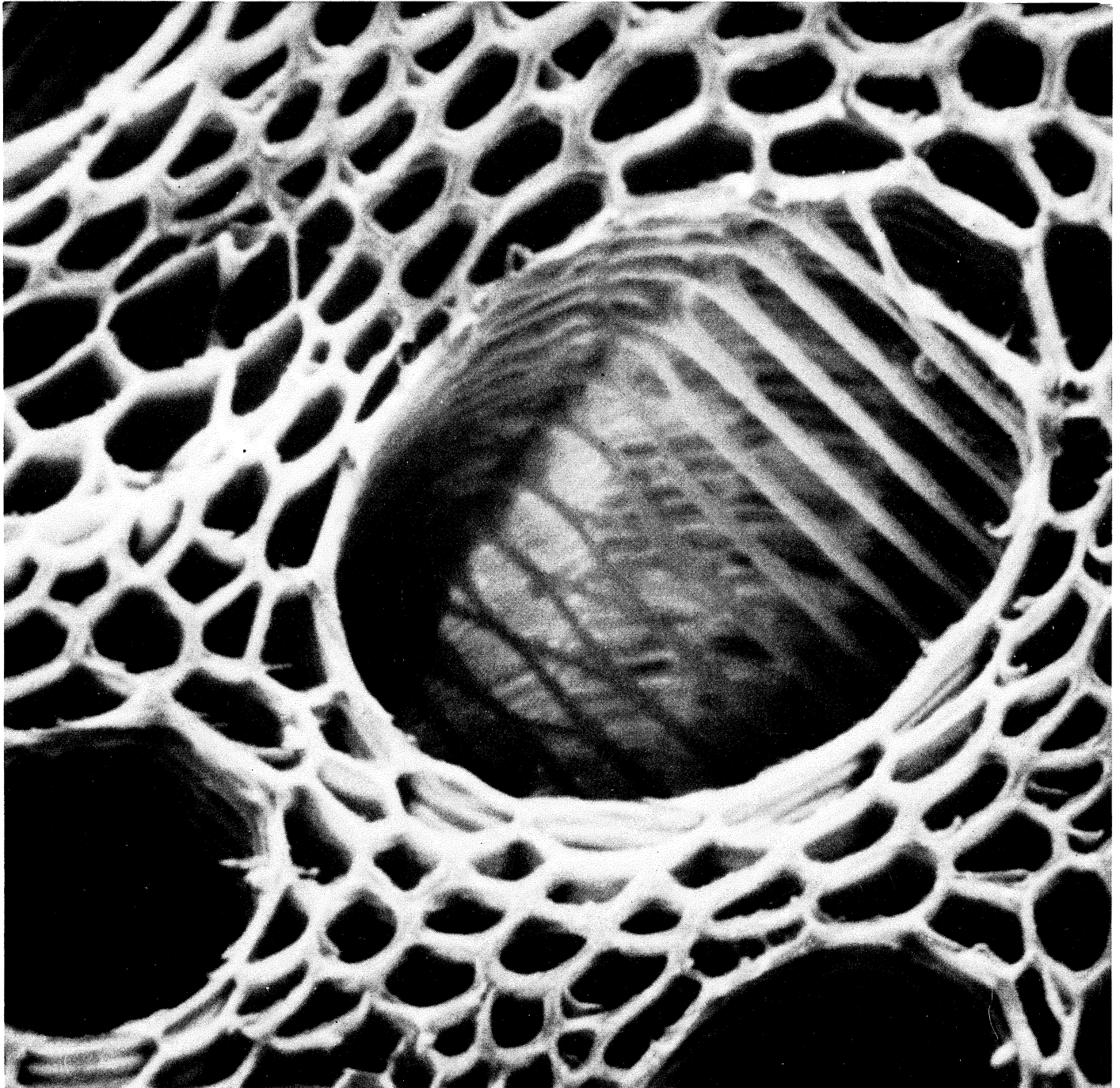


# THE HARVARD FOREST, 1976-77

Harvard University



Frontispiece: Vessels, the conduits of water transport, in a root of the palm *Chamaedorea microspadix* Burret. The diameter of the larger one is ca. 125  $\mu\text{m}$ , those of the smaller ones 60  $\mu\text{m}$ . A perforation plate with numerous bars is visible in the large vessel. A bundle of thin-walled phloem cells occurs at the upper left. Scanning electronmicrograph by Larry Klotz.

