The ARNOLD ARBORETUM of HARVARD UNIVERSITY

Annual Report 1985-1986

To the President of the University:

The financial position of the Arnold Arboretum, which has received increasing concern in the last three annual reports, further seriously deteriorated during this year. This was partly due to a still further decline in the largely oil-based Mercer endowment, and partially because salaries were increased among many staff following a review which determined that they had fallen substantially behind the average for Harvard institutions.

Mr. Alan G. Fein, who had been seconded by the Harvard administration as Associate Director of the Arnold Arboretum pro tempore in 1984, charged to review and further refine the administrative structure and financial strategies resigned from the university in October 1985. That month, Ms. Lydia Kowalski was appointed as Executive Director of the Arnold Arboretum. She inherits Fein's responsibilities and has also been responsible for daily operations, including personnel management and the oversight of public programs.

Staff and facilities cannot be further cut back without dissolution of the Arboretum's main program structure. In view of the severe restraint with which all staff have been managing their budgets, the inability to fill needed staff vacancies and the shortage of room and capital to expand revenue generating facilities, Kowalski devoted first attention to developing predictive financial models for the next five years. All indicated a widening gap between income and expenditures, even with minimal inflation. They clearly showed, in the absence of opportunities for a capital fund drive, that assets unessential to the central mission and operations of the operation had to be divested.

The Arboretum owns thirteen residences, many of which are in need of extensive repairs following deferred maintenance. Also, land existed at the Case Estates which had not been used in recent years. Further, containerization of nursery stock has now eliminated the need for nurseries in Weston. The development of horticultural display gardens, as at Weston, is not part of the Arboretum's mission as an institution allied to a university department of theoretical biology. However, it has always been our hope that another institution with such interests might be interested in developing such a public amenity at the Case Estates.

In the meantime, immediate steps have been taken to sell an unused thirty-eight acre field at the Case Estates and one residence, also in Weston. The net sale value has been reinvested into the Arnold Arboretum endowment, but will not fully make up lost income.

Further divestment is therefore called for, and Ms. Kowalski is investigating options regarding other residences, and for alternative uses for the Case Estates. The remaining nursery material is meanwhile being consolidated or propagated prior to transfer to Jamaica Plain.

These options were presented at the March 1986 meeting of the Arnold Arboretum Executive Committee with the request for permission to launch a capital fund drive which would address the need for additional long term operating support and the construction of a Regional Wet Lab facility, the case for which was summarized in the introduction to my annual report for fiscal year 1985. In June 1986 the Executive Committee responded that the Arboretum should proceed with the divestment described, and that limited approval for fund-raising for the Wet Lab would be given pending the presentation of a revised five-year financial plan.

Productive discussions were held with colleagues from Boston University, University of Massachusetts, University of New Hampshire, Northeastern University, and Wellesley College concerning the development of the proposed service laboratory in Jamaica Plain. Letters of support were also received from Brown University and Yale University. Number of meetings were held to plan for the development of the facility. A program was developed analyzing space and equipment needs. Harvard's Planning Group provided a cost analysis. This was presented to the Executive Committee at the March meeting.

To bolster some of the Arboretum's financial resources, Ms. Kowalski prepared grant proposals for the Institute for Museum Services, the National Science Foundation, the Massachusetts Council for the Arts and Humanities, the Arts Lottery, and the Fund for the Arts. A grant of $22,200 was received from the Institute for Museum Services for new herbarium cases; $7185 from the National Science Foundation for participation in a Museum Institute for Teaching Science (see under public programs); $9250 from the Massachusetts Council for the Arts and Humanities for a bilingual school program; and $1000 from the Arts Lottery to assist our exhibition program.

Groundwork for future funding was laid during the spring with advocacy efforts for support through the capital outlay budget for the Department of Environmental Management. With the help of Senator Arthur Lewis, the Arboretum was included in Senate Bill 1836 which will fund the rehabilitation of a number of Olmsted Parks. If approved, the bill could provide up to $500,000 for long overdue repairs to the public amenities (fences, roads, water fountains, etc.) of the Arboretum. House review of this bill will take place late in the fall of 1986.Lobbying assistance was received from the Arboretum Committee, the Arboretum Associates, and a number of volunteers and supporters.

The Boston Natural Areas Fund, a not-for-profit institution dedicated to the support of the Boston public parks, has expressed interest in establishing an endowment for the purpose of assisting the Arnold Arboretum as a public asset. Gifts are sought to build a fund which, on application of the Director, will be used to offset road, bridge, gate, wall, and fence maintenance, and all ornamental (as opposed to scientific) aspects of the Arboretum plantings at Jamaica Plain. Legal documents were reviewed, pamphlets were written, and guidelines were established separating Boston Natural Areas Fund's efforts from those of the Arnold Arboretum.

