)  
Roelof A. A. Oldeman, Bullard Fellow (March - April, 1975)  
Chadwick D. Oliver, Research Fellow (until March 5, 1975)  
Hugh M. Raup, Charles Bullard Professor of Forestry, *Emeritus*  
Kunihiko Syōno, Cabot Research Fellow  
P. Barry Tomlinson, Professor of Botany  
John G. Torrey, Professor of Botany and Director of Cabot Foundation  
Wayne H. Weidlich, Atkins Research Fellow  
James F. White, Instructor in Biology (until September 2, 1974)  
Martin H. Zimmermann, Charles Bullard Professor of Forestry and  
Director of the Harvard Forest

Supporting personnel included:

Dale Callahan, Laboratory Technician (from November 20, 1974)  
Catherine M. Danahar, Business Secretary and Librarian  
Peter J. Del Tredici, Research Assistant II  
Wayne E. Elliott, Custodian  
Anne Faulkner, Laboratory Technician (from December 15, 1974)  
Patricia L. Goforth, Laboratory Technician  
Vibeke Holm, Assistant to the Librarian  
Edward H. Hyde, Woods Crew  
George T. Kenney, Woods Crew  
Shirley P. LaPointe, Laboratory Aide  
Monica R. Mattmüller, Laboratory Technician  
Donald C. Mitchell, Assistant to the Manager of the Black Rock Forest  
Gordon B. Mitchell, Woods Superintendent  
Frances E. O'Brien, Secretary  
Theresa A. St. Helaire, Clerk-Typist (from November 1, 1974)  
Dorothy R. Smith, Clerk-Typist  
Charles F. Upham, Woods Crew, retired (working part-time)  
Sandra K. Weidlich, Clerk-Typist

The following changes in staff have taken place during the year. Mr. James White, our ecologist, who had served as Instructor in Biology for a number of years, left us in September to return to his native Ireland where he joined the staff of the University of Dublin. Mr. Chadwick Oliver, Research Fellow in Silviculture, took up a position of Assistant Professor at the University of Washington in Seattle. Dr. William Newcomb departed to join the staff of the University of Guelph (Canada) as a post-doctoral fellow. Dr. Kunihiro Syōno from Kitasato University in Japan spent a year working at the Harvard Forest in Dr. Torrey's laboratory. He returned home early in July, 1975. Dr. Haviva Langenauer, who had received her Ph.D. from the University of Massachusetts and subsequently spent a year at the Department of Plant Genetics, Weizmann Institute, Rehovot, Israel, joined Dr. Torrey's laboratory as a post-doctoral fellow. Dr. Roger Lee arrived in May 1975 to join Dr. Zimmermann's group. A native Canadian, he received his Ph.D. from the University of Aberdeen in Scotland with Professor P. E. Weatherley. He then acted as Chairman of the Department of Biology of Mt. Allison University in Sackville, New Brunswick (the University where he had received his college degree). Immediately prior to his arrival at the Harvard Forest he was Visiting Assistant Professor at Brandon University in Brandon, Manitoba, where he taught a first-year course "Contemporary Biology" in three northern centers. This involved 1000 miles travel every week.

## STUDENTS

The following courses were offered in Cambridge by our staff members. Most of these, as well as other biology courses, included field trips to the Harvard Forest. Dr. Tomlinson, in collaboration with other members of the Department of Biology, taught the course Biol. 11a (to be re-numbered as Biol. 18 in the future) *Diversity in the Plant Kingdom* in the fall semester. Biol. 111, *Structure and Physiology of Trees*, was given by Dr. Zimmermann in the fall. Biol. 149, *Structure and Functioning of Plant Communities* was also given in the fall, by Mr. Oliver. During the spring semester, Dr. Torrey offered (in collaboration with Dr. Bogorad, and three guest lectures by Dr. Zimmermann) Biol. 11b (to be re-numbered Biol. 11), *Plant Physiology*. Also in the spring, Dr. Tomlinson taught Biol. 168, *Plant Form and Structure*. In addition to his participation in Biol. 11b, Dr. Torrey offered his Freshman Seminar, *Plant Propagation*, in collaboration with Mr. C. F. Smith, greenhouse supervisor of the Biological Laboratories. On May 2 - 4, 1975, Dr. Torrey had 12 of his 16 Freshman Seminar students at the Forest for weekend lectures, discussions, demonstrations, laboratory experiments and a rather wet field trip. Many students considered the weekend one of the highlights of the term. In addition to these regular courses, Dr. Dunford offered a tutorial course (Biol. 99hf) in Cambridge, entitled *The Plant*

*and its Physical Environment*. These tutorials are half courses like those listed above, but they are taught only once a week and spread out over both semesters.

Three courses are now given entirely at the Harvard Forest. Biol. 298, *Soil, Land and Human Environment*, has been offered by Dr. Gould and Mr. Lyford for a number of years for four weekends during the fall semester. The continued oversubscription, as well as the fact that the students requested the inclusion of the two Monday holidays which happened to follow two of the four weekends, indicate the success of this course. — For many years we have had the problem that many students heard about the existence of the Harvard Forest only late during their career. We tried various methods of "communication", none of which seemed successful. This spring we made a renewed effort by offering a *Freshman Seminar on the Harvard Forest*, given like Biol. 298, during four weekends in Petersham, with additional orientation meetings in Cambridge. This was very successful and will probably solve our problem of communication because practically all incoming freshmen read the Freshman Seminar booklet. We are looking forward to future seminars and are curious to see its long-range effect. — The summer course Biol. S-146, *Plants in Relation to their Environment*, was again offered in the summer. Its enrollment remains relatively small because of the shortage of financial aid.