# ANNUAL REPORT OF HARVARD UNIVERSITY ACTIVITIES AT THE HARVARD FOREST 1976-77

## STAFF

The staff during the year 1976-77 consisted of the following persons:

Phillip J. Craul, Bullard Fellow (from September 8, 1976)  
Ernest M. Gould, Jr., Forest Economist  
Jack J. Karnig, Forest Manager  
Larry Klotz, Cabot Research Fellow (from October 1, 1976)  
Craig G. Lorimer, Research Fellow in Silviculture (from August 1, 1976)  
Walter H. Lyford, Soil Scientist, *Emeritus*  
Thompson D. Pizzolato, Bullard Fellow (from September 1, 1976)  
Usher Posluszny, Cabot Research Fellow (until December 1976)  
Hugh M. Raup, Charles Bullard Professor of Forestry, *Emeritus*  
Brent Tisserat, Cabot Research Fellow (from August 15, 1976)  
John Tjepkema, Assistant Professor of (Soil) Biology  
P. Barry Tomlinson, Professor of Botany  
John G. Torrey, Professor of Botany  
Boris Zeide, Bullard Fellow (from September 11, 1976)  
Martin H. Zimmermann, Charles Bullard Professor of Forestry and  
Director of the Harvard Forest

Supporting personnel included:

Nancy Levinskas Armstrong, Research Assistant (from January 24, 1976)  
Dale Callahan, Laboratory Technician  
Catherine M. Danahar, Business Secretary and Librarian  
Peter J. Del Tredici, Research Assistant  
Wayne E. Elliott, Custodian  
Anne Faulkner, Laboratory Technician  
Patricia L. Goforth, Research Assistant (until November 30, 1976)  
Vibeke Holm, Assistant to the Librarian  
Edward H. Hyde, Woods Crew  
George T. Kenney, Woods Crew  
Shirley P. LaPointe, Greenhouse Assistant  
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  
Dorothy R. Smith, Secretary  
Charles F. Upham, Woods Crew, retired (working part-time)

In anticipation of Walter Lyford's retirement (see last year's report) the Chairman of the Department of Biology appointed a search committee to look for an Assistant Professor in the general field of soil biology. The search resulted in the appointment of John Tjepkema, who received his Ph.D. from the University of Michigan where he had studied the relationship between oxygen concentration and nitrogen fixation in the nodules of soybeans. Post-doctoral work was done at Washington University, the University of Wisconsin, Oregon State University and in Brazil. Much of this research was concerned with nitrogen fixation associated with the roots of non-nodulated plants. John took up his position at the Harvard Forest on July 1, 1976.

Larry Klotz, who had received his Ph.D. with Dr. Parthasarathy at Cornell, arrived at the Harvard Forest on October 1, 1976, to work with Barry Tomlinson and Martin Zimmermann on palm xylem. Craig Lorimer, who had received his Ph.D. at Duke University, arrived on August 1, 1976, to take up his post-doctoral position in silviculture. Usher Posluszny, who had been a post-doctoral fellow with Barry Tomlinson accepted a visiting research fellowship at the Hebrew University in Jerusalem and subsequently was appointed Assistant Professor in the Department of Biology at the University of Guelph in Ontario. After obtaining his Ph.D. in the Department of Biological Sciences at the University of California at Riverside, Brent Tisserat joined John Torrey's group on August 15, 1976. He left on June 15, 1977, taking up a position at the U.S. Date and Citrus Station, Indio, California.

Ann Hirsch came from the University of Minnesota to be a Cabot Research Fellow with John Torrey. She worked at the Biological Laboratories in Cambridge.

## STUDENTS

The following courses were offered in Cambridge by our staff members. During the fall term Barry Tomlinson gave *Plant Form and Structure* (Biol. 168), and in collaboration with other members of the Department of Biology, *Diversity in the Plant Kingdom* (Biol. 18). Martin Zimmermann taught his course *Structure and Physiology of Trees* (Biol. 111). During the spring term, John Torrey taught the intermediate level course *Plant Physiology* (Biol. 11) in collaboration with Drs. Bogorad and Ausubel. He offered his Freshman Seminar on *Plant Propagation* with C. Smith. John Tjepkema offered a new course, *Soil Biology and Ecology* (Biol. 108).