A $20,000 gift was received from John Morss as a memorial to his wife, Jane Morss, for the purchase of a new computer system. A computer survey was completed for all departments

in the Arboretum. Dr. Kerry Walter from the Center for Plant Conservation assisted us in designing an appropriate system and in reviewing bids from two computer companies. An IBM networking system was selected to meet the needs of linking and computerizing collections records files at Jamaica Plain. A cable connection is planned to link the greenhouse to the main file at the Visitor Center. The system will also provide the Arboretum with the capability of linking up with other botanical collections throughout the world.

ADMINISTRATION

The Raytheon company made a gift of office furniture, including chairs, a desk, and filing cabinets, a bookshelf and locker system. To raise public visibility and increase income sources, a number of steps were taken to make the Arboretum more accessible to the public. The facilities and grounds were reviewed by the staff to determine potential sites for public functions. Outdoor sites were approved, and a new functions program was developed. This resulted in a substantial increase in paid functions at the Arboretum. The Visitor Center was opened on weekends to provide information for visitors. It resulted in a dramatic increase in gift shop sales. Vendors were brought in for public events, particularly for Lilac Sunday. New signs were placed on donations barrels. Each of these steps helped to increase earned income.

Barry Carlton, Financial Assistant in the Business Office, terminated on December 6, 1985. Jacqueline Jamieson was hired to fill the position of Accounting Assistant IV as of February 2, 1986.

RESEARCH AND INSTRUCTION

Temperate Asia

Dr. David Boufford, Assistant Director for Collections of the Harvard University Herbaria and Research Taxonomist, has taken charge of Arnold Arboretum projects in temperate Asia, notably the China program.

With Dr. Bruce Bartholemew, Arnold Arboretum Associate and Curator of Botany at the California Academy of Sciences, Boufford visited Bhutan during March and April 1986 to inventory the flora in the middle altitude forests. The vegetation of most of the country, except near the border with India and in the flatter valleys, has remained remarkably well preserved, and especially at mid to low elevations. These forests are thought to be similar to those which once existed in Yunnan Province in southwestern China at the same elevations. Accelerating deforestation gave particular urgency to the expedition. Supported by the National Geographic Society, visits were made to sites near Thimphu, Wangdiphodrang, Shemgang, Phuntsholing, and Tongsa. Despite problems in obtaining permits, about 250 collections were made.

Arriving June 1985, Professor Tsun-shen Ying, Institute of Botany, Peking, has spent a year working with Boufford towards a revision of Mahonia (*Berberidaceae*), preliminary to treating *Berberidaceae* for the Flora of China with support from the National Science Foundation. Access to much new material both at the Arboretum and in Chinese herbaria

necessitated a broader species concept, and led to significant reductions in the local endemism recognized in the previous treatment. While at the Arboretum, Ying was also able to examine critical material of Berberis. During the same period, Professor Li Hsi-wen, Director of the herbarium of the Institute of Botany, Kunming, was at the Arboretum to examine material of *Labiatae*, also for the Flora of China Project.

As part of this same exchange which is funded by the National Science Foundation, Bartholemew and Dr. Leslie Landrum accompanied the two Chinese botanists on a six-week collecting trip to Mexico. In March, Bartholemew visited western Yunnan at the invitation of the Chinese Academy of Sciences in order to study wild populations of Camellia reticulata.

Dr. Stephen Spongberg, curatorial taxonomist, continues his research on Asian Sorbus. He presented a lecture on results to date at the University of North Carolina in February.

George Staples, a graduate student advised by Professor Richard A. Howard, received a Doctoral Dissertation Improvement Grant from the National Science Foundation in order to visit Asia in connection with his work on the genus Porana and other Convolvulaceae. Staples visited the herbaria at Calcutta, Kathmandu, Bangkok, Rangoon and six cities in China, as well as field sites. He returned with seed and cuttings for propagation, and a sizeable herbarium collection.

The herbarium received plant material from Arnold Arboretum Associate, Professor Hiroyoshi Ohashi, Tohoku University, Japan, who has been leading annual expeditions to Taiwan. He continues his revision of the Leguminosae of that island.