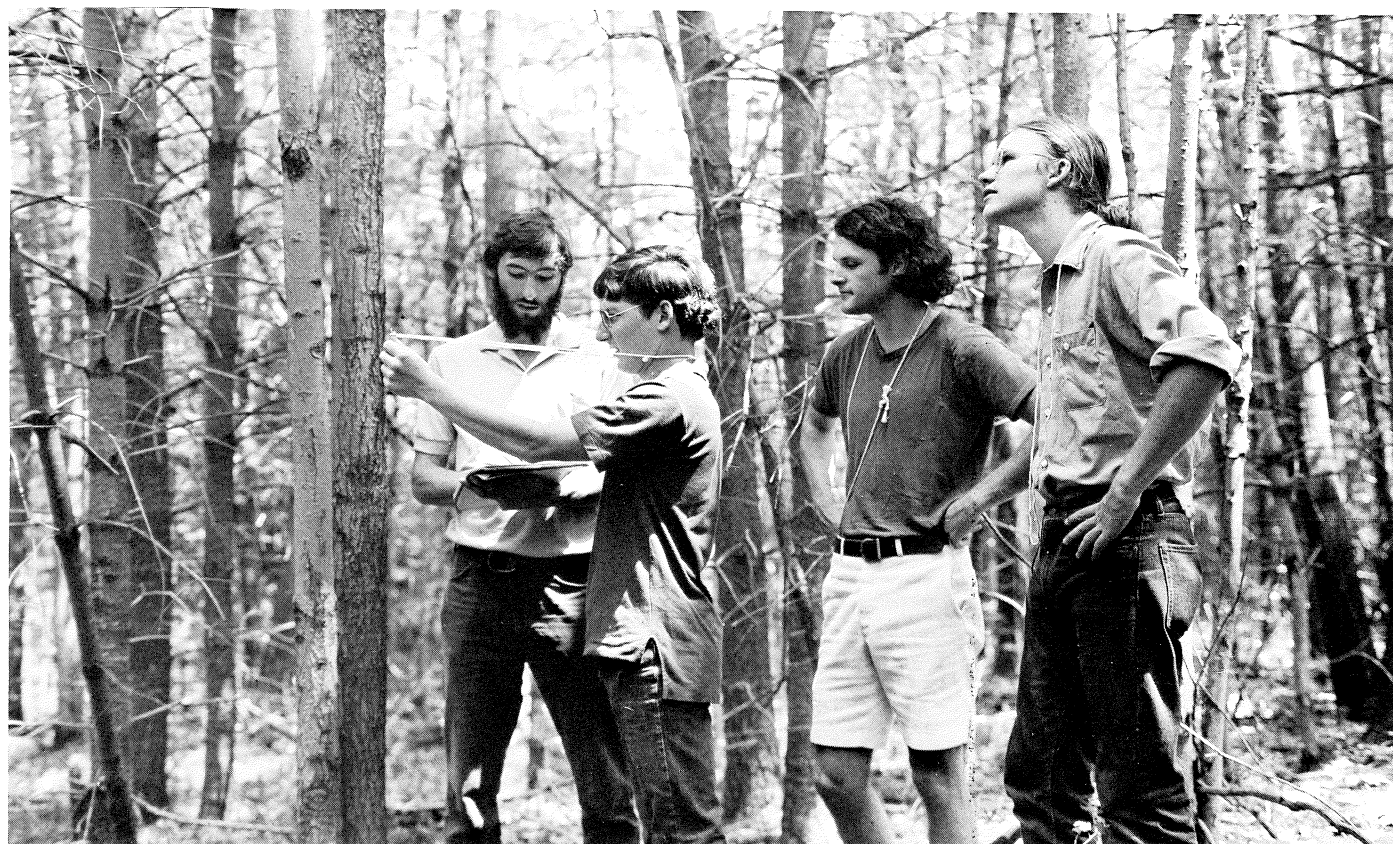
Dr. Tomlinson again offered his summer course Biol. S-105, *Plants of the Tropics*, this time all four weeks given at the Fairchild Tropical Garden in Miami, Florida.

The Department of Landscape Architecture again brought their graduate students to the Harvard Forest for a few days prior to registration in September 1974.

Two students worked toward their M.S.F. degree. Mr. Robert Baltaxe, whose research is described under the heading Bullard Fellows, will present his findings in the form of a thesis in November 1975. Mr. Sun Joseph Chang was concerned with a trial application of a new analytical technique called "goal programming". Theoretically, this procedure should be a useful tool in forest planning, so Mr. Chang used it to analyze possible developments on the Kilkenny District of the White Mountain National Forest. This practical trial suggests that a good deal more work is needed conceptually as well as on the practical computing level before goal programming can be widely used by foresters. Mr. Chang received his M.F.S. degree in June and has been accepted as a doctoral student at the University of Wisconsin.