As in past years, three courses were based at the Harvard Forest. Biol. S-146, *Plants in Relation to their Environment*, was given during the summer of 1976. Autumn 1976 marked the end of an era when Biol. 298, *Soil, Land and Human Environment* was offered jointly for the last time by Ernie Gould and Walter Lyford. Although Walter retired at the end of June 1976, he had agreed to help Ernie once more with the course in the fall. The course has continued to be popular; its content will be somewhat changed in the future and it may be

given only every other year. During the spring term the Freshman Seminar on the Harvard Forest was given again.

Biol. S-105, *Plants of the Tropics*, was taught by Barry Tomlinson at the Fairchild Tropical Garden in Miami, in June and July 1976.

The Department of Landscape Architecture again brought their graduate students to the Harvard Forest for a few days prior to registration in September 1976.

The following students took units of undergraduate and graduate research. Biol. 90r: Jane Clark (Radcliffe '77), *The Role of Abscissic Acid as an Inhibitor of Auxin-Induced Lateral Root Initiation in Isolated Pea Root Segments*. Geology 90r: Laurie Wayburn (Radcliffe '77), *Soil-Forming Processes and Soil-scapes of Arctic and Subarctic Regions*. Engineering 376: Thomas Sleeter (graduate student, Department of Engineering), *Free-Living, Nitrogen-Fixing Bacteria: Their Possible Significance to Hydrocarbon Degradation in the Sea*. Biol. 299r: Shary Berg (graduate student in the Department of Landscape Architecture), *Guidelines for Backcountry Campsites*; Kathy Holland (Radcliffe '77), *Tylosis Formation (Wood Anatomy)*; Karen Johnston (Radcliffe '77), *Water Quality Control on the Charles River*; David Levine (Harvard '77), *An Economic Analysis of Timber Resources on Proposed New National Forests in Alaska*; Eleanor Palais (graduate student at the Kennedy School of Government), *The Effects of Sulfur Dioxide on Plants*; John Thomas (Harvard '77), *History, Analysis and Proposed Treatment for a Mixed Hardwood Stand at the Harvard Forest*. Biol. 311: Peter Alpert (graduate student in biology), *Field Instrumentation*.

The following graduate students, working towards a Ph.D. at the Department of Biology in Cambridge, have advisers located at the Harvard Forest: Dwight Baker, Cecilia Lenk, Patricia Pierce and David Wheat.

Two students worked toward the degree of Master of Forest Science during the past year. Based upon research done mostly in Florida, Janet McDonough wrote a thesis entitled "An investigation of xylem pressure in coconut palm with reference to lethal yellowing". She received her MFS diploma in June 1977. Steven Sher made a thorough analysis of growth of red pine from which he reconstructed growth in three dimensions over time and the effect of crown shape upon stem growth. He is presently writing his thesis and expects to have his diploma awarded in November 1977.

Sally Kleinfeldt, a graduate student at the University of Michigan, in Ann Arbor, a former Radcliffe undergraduate and alumna of Biology 298, arrived in March to study plant-herbivore interactions at the Harvard Forest during the summer of 1977. Four students assisted her in this work: Lynn Disney, Anne Krantz, Tina Ochrymowych and Julie Zickefoose.

Patricia Caffrey, who had taken Biol. S-146 during the summer of 1976, assisted in John Torrey's laboratory from September 1 to December 24, 1976, on a work-study program from Antioch College.

Joanne Dintzis (Radcliffe '80), who had taken the Freshman Seminar on the Harvard Forest during the spring term 1977, cooked for the students during

the summer 1977 and later helped with maintenance work. Sarah Braun (Radcliffe '80), who had also been in the Seminar, and Richard Allen (Harvard '78) also did maintenance work, mowing lawns and painting.