Dr. Hu Shiu-Ying, retired staff member, is concentrating on studies of Chinese ethnobotany. This year she completed a comprehensive manuscript on Chinese food plants for Arnoldia which includes information on cultivation, processing including fermentation, detoxification and pickling, as well as on special health foods (Pupien). Dr. Hu is becoming widely known as an authority in Chinese foodstuffs and medicines, and has been responding to an increasing number of questions from importers and users throughout the country. Dr. Hu continues unstintingly to provide food, shelter and wisdom to our many visitors from China.

The Arnold Arboretum cosponsored lectures on botanical exploration in China for the China exhibit at the Boston Museum of Science. Dr. Boufford and Spongberg were the speakers.

Tropical Asia

During the summer of 1985 Professor Peter Ashton was in peninsular Malaysia and Sri Lanka, initiating separate research programs. In collaboration with the Forest Research Institute, Malaysia, and with major funding from it as well as from the National Science Foundation, the Smithsonian Institution, UNESCO, and the Conservation, Food, and Health Foundation, tree demographic research has begun at Pasoh Forest, Negeri Sembilan. Jointly conceived with Professor Stephen Hubbell, University of Iowa, and managed in the field by Arnold Arboretum Associate N. Manokaran, F.R.I.M., and Geoffry Klahn, a 50 hectare forest sample is being laid out which will allow direct comparisons with a similar sample already

established in the new world at the Smithsonian Tropical Research Station, Panama. The performance and fate of the trees in the two samples will be followed in order to resolve a central paradox in tropical forest ecology: how so very many different species, of remarkably similar form, coexist in apparent equilibrium in a uniform habitat. The results will increase our understanding of the stability of artificial tree plantations in the tropics and hence have implications for plantation design and management. They will also allow a more rigorous approach to silvicultural management of natural forest for exploitation, as well as for conservation.

With funding from the National Science Foundation and the Sarawak Forest Department, Arboretum Associate Professor Richard Primack, Boston University, has begun research into the comparative demography of tropical trees growing in populations of contrasting density. Ashton is coinvestigator of this project, and the field work is being carried out by staff of the Sarawak Forest Department and graduate student Pamela Hall. This research, which complements that at Pasoh, is based on a set of three forest samples laid out by Ashton in 1966 on contrasting soils in lowland Sarawak, and subsequently remeasured at five-year intervals by the Sarawak Forest Department.

This year, Ashton was also able to draft three papers which synthesize results of previous work on these and other plots in Sarawak. The papers describe patterns of floristicvariation, variation in structure and dynamics, and variation in species richness respectively. Primack, who had earlier spent two years in Sarawak undertaking research into trees in the breadfruit family (*Moraceae*) native to forests there with support from a grant to Ashton from USDA, published the results of this work during the year.

In Sri Lanka, Ashton is cooperating with Professors C.V. S. and I. A. U. N. Gunatilleke, University of Peradeniya, and Arnold Arboretum Associate K. S. Bawa, University of Massachusetts, in research into the reproductive biology and population biology of certain wild forest plants which are nevertheless important in the rural economy. The aim is to provide basic information necessary for their introduction into cultivation in the planted buffer zones which surround the remaining rain forests, and thus to reduce pressure on the wild populations. The plants under investigation are Coscinium fenestratum (*Menispermaceae*), a medicinal, Caryotaurens, a sugar palm, Elatteria ensal, a condiment, and the timber trees Vateria copallifera and Shorea (Doona) species. The research is funded by USAID.

Steven Rogstad, graduate student advised by Ashton, is completing his thesis dissertation on the systematics and ecology of the hypoleuca species series in Polyalthia (*Annonaceae*), forest trees of the Far East. Rogstad's research attempts to understand the bases of tree species richness in tropical forests by examining the interactions of co-occurring closely related species. He has shown that, though these trees are indistinguishable on foliage characters in the herbarium, they are readily recognizable in the field by their size, bark, and reproductive behavior. Though up to three species can co-occur in a forest, they manifest pronounced, non-overlapping differences in ecology.

Another of Ashton's graduate students, Alex Moad, was this year awarded a Fulbright Scholarship to investigate the demography and physiological ecology of seedlings of certain timber trees in the genus Shorea (*Dipterocarpaceae*) in Sabah, East Malaysia. Plants were brought to Harvard at year's end for experimentation in controlled environments.

During the year, Ashton organized a symposium on biological diversity and development on behalf of the State Department at the ASEAN Science and Technology Week held in Kuala Lumpur, Malaysia, April 1986. He is serving on a panel convened by the American Association for the Advancement of Science to identify major future areas for new research funding by the National Science Foundation. He serves on the Plants Advisory Group of the International Union for the Conservation of Nature, and on the advisory committee for a new rain forest exhibit being sponsored by the Smithsonian Institution Traveling Exhibition Service.