Dr. Lewis Feldman obtained his Ph.D degree in June, having worked with Dr. Torrey for the past four years on the problem of the organization of





The students of the summer course of 1974 planning a forest thinning. Above (from left to right): Chad Oliver (standing), Mr. Lyford, Regula Zimmermann (background), Margie Friedman (foreground), Tom Guobis, John Tilney, Jonathan Walton, Tom Lock, Bayard Clarkson, Greg Mello and Dr. Gould. Below (from left to right): Greg Mello, Tom Lock, Bayard Clarkson and Jonathan Walton.



Above, studying pond vegetation (from left to right): Greg Mello, Mr. James White, Bayard Clarkson, Tom Lock, Margie Friedman, Tom Guobis, Dr. Torrey. Below, studying ferns in the laboratory (from left to right): Regula Zimmermann, Dr. Rolla Tryon (foreground), Bayard Clarkson, Dr. Alice Tryon, Tom Guobis, Jonathan Walton, Margie Friedman, Greg Mello, Tom Lock (partly hidden).

the root apex in *Zea mays* (see Research). He began his graduate training at Harvard as a student at the Forest in the summer course S-146. Suitably enough, he set a precedent by having his Ph.D. thesis examination at the Forest as well. — Mrs. Sandra Ferré Simpson is a continuing graduate student working with Dr. Torrey on xylem differentiation.

In addition, the following students took units of undergraduate and graduate research. Biol. 96r: Thomas Lock (Vascular anatomy of sarsaparilla) and Bruce Larson (Epicormic branching). Biol. 299r: Gregory Mello (The nitrogen economy of an 18th century New England farm). David Weir, a member of the Biol. 298 class in the fall, continued during the spring term with a study of planning a farm holding in New Hampshire.

Under Dr. Tomlinson's supervision John Kress, a senior, completed his honors thesis dealing with the floral biology of *Rhizophora mangle* (red mangrove) in Florida. Field work was conducted at Fairchild Tropical Garden during July and August, 1974. An exceedingly interesting observation showed that about 5% of the individual red mangroves are genetically male sterile, suggesting an effective out-breeding mechanism.

Two undergraduate students from Antioch College in Yellow Springs (Ohio) spent a semester each at the Harvard Forest in their work-study program. Miss Sarah Gerault worked with Mr. Oliver in the fall semester 1974 graphing changes in axis shape through time in red oak trees. Miss Kathryn Kamo worked in Dr. Torrey's laboratory from April 7 to June 6, 1975, assisting Pat Goforth in the sterile culture of embryos of *Comptonia peregrina* and their excised roots. From February 1 until March 10, 1975, Mr. Dwight Baker, a senior at Defiance College (Ohio), joined Dr. Torrey's group concerned with pollen cell culture.

During the summer of 1975, Elizabeth Gross (Radcliffe '76) assisted Dr. Dunford's research on long-distance transport in trees; Mr. Joseph Chang helped Dr. Gould during June and July, 1975, preparing a computer program for analyzing the growth records and testing a library program that we obtained from Dr. O'Regan and Mr. Bruce Yerge of Berkeley, California, both former Bullard Fellows. Miss Christina Kacandes (Radcliffe '78) who had been a participant in the Freshman Seminar on the Harvard Forest during the spring semester, cooked for the summer students with the help of her sister Georgia. Miss Sherry Recos (Mahar Regional High School) helped in Dr. Torrey's laboratory from November 5, 1974.



## BULLARD FELLOWS

Mr. Robert Baltaxe from the FAO of the United Nations in Rome spent most of his time in Cambridge. He studied how satellite imagery can be used to help assess present and future possibilities in developing countries. He was able to obtain satisfactory imagery for Sierra Leone and to supplement his laboratory analysis with field work in that African country.

Dr. Henry S. Horn of the Department of Biology, Princeton University, did the final writing of his *Scientific American* article on forest succession in which he deduced a hypothetical successional pattern from comparisons of the age structures in trees in several New Jersey stands that were abandoned at various times from 40 to 250 years ago (see the Bibliography). He gave empirical estimates of relative production at each stage and presented new and more compact versions of theories that he had developed before about successional "strategies" of the geometrical distribution of leaves in the trees and about successional patterns that occur automatically when there are fixed probabilities that a tree of a given species in a forest will be replaced by another of its kind or by another species. — He spent most of his time extending a stochastic theory of forest succession in the absence of disturbance, to provide insights into vegetational change and stability where disturbance is frequent and/or devastating. Under conditions of chronic and patchy physical disturbance, convergence may occur in one generation, because all species invade small gaps that are recently vacated, and most any species can replace each individual tree. Under conditions of strong interspecific competition, convergence may be approached so slowly that it cannot be recorded. Practices of seeding, planting, weeding, and group selection that foresters have used for centuries, are simple and effective means to modify succession by influencing the natural competitive exclusion. — Dr. Horn worked also on some other projects; he analyzed data of a previous study on the phenology and population dynamics of butterflies, and gave a number of seminars both in Cambridge and at the Forest.