## BULLARD FELLOWS

*Phillip J. Craul*, Associate Professor of Forest Soils at SUNY-College of Environmental Science and Forestry, Syracuse, arrived at the Forest on September 8. His major effort during the year was devoted to re-examination of physical land classification, especially where landforms relate to soils. He was also involved in guest lecturing for Biology 298 and in several courses for the Graduate School of Design at Cambridge. In one course he served as a juror for master plan development projects for first-year graduate students. Several seminars were given at the Forest. In the spring he undertook, with Walter Lyford, a project to determine depth to bedrock and perched water table on one of the Prospect Hill watersheds. This was accomplished through the use of a hammer seismograph and an electric resistivity meter. Phil returned to Syracuse at the end of June.

*Thompson D. Pizzolato* came to the Harvard Forest from the North Central Forest Experiment Station in Rhinelander, Wisconsin, where he had completed a year as Visiting Scientist. He participated in our current research on phloem. He improved the technique for embedding and cutting (relatively) large pieces of stem in plastic. On long series of 10  $\mu$ m thick transverse sections he analyzed the path of sieve tubes in the phloem of linden (*Tilia americana* L.). In addition, he found linden stems to be ideal material to test histochemical procedures for mucilages and starch. Tom and his wife Betsy moved to Newark, Delaware where Tom is an Assistant Professor in the Division of Plant Science at the University of Delaware.

*Boris Zeide*, originally from the All-Union Research Institute of Standardization, Moscow, USSR, arrived at the Forest on September 11, 1976 from the Department of Botany, Hebrew University, Jerusalem, Israel. His study during the year was concentrated on tree growth and survival. In connection with this problem, horizontal structure of stands was also studied. Ecological factors affecting tree growth were arranged based on the idea that the more important the factor the greater the negative correlation between it and the sum of the other factors. Several seminars were given at the Harvard Forest on current research studies and expeditions through Russian forests. He and his wife Alla moved to New Brunswick, New Jersey, where Boris took up a position in the Department of Horticulture and Forestry at Cook College, Rutgers University.



Phil Craul using the electric earth resistivity meter for determining depth to the perched water table above bedrock.

## MEETINGS AND VISITORS

A number of meetings were held at the Forest during the past year. In September 1976, Usher Posluszny and Barry Tomlinson organized a weekend meeting, attended by fourteen participants from a number of countries at which the biology of the monocotyledonous order Helobiae, the largest group of aquatic plants, was discussed. One outcome of this meeting was the issue of a "Helobiae Newsletter" edited by Professor R. B. Knox of the University of Melbourne, Australia. Over 100 copies have been distributed on request.

An informal workshop on nitrogen fixation was organized by John Torrey and John Tjepkema in an all-day conference of New England scientists who gathered at the Harvard Forest on February 5, 1977. Twenty-eight participants came from MIT, Northeastern University, Connecticut College and departments within Harvard, including the Biological Laboratories, the Division of Engineering and Applied Physics and the Museum of Comparative Zoology. Presentations and discussions ranged from the molecular biology of the *nif* genes in *Klebsiella* to estimates of  $N_2$  fixation in the oceans.

The 8th New England Fern Conference was held here on May 27-29, 1977. Twenty-five participants, many of them students, discussed their research, ranging from taxonomy to development and biochemistry of ferns and related plants.

Many groups again visited the Harvard Forest and the Fisher Museum, among them the Trustees of Reservations. Scientists from all over the world visited us individually. On the other hand, many of our staff members were again invited to lecture at conferences and university departments in the United States and abroad.

## RESEARCH

Ernie Gould continued his exploration of public planning processes by getting first-hand experience in several ways. This fall he joined the Boston Working Group formed by the U. S. Forest Service to review and propose plans for the Waterville Valley Unit of the White Mountain National Forest. This committee represented a cross section of the many interested National Forest users and was a formal part of the new planning process being developed in response to the Resources Planning Act. This form of public participation was extremely useful because the twenty or so participants, familiar with the Waterville Valley area, were furnished with specific information about the available resources for the unit so they could deal realistically with feasible options. Although this form of public participation is expensive, it promises much more useful guidance than the public hearings so often used by governments to gauge public opinion. This spring, at the request of the Secretary of Environmental Affairs, Ernie chaired the Massachusetts Forestry Program Review Board. This group of about 50 foresters, loggers, landowners, administrators and environmentalists met regularly for about four months. Their charge was to review the state legal and administrative framework for forest use and make suggestions for change. They concluded that the state was basically well equipped with forest laws and agencies but that nearly 50 administrative adjustments and 25 legal revisions were needed to help the state cope with modern forest problems. The report was completed in June and is being prepared for the printer.