Professor Peter F. Stevens continues monographic research in Asian Clusiaceae. During a trip to Europe in 1985 additional specimens of particular importance were checked; full descriptions have been written for all species in Mesua (including Kayea), as well as most taxa of Mammeaoutside Madagascar, and a key to them prepared. With the assistance of research assistant James Albright, anatomical studies on all taxa of Mesua in the broad sense, most species of Mammea from outside Madagascar, as well as a representative sample of many other genera in the Guttiferae have been carried out. The focus has been on features of the anatomy of leaf and young stem.

In the course of work on Mesua, it became ever more apparent that there were two main elements in the genus, but it was ever less apparent that those two elements shared a common and immediate evolutionary origin. In order to resolve this problem, an extensive survey of all features of the Guttiferae and Bonnetiaceae is underway. The units of study are genera or their subdivisions. Some new generic subdivisions, and transfer of species to different genera are needed to avoid working with taxa of unrelated or mixed origin. It is already clear that the current classification of these plants neither suggests the probable final hypothesis of phylogeny, nor is of much predictive or other use.

Stevens visited London and Geneva in connection with his research into the history of systematics. In London he consulted early literature of George Bentham, in Geneva correspondence between Alphonse de Cendolle and A. L. de Jussieu.

The Americas

The Generic Flora of the Southeastern United States is currently supported by two, three-year, National Science Foundation grants. One, with Professor Carroll Wood as principal investigator, is paired with another with the same title and goals with Dr. Norton Miller, New York State Biological Survey, Albany, as principal investigator. With the pair of grants the Generic Flora is funded for two postdoctoral research associates in Cambridge, and for another two in Albany. The second grant also includes funds for the Albany researchers to visit Cambridge twice a year.

The fiscal year began with Dr. George K. Rogers and Dr. Ihsan Al-Shehbaz as research associates in Cambridge and with Mrs. Barbara Nimblett as part-time secretary and jack of-all-trades. Dr. Rogers, who had worked on the Generic Flora project for almost four years, left the project in August 1985 to become Horticultural Taxonomist at the Missouri Botanical Garden. He is continuing to collaborate on the Flora in his new position. Dr. Thomas J. Rosatti continued through the year with Dr. Miller in Albany, and Dr. Gordon Tucker joined him in July 1985. Both men worked at the Harvard Herbaria for a week in the fall and another in the spring; Dr. Miller was able to spend a week working on the Meliaceae in Cambridge.

During the year Dr. Al-Shehbaz continued research onthe tribes of Cruciferae (*Brassicaceae*), Dr. Rogers made substantial progress on the Rubiaceae (continued at the Missouri Botanical Garden), and Dr. Wood continued on the Buxaceae (with Dr. R. B. Channell, of Vanderbilt University), the Haloragaceae, and the subfamily Faboideae of the Leguminosae (Fabaceae). With monies freed by the University of the State of New York, Dr. Miller invited Dr. Robert B. Haynes, of the University of Alabama, to spend a week in June in Albany and another in Cambridge with Dr. Wood to complete work on the family Zanichelliaceae for the Generic Flora and to do much of the library and herbarium work associated with the family Hydrocharitaceae.

Treatments of the genera of Loganiaceae (by Rogers), the genera of the tribe Brassiceae (*Cruciferae*) (by Al Shehbaz), and the genera of Sphenocleaceae and Campanulaceae (by Rosatti) were published in the *Journal of the Arnold Arboretum*. At the end of fiscal year 1985, Dr. Al-Shehbaz's genera of the Lepidieae (*Cruciferae*) published in July 1986), Dr. Tucker's genera of the Elatinaceae (to be published October 1986), and Dr. Rosatti's genera of the Elatinaceae (to be published January 1987) were in press in the *Journal*. These bring “the number of Generic Flora papers to 113. All of these have been edited by Dr. Wood; and all of those prepared since Dr. Millker joined the Flora project have been edited by both Wood and Miller.

Additions have routinely been made to the reference files and to those of journals cited in the Generic Flora papers. Mrs. Nimblett is in the process of putting into computer memory the entire list of abbreviations used for journals cited in the Flora. A proposal to prepare a Flora of North America, prepared by Dr. Nancy Moran of Missouri Botanical Garden, failed to gain funding from the National Science Foundation. Funding to begin the project will now be sought from private sources. Dr. David Boufford will serve as regional coordinator and taxon editor for the project. Despite the lack of funding, a commitment has been made by several workers to prepare treatments for all of the gymnosperms in North America. These treatments would