Dr. James O. Klemmedson, School of Renewable Natural Resources, University of Arizona in Tucson, is interested in biotic influences on amount, distribution and transfer of nitrogen and carbon in ecosystems. During the course of his eight years of research he had found significant differences between grasslands and nearby forest in that, under steady-state conditions soil of grasslands accumulates and maintains more nitrogen than that of forests. He used his year at the Harvard Forest to compare and combine his data with the world literature. He found information for over 60 forest and nearly 120 shrub systems, but comparable data for grasslands seem to be virtually lacking. One of his main questions is to determine if the distribution pattern of nitrogen is really unique in grasslands. The lack of information on grasslands in the literature was a bit disappointing. On the other hand, this fact makes his own findings, which he analyzed very carefully, new and particularly interesting. He has been able tentatively to

reject some hypotheses and propose new ones that will form the impetus for research in the years to come. He visited a number of research institutes in Great Britain, continental Western Europe and Sweden to discuss these problems with colleagues. — In addition Dr. Klemmedson worked on several manuscripts, some of them with former students, wrote the terminal report for his IBP Desert Biome project which was concluded December 31, 1974, and helped write a chapter on structural distribution of nitrogen in desert ecosystems for the forthcoming IBP Biome synthesis volume.

Dr. Roelof A. A. Oldeman, on secondment to the Government of Ecuador by the French Organization Office de la Recherche Scientifique et Technique d'Outre Mer for which he works, was at Harvard Forest as a Bullard Fellow during March and April, working with Dr. Tomlinson as reported elsewhere.

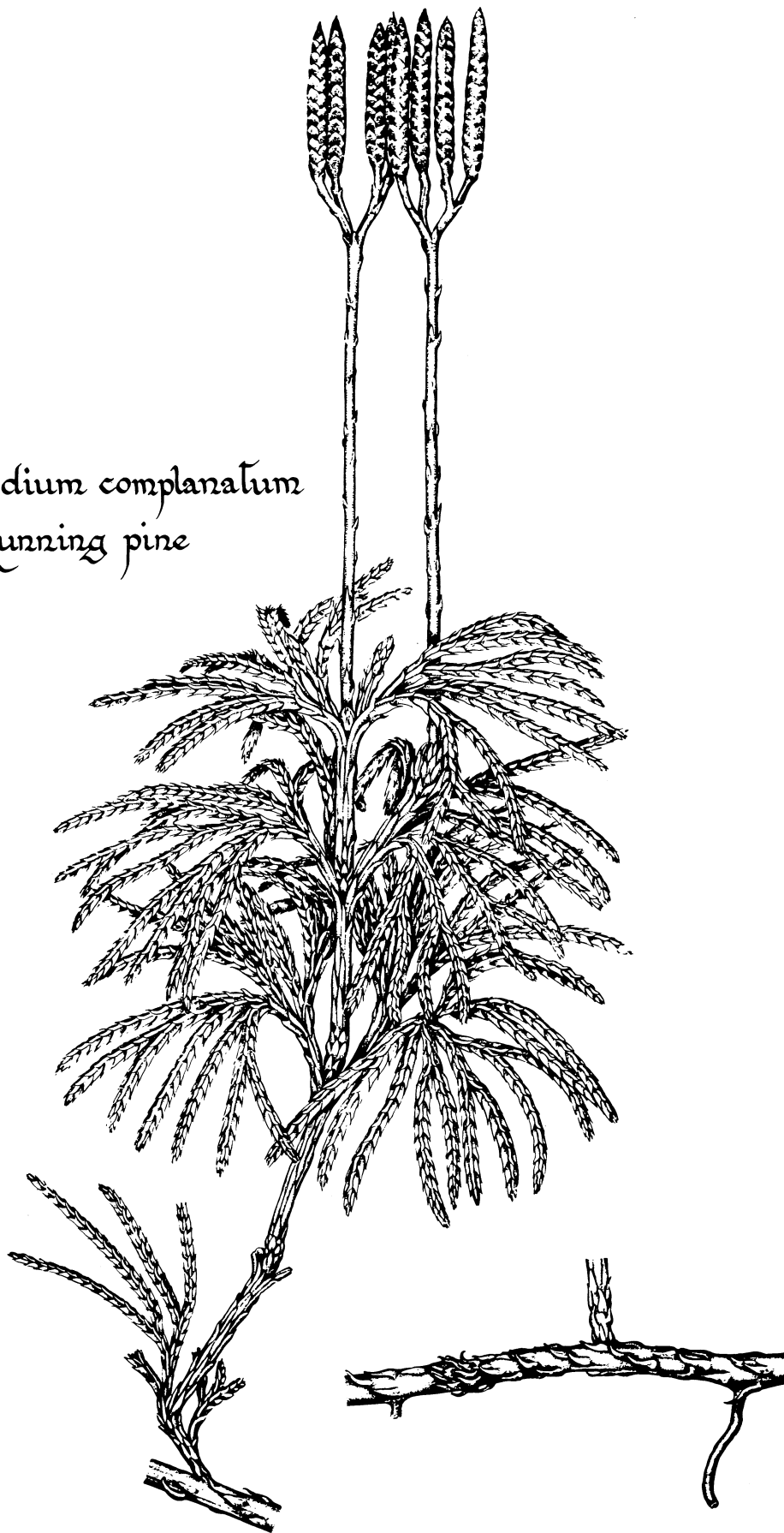
## MEETINGS AND VISITORS

Many meetings were held at the Forest by outside groups, usually with staff members participating in one way or another. They were, in approximately chronological order: the Biochemistry Department of Harvard University, the Northeastern Forest Economists, the Massachusetts Audubon Society, the Massachusetts Tree Farm Committee, the New England Forestry Foundation, the Sixth New England Fern Conference, the Northeastern Bird-Banding Association.