Craig Lorimer worked on two research projects. His study of population dynamics of understory trees is based on long-term data from permanent sample plots at the Harvard Forest and Black Rock Forest, which were established by Ernie Gould, Walter Lyford, and Mr. Tryon (formerly of the Black Rock Forest). The survival and growth of over 1400 individually numbered understory trees has been traced over a period of 13-42 years. Data have been computerized for 15 species on three sites. Results show wide differences in mortality rates among species, ranging from complete disappearance of understory white oak to a very low attrition rate for red maple. These trees grew very slowly in diameter ranging from 0.07 to 1.1 mm per year, depending on the species. Statistical analyses indicate that mortality rates can be predicted with a high degree of accuracy, using correlated variables such as density of overtopped trees and the ratio of crown length to total tree height. Craig also conducted experimental field work on the control of chestnut blight by "hypovirulent" fungal strains, started last year by Dutch Weidlich. A permanently marked study area was established, containing about 60 treated and untreated chestnut trees. Preliminary results have been encouraging, with most of the diseased areas on treated trees showing little or no spread over a period of 1½ summers.

Usher Posluszny completed work on floral development in the aquatic monocotyledonous family Zannichelliaceae which has a cosmopolitan distribution and began work on floral development in the seagrasses (marine vascular plants). The importance of aquatic plants as primary producers in a variety of ecosystems is increasingly recognized.



Barry Tomlinson completed the manuscript of a book "Tree Architecture in Tropical Forest Ecosystems" (Springer Verlag); it had been written jointly with Dr. Francis Hallé, University of Languedoc, France and Dr. Roelof Oldeman, now Professor of Silviculture, University of Wageningen, Netherlands. In collaboration with Martin Zimmermann, he edited the Proceedings of the Fourth Cabot Symposium "Tropical trees as living systems" (Cambridge University Press). Tropical forests remain the largest, and at the same time, least investigated of all ecosystems so that this emphasis is appropriate and necessary.

Research on the woody monocotyledons was continued with a detailed anatomical analysis of the Xanthorrhoeaceae. A clarification of the fern genus *Acrostichum* in South Florida was completed with the assistance of David Adams, a graduating senior. Using cinematographic techniques, David Adams finished a study of vascular architecture in the tree fern *Cyathea fulva*, and submitted a paper for publication (see also last year's report).

During the Spring Term, Barry was on study leave in the South Pacific, aided by the award of a visiting Erskine Fellowship at the University of Canterbury, Christchurch, New Zealand. Research on the architecture of New Zealand woody plants was concentrated on the peculiar "divaricating" condition in which many species show intricately interlaced branches, sometimes restricted to the juvenile stage. Numerical analytical methods showed that the condition results from loss of the organizational ability which otherwise characterizes woody plants. Theories of architectural quantification are being developed. Research on woody plants in New Zealand was facilitated by support from the Office of International Programs of the National Science Foundation via a grant under the U. S. - N. Z. Scientific and Technological Agreement. The same grant, but under the U. S. - Australia Scientific Collaborative Program, permitted a five-week visit to north Queensland where research on mangrove communities was continued in collaboration with the Inshore Productivity Group of the Australian Institute of Marine Science, Townsville. This study completed one phase of this research, since it was concluded that although the mangrove members of the family Rhizophoraceae have a basically similar floral plan, six mechanisms of flower behavior can be recognized. An earlier visit to Australia was extended to Perth, where the main objective was to collect material of members of the Xanthorrhoeaceae.

Larry Klotz spent much of his time on a comparative anatomical survey of palm stems, a project on which he is collaborating with Barry Tomlinson. The object of the study is to describe the taxonomic distribution of various microscopic anatomical features within the palm family. The study is intended to form a chapter in a book on palm stems that Barry Tomlinson and Martin Zimmermann are writing. Larry also has begun working on functional aspects of the anatomy of xylem in palms. He spent several weeks in Florida in February to test a hypothesis about the width of vessels in the petioles of several species. Now he is trying to obtain data on the length of vessels in palms, a project which will probably involve the technique of cinematographic analysis.



Janet McDonough spent the months of late fall and winter at the University of Florida Agricultural Research Station in Fort Lauderdale studying the diurnal course of xylem pressures in coconut palms. This study is an extension of some of the work John Milburn began as a Bullard Fellow (see the Annual Report 1973-74). Xylem pressures follow a diurnal cycle with a maximum around  $-4$  atm. during the night, and a minimum around  $-10$  atm. about 11:30 a.m., at which time the stomata begin to close. Research into these matters is of considerable importance for the understanding of lethal yellowing, a disease of coconut and other palms that has killed millions of trees in the Caribbean area during the past few years. Interestingly enough, lethal-yellowing-diseased trees have a high xylem pressure between  $-2$  and  $-3$  atm. and there is no diurnal change. This seems to indicate that the disease causes closure of the stomata. Janet found such raised xylem pressures in a few palms at least two weeks before they showed any lethal yellowing symptoms. This method for early recognition will be very helpful in the study of this disease. (See the illustrations above.)

The leaves at the top of the crown of a forest tree are the most important ones because it is with these that the tree can best compete with its neighbors for a place in the sun. But the top leaves are also the most "expensive" ones because water has to be brought over the longest distance and at the same time it has to be lifted to great height. How does a tree manage, under conditions of water shortage, to prevent its lower leaves from taking all available water and thus dry out the top leaves? Some light has been shed

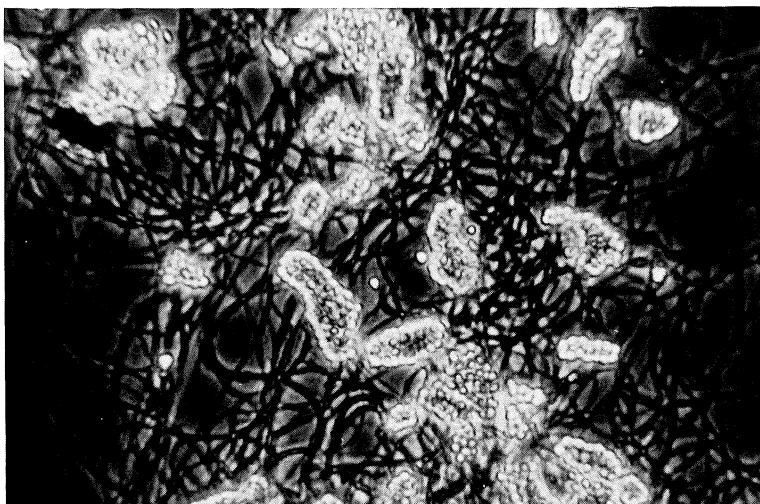
on this question in Martin Zimmermann's study of the hydraulic architecture of trees. This work began in the spring of 1976 and was the project topic of one of our summer students, Patricia Caffrey. But it was not until late summer of 1976 that most of the technical difficulties were overcome. The resistance to flow of distilled water in a piece of stem increases continuously during measurement. This observation had been made previously by numerous workers, and ascribed to xylem blockage by tiny air bubbles. We found that the problem has nothing to do with xylem blockage because it can be avoided by use of a dilute ionic solution such as 5 or 10 mM KCl, a salt concentration comparable to that of natural xylem sap. Looking at the hydraulic architecture of a whole tree, we found that conductivity of the trunk is about three times that of lateral branches. Moreover, the conductivity in the junction from stem to branch is often even lower than that of the branch itself. Another "hydraulic bottleneck" is between twig and petiole. This means that on its way to the leaves the water has to flow faster in the branches than in the stem, and still faster from stem to branch and from twig to petiole. At the same time, the xylem pressure drops accordingly. In case of a drought, leaves will wilt and dry out before the tree is killed by embolism of the stem xylem.