On March 28-29, 1975, the Cabot Foundation organized and the Harvard Forest served as meeting ground for a gathering of all tenured botanical faculty within the University. Discussions centered on current research activities and plans and prospects for future research goals. The friendly exchange of information and views was very useful and it was agreed that such a meeting should become a regular, at least annual, event.

Numerous colleges from New England and elsewhere brought classes that were given lectures and guided tours. The Fisher Museum continues to attract many individual visitors as well as groups. The booklet describing the dioramas went out of print after 34 years; it was revised, given an attractive, new cover and reprinted (see Bibliography). The upstairs part of the museum is nearly finished. Dr. Mark Swan is responsible for the imaginative displays. Dr. Gould helped him with designs and assembly. A local carpenter made the display cases and boards, and the woods crew spent a good deal of time painting and assembling. The upstairs museum will probably be ready to be opened to the public during the summer 1975.

*Lycopodium complanatum*  
Running pine



Scientists from all over the world, too numerous to list, again visited the Forest to discuss matters of common interest with staff members, see our facilities and learn our techniques. Needless to say, these visits are very stimulating and helpful for our academic well-being.

## RESEARCH

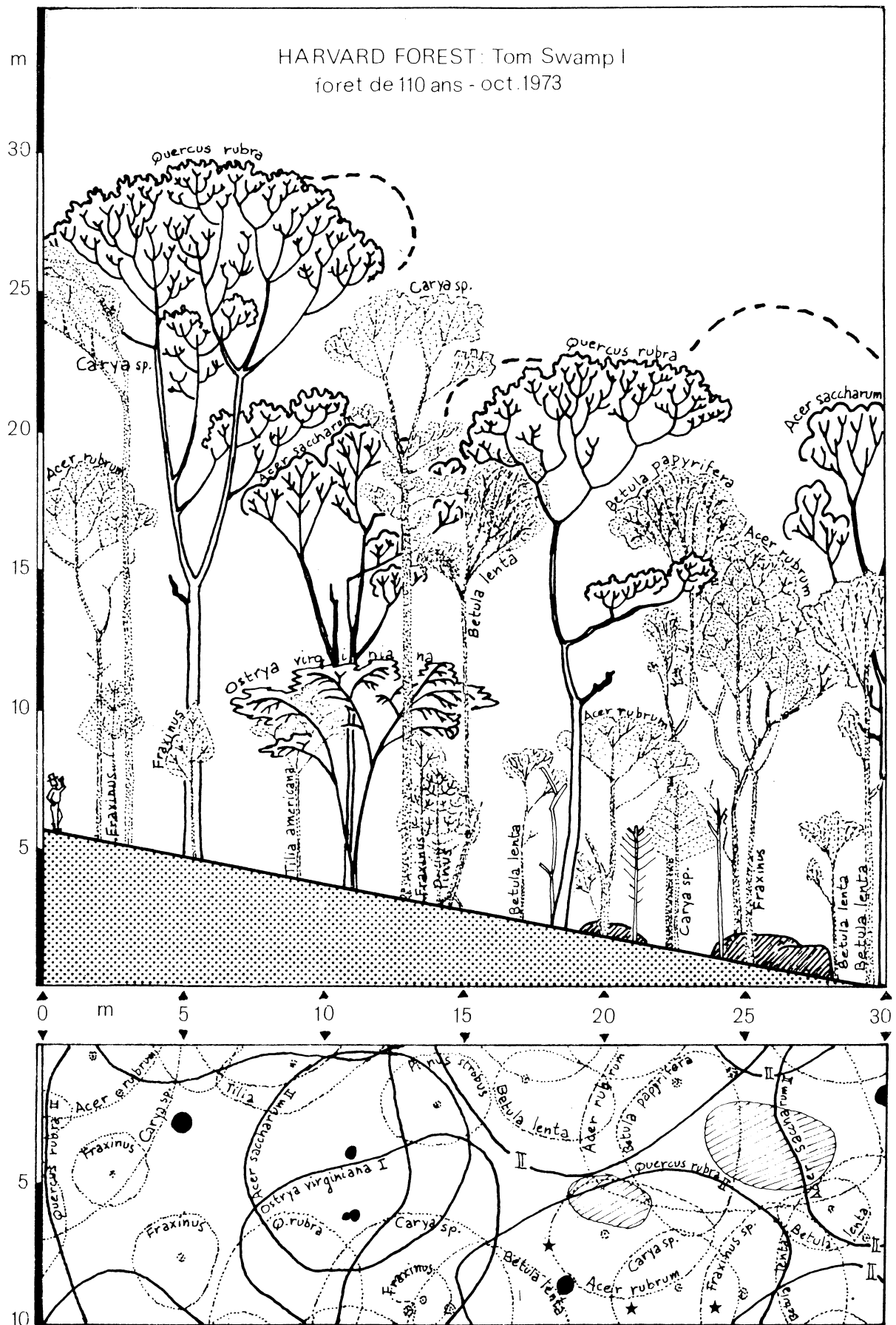
Dr. Gould's work on town planning continued with cooperation of the Soil Conservation District to produce a Natural Resources Inventory for Petersham. This information, together with other data, will be used to develop a town conservation plan during the coming year. He continued to serve on the New England Council's Natural Resources Committee. He also served on the Governor's Committee on the location of Highway I 190 during the brief pre-election life of this special study. He is now on an advisory group studying which Quabbin lands should be set aside for research.