During the summer of 1976 Ayodeji Jeje, a chemical engineer from the University of Lagos, Nigeria (Ph.D. from MIT), worked in our laboratory, studying cavitation of water in xylem vessels (embolism). He laboriously isolated xylem strands from the petioles of *Plantago major* L. (common plantain, a weed) and induced cavitation by application of sulfuric acid and nitrate gels under the microscope. He observed and recorded cavity expansion on film, and also observed the nature of the reverse process, bubble collapse. His experiments did not yet enable him to make a full quantitative analysis, but he will be a Bullard Fellow during the coming year and will pursue this research further.

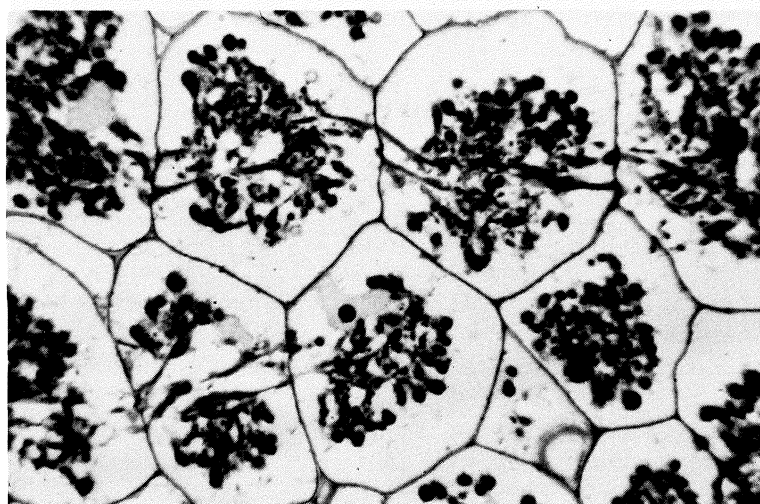
John Tjepkema is working on several problems in the area of nitrogen fixation. One project concerns the regulation of oxygen tension in the root nodules of *Myrica gale*. He found that the roots which extend upward from the nodules may increase the rate of oxygen uptake by the nodules, thus increasing the rate of nitrogen fixation. Other research includes the energy requirement of nitrogen fixation and a study of the amount of nitrogen fixation associated with the roots of non-nodulated plants.

Research efforts in John Torrey's laboratory continue to center on root nodulation of non-leguminous woody species caused by a soil actinomycete. Work on *Comptonia peregrina*, the common sweet fern, has progressed on several fronts. Seed germination is possible using scarification and treatment with gibberellic acid. Isolated roots grown in sterile nutrient culture show a requirement for the sugar alcohol myoinositol as well as for vitamins and sugar. Roots in culture form shoot buds endogenously and the root undergoes secondary thickening without hormone treatment.

Early stages of nodule development were studied in detail. Root hair infection has been demonstrated from light and electron microscope studies. Similar evidence has been obtained for root-hair infection in *Casuarina cunninghamiana* and for *Myrica gale*. In *Comptonia* root-hair infec-



Whole mount preparation of a colony of the '*Comptonia* isolate' grown in axenic culture. The sporogenous bodies which give rise to ovoid spores or cysts appear bright when observed by phase-contrast. Magnification x 750.



Section of the infected cortical cells of a *Comptonia* root nodule produced by inoculation of seedlings with a culture of the '*Comptonia* isolate'. The nodules show normal nitrogen fixing abilities. Magnification x 1000. Photomicrographs by Dale Callaham.

tion is followed by pre-nodule development involving root-cortical-cell hypertrophy and subdivision. Associated with pre-nodule formation is the initiation of modified lateral root structures, which form the nodule lobes where the endophyte proliferates. Later, nodule roots form from the nodule lobes.

Dale Callaham has been studying the growth of the actinomycete isolated from nodule tissue. A pure culture of an organism derived from nodules of *Comptonia* has been cultured and subcultured for about a year. It grows very slowly in a range of bacterial nutrient media and appears to be micro-aerophilic. In culture the organism produces filamentous colonies on which are formed complex sporogenous bodies (see Figure) which resemble structures which have been described by others from light microscopic sections of *Alnus* nodules as "spindles". They are believed to give rise to resting, resistant stages in the life cycle of the endophyte. The spore-like structures released from the sporogenous bodies from the *Comptonia* isolate will germinate with low frequency.