Dr. Gould developed two short studies during the year. One, on wilderness opportunities, was presented at the National Meeting of the Society of American Foresters, the other was on forestry incentives (see Bibliography). In February, he went to California to collaborate with Dr. O'Regan on a long-term planning project. While there, he gave a lecture at the Forestry School, University of California at Berkeley. In the spring he presented a paper on land use aesthetics at the National Conference on Forest Residuals held at the University of West Virginia.

Mr. Lyford spent a good deal of his time writing up former research work done at the Forest, particularly that dealing with small watersheds and with soils. He prepared a paper on tree root intermingling and presented it at the national meeting of the Soil Science Society. In late winter he spent a few weeks at the University of Florida Education and Research Center in Welaka, where he conducted research on the root system of slash pine with Dr. W. L. Pritchett who had spent the year 1972-73 here at the Forest as a Bullard Fellow. — Mr. Lyford participates actively in many of the visiting groups, be they Harvard students or classes from other schools. He also did consultation and advisory work and served on thesis committees at Harvard and Yale.

Dr. Tomlinson spent the months of July and August, 1974, in France, working with Dr. Francis Hallé (Université du Languedoc, Montpellier, France) and Dr. R. A. A. Oldeman (Office de la Recherche Scientifique et Technique d'Outre Mer, France) working on the manuscript of a book entitled, *Trees and Forest Architecture in Tropical Ecosystems*. Dr. Oldeman, on leave from his





O.R.S.T.O.M. mission in Ecuador spent the months of March and April, 1975, at the Harvard Forest to prepare further chapters. (An illustration of a stand in the Tom Swamp Tract I of the Harvard Forest, prepared during an earlier visit, is shown on p. 13). The volume will analyze the architecture of individual trees on the basis of a wide sampling of tropical species and attempt to describe tropical forests in terms of the collective behavior of individual trees. In pursuance of a general interest in reproductive biology in tropical trees, Dr. Tomlinson attended a symposium on "Variation, breeding and conservation in tropical forest trees" held at Oxford University in April 1975. The importance of this subject in preserving genetic resources is becoming internationally recognized.

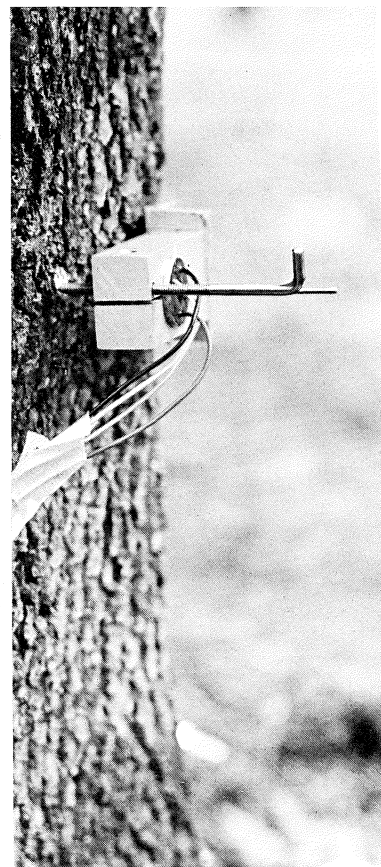
During the months of October and November, 1974, Dr. Tomlinson visited Papua New Guinea with support from the National Geographic Society. He studied floral biology and gross morphology of many Old World mangrove species and collected material for illustration and for anatomical analysis. A visit to Australia, during the same trip, allowed him to collect additional material of sea grasses as a contribution to a larger morphological and anatomical survey of these important plants. Most of this information will be used for the preparation of a forthcoming volume of the *Anatomy of Monocotyledons*.

Dr. Tomlinson also continued his work on rhizome organization in collaboration with Dr. Adrian Bell who is now at the School of Plant Biology, University of North Wales, U.K. From original observations and a survey of the literature it appears that a limited number of "strategies" of rhizome growth are available. One can make a distinction between "linear" and "non-linear" types and appreciate in the latter that economical ways of distributing meristems by vegetative growth have been achieved in the basic organization of many plants. This information is of ecological significance.