Their role in the behavior of the organism remains to be defined. Recent tests in which the organism in pure culture is used as a suspension to cause nodulation have been successful with sand-grown seedlings of *Comptonia* as well as with young plants grown aeroponically. The evidence is quite strong that the cultured organism is the true endophyte for *Comptonia*.

Brent Tisserat worked with root development in seedlings of *Myrica gale* and *Casuarina cunninghamiana* grown in aseptic culture either in liquid or in agar media. He studied in particular the effects of low concentrations of plant hormones on root development, observing that certain hormone treatments elicited nodule-like formations. Other modifications in root development were also observed and studied.

## FOREST OPERATIONS

Normal cordwood cutting activities were entirely eliminated this year due to emergency clean-up operations following two severe storms. The first of these occurred in March and brought wet snow and high winds. The second was a wet snow fall at a time when the leaves were about one-half expanded. Many saplings were bent or broken and considerable damage was done to the red pine plantation next to Shaler Hall. We estimate that when the clean-up operation is completed, a total of about 20 thousand board feet of sawlogs will have been salvaged.

Again this year much of the crew time was devoted to maintenance work, road and trail clearing, repair of equipment and facilities, and painting of buildings. In the latter work, and lawn mowing, the woods crew was assisted by two undergraduate students during the summer of 1977.

## HARVARD BLACK ROCK FOREST

During 1976 and early 1977 John Bascietto, a graduate student from New York University studied the ecology and microenvironment of beaver (*Castor canadensis* Kuhl) at selected locations within the Forest. Using elaborate recording devices, he monitored temperature and sound from the interior of several beaver houses to determine activity levels and birth dates of kits. His project will continue its field phase until late 1977.

Research aides, D. Jensen Bissell and David Paradowski, working as a team, thinned a young hardwood stand in Compartment III adjacent to the lower

Hulse Road. In Compartment XIV they laid out and performed a release cutting in a white spruce plantation. They also pruned a large number of potential spruce crop trees at the east end of Tamarack Pond.

Remeasurement of the 40-year-old silvicultural study plots was made during the fall of 1976. Growth of the walnut plantation located in the field surrounding Forest headquarters was also monitored. These latter trees are making excellent progress due mostly to favorable site conditions.

The tree plantings in the experiment in wildlife clearcuts in Compartments XXIII and XXV mentioned in last year's report were thoroughly checked to determine their condition. About 90% of the unprotected seedlings had been browsed by deer or were dead or missing. Based upon this short-term observation, it is obvious that reforestation using conifers is not a practical means for revegetating these openings. Deer continue to interfere with effective regeneration of harvested portions of the Forest.

The above findings, together with statistics gathered by personnel of the New York State Department of Environmental Conservation, were used to initiate an antlerless deer hunting season during the fall of 1976. A special antlerless deer hunting unit (#54) was established by the State which included our 3,600 acres, the USMA reservation and a portion of the Palisades Interstate Park south of Storm King mountain. Limited success in reducing overall deer populations was achieved. On this Forest a normal number of bucks (37) were harvested and, in addition, 23 antlerless deer. Plans have been formulated to repeat this antlerless hunting in 1977.

On December 3, 1976, Jack Karnig gave testimony at a hearing at Bear Mountain State Park held under the auspices of the New York State Assembly, Conservation Committee. His statement defended the tax exempt status granted educational institutions whose land is open to the public and who engage in active conservation programs.

Some of the activities can be best described as public relations. Jack spoke at a delegates' meeting of the N.Y.-N.J. Trail Conference held at New York City. His subject was the proposed new Forest Tax Law 480A, a piece of legislation being considered in Albany. Also, he led several nature study hikes into the Forest as a means of getting local residents acquainted with our vast and unique facilities.

Assistant Manager, Donald C. Mitchell, continues to be the mainstay of forest road and trail maintenance. These vital facilities remain in good condition thanks to his untiring efforts. In addition, Mr. Mitchell cut and sold 54.5 standard cords of wood during the last year. Most of the wood came from roadside salvage cuttings and from thinnings made by the summer crew.

Petersham, Massachusetts  
August 1977

Martin H. Zimmermann  
Director

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