My own work on vascular anatomy and pattern of vascular development of arborescent monocotyledons was pursued in two different directions. On the one hand, I have spent considerable amounts of time working on a teaching film. A temporary version of a Kodachrome demonstration film is now used for limited distribution; duplicates are supplied for teaching purposes upon special request. We are also shooting sequences on Eastman color negative film, to be used eventually in a film to be published like our earlier wood-structure film (see Annual Report 1971-72). Our motion-picture technique of vascular analysis has opened a wide new field of investigation, and we are now, ten years after our first attempts to find out how a large stem is produced by primary growth, in a position to compare patterns in different families. The *Rhapis* principle, i.e. bundle differentiation from the cap, may be regarded as fundamental. There are two divergent types of elaboration, continued differentiation in the outer system (monocotyledons with secondary growth) and continued differentiation in the inner system (Pandaceae, Araceae, etc.). The motion picture technique continues to be useful in other fields; occasional visitors spend time in our laboratory to get acquainted with the procedures.

Dr. Weidlich is continuing his research on the stem vascular system in the Nymphaeaceae. Two manuscripts dealing with the five subgenera of *Nymphaea* have been submitted for publication. The vascular system in the stem of *Nymphaea* is unusual and complex, but no characteristics fundamental to monocotyledonous vascular systems are present. Work is in progress on the remaining genera of the family — *Nuphar*, *Ondinea*, *Victoria*, and *Euryale*. He has also set up an experimental plot in the Harvard Forest for the growth and care of the American chestnut (*Castanea dentata*), a once abundant and important commercial species that was destroyed by the chestnut blight in the first part of this century. The plot is in a burned-over area containing much chestnut. Fourteen seedlings, grown by Peter Del Tredici, were planted. Dr. Weidlich is maintaining the present American chestnut population through bridge grafting, thinning, and attempts to eradicate the chestnut blight. He has found a way to "cure" the blight canker by placing an airtight soil compress over the infected area. Dr. Weidlich is optimistic for the survival of these chestnuts. With many trees growing in close proximity it may be possible to develop a blight-resistant strain or to decrease the virulence of the blight.

Dr. Susan Sovonick Dunford (below) continued her work on translocation in ash trees. During August 1974 she and Dr. Milburn attended an advanced study institute on phloem transport in Banff, Alberta, sponsored by



NATO and the National Science Foundation. She acted as a discussant for a paper entitled "Phloem loading and associated processes", given by Dr. D. Geiger from the University of Dayton (Ohio). During the winter months, she continued her work on the vascular anatomy of squash and analyzed data from experiments performed during the preceding summer. Her research concerns primarily the inter-relationship between the phloem (the inner bark), the tissue in which sugars are exported from the leaves, and the xylem (the outer wood) the tissue in which water and root nutrients ascend. Her results so far indicate that the effect of the xylem upon the phloem decreases as the season advances because the fibers of the latewood act as a barrier to water movement from the xylem vessels to the phloem. It is possible that the ability of the phloem to transport sugars is enhanced during the period when lack of water might be a serious problem for the tree. A relatively new technique, previously applied to small herbaceous plants, is being adapted to trees as a means of pursuing this problem. Linear displacement transducers (p. 15, illustration on right) with which extremely small movements can be measured, are used to record the diurnal swelling and shrinking of the tree stem as water is lost by transpiration from leaves and replenished from the roots. These fluctuations are on the order of 100 microns (0.004") in eastern white spruce. The device permits the observation of the daily radial stem growth which has been found to be on the order of 25 microns (0.001").

In collaboration with Dr. Milburn of the University of Glasgow (who was a Bullard Fellow here last year), I have been editing the first volume (on phloem transport) of the *Encyclopedia of Plant Physiology, New Series*. The manuscripts were delivered to the publisher in the fall of 1974. The book is presently in page proof and hopefully will be out in late autumn 1975.

A subject of active research interest during the past year in Dr. Torrey's laboratory has been the initiation and development of root nodules in legumes and non-legumes, produced by soil microorganisms and capable of fixing atmospheric nitrogen. Dr. Kunihiro Syōno spent the period from July 1, 1974 into July 1975 working on an analysis of hormonal control of rhizobial-induced nodules in roots of the garden pea. He found that cytokinin levels were high in the nodules when they were first initiated and then dropped rapidly as meristematic activity in the nodule ceased. The cytokinins zeatin and isopentenyladenine and their ribosides and ribotides were characterized by thin-layer chromatography of purified nodule extracts and bioassay.

Dr. William Newcomb, in his second year as a Cabot Fellow from the University of Saskatchewan, examined the light microscopic and electron microscopic structures of the developing pea nodule. Of particular interest were the observations on the release of the bacteria into the host cells at the time of infection. A polysaccharide material in which the bacteria were



embedded within the infection thread is extruded into the cell together with the bacteria. Dr. Newcomb also examined the structure of root nodules of non-leguminous nitrogen fixers, including *Casuarina* and *Comptonia*. The infective agent is probably an actinomycete. With the help of Peter Del Tredici, who is in charge of the controlled-environment facility, nodules were taken at several different stages of seedling development from plants grown aeroponically. — During the past year success has been achieved in the routine germination of seeds of *Comptonia peregrina*. Peter Del Tredici has worked out a method of gibberellic acid treatment of the seed of *Comptonia* and several closely related *Myrica* species to achieve high percentages of rapid germination. Seedlings grown in aeroponics can be inoculated so as to produce root nodules capable of fixing atmospheric nitrogen.

*Right:*

From left to right, Kathy Kamo, Dr. Wm. Newcomb and Pat Goforth in Dr. Torrey's laboratory.  
(Photograph by Dale Callahan)



Dr. Haviva Langenauer's research has centered on the problem of the control of vascular pattern formation in seedling and cultured roots.

Dr. Lewis Feldman's thesis research concerned the activity and inactivity of the quiescent center (QC) in corn roots. Root decapping activates cell divisions in the QC, leading to root cap regeneration. Quiescent centers were surgically isolated and grown in sterile nutrient culture where they formed new roots directly. From these and related studies Dr. Feldman was able to conclude that the QC controls the primary vascular pattern formation in the root.

In the spring of 1974, Dr. Colette Nitsch worked in Petersham on the culture of pollen cells of tree species. This research was continued in the present year, first on herbaceous species for the development of techniques and then on tree species, especially sugar maple, for the brief span of their flowering period in April. Dr. Newcomb and Dale Callahan, Research Technician, pursued this work. Dr. Martin Mathes of the Department of Biology of the College of William and Mary in Williamsburg, Virginia, joined in the effort with sugar maple anther and pollen cell culture, working first in Virginia and then coming north in April to work with flowering trees in Petersham. Despite initial hopes for success, no definitive embryonic structures have been produced from these studies to date.

Dr. Torrey's own research continues to focus on the problems of the hormonal control of cytodifferentiation, especially the early cytological and nuclear changes, in the formation of tracheary elements in cultured explants of the pea root complex. The relationship between auxin-cytokinin induced DNA synthesis and subsequent cell specialization is being studied using autoradiography. Mrs. Sandra Ferré Simpson is a continuing graduate student whose research centers on the same system.

## FOREST OPERATIONS

A great deal of woods crew time was again spent on building maintenance. During the winter months, extensive interior painting was accomplished on Shaler Hall as well as several apartments. Another large block of crew time was used in setting up exhibits in the upstairs part of the museum. Display cases had to be mounted on bases, aligned and painted, and exhibits had to be built and arranged.

Operations in the forest continued at a modest pace. About 2,000 board feet of lumber was sawed at our mill. These products are used almost exclusively for local construction. The cordwood inventory was increased slightly so that we would be able to switch to firing wood in case of another fuel crisis.

## HARVARD BLACK ROCK FOREST

**Research.** During the summer of 1974, Vincent and Arlene Dubiansky served as forestry aides at the Black Rock Forest, assisting with timber marking, forest-stand improvement, trail maintenance and a survey of hikers. This survey was undertaken with a similar large-scale effort by the Palisade Interstate Park Commission at Bear Mountain Park. At the Black Rock Forest we used a similar questionnaire. The survey showed that the Black Rock Forest attracts a much greater number of local users, who know the rules and are more satisfied with the level of use, when compared with visitors of the Bear Mountain Park. Visitors interviewed at the Black Rock Forest were generally older, better educated managerial or professional people who have hiked and camped over a long period of time. When asked what improvement is most needed in the Forest, an overwhelming majority replied, "leave it alone."

Iris L. Goldfarb, of City College of New York, who is affiliated with the American Museum there, used the Forest as a field station several times during the year. Her interest is the study of spiders with particular emphasis on behavior patterns in a natural setting.

*Right:*

Jack Karnig collecting scions of American chestnut from a healthy unblighted 11.1" Dbh tree located off Long Hill Road near the Black Rock Forest. The cuttings collected were grafted on Chinese chestnut root stock in an attempt to vegetatively propagate this resistant tree. (March 1975)



Forest Operations. Two parcels of mature oak timber were marked for cutting during July, 1974. A total of 140 Mbf was the estimate of volume in Compartment VI, in the Mt. Misery area and Compartment XVIII, a triangular segment of woods north of the Old West Point Road. This marked timber was bought by the Kelly Sawmill Co. of Dover Plains, N.Y. on competitive bid. It was logged during September by a contract logger, Honore Dube, who did an efficient, workmanlike job while conforming to all provisions of the logging contract.

Sale of firewood to local customers totalled 41 standard cords. Most of the wood came from a small patch cutting in Compartment VI immediately south of the Upper Reservoir. Smaller quantities of wood were salvaged from the Hill of Pines area, Hall road cutting and from storm-damaged timber along our road network.

Our road system is extremely vulnerable to heavy rain and sudden spring runoff due to mountainous terrain. We have been fortunate during the past year, but normal repairs had to be made mostly during April and May of 1975. Assistant Manager, Donald C. Mitchell was able to effect repairs using our aged tractor and much ingenuity. Volunteers from the Black Rock Fish and Game Club again assisted in clearing ditches and opening culverts.

Use of the Forest by hunters, snowmobilers and motorcyclists continued at a normal pace. The requirement of hunting passes and permits for motorized vehicles has kept traffic within reasonable limits.

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This is a list of publications which have appeared in print between July 1, 1974 and June 30, 1975. Naturally, publication always lags one or more years behind the description of research in this report. Many of these publications are available as reprints. If you are interested in receiving any of these, please write to the authors or to the Harvard Forest, Petersham, Massachusetts 01366.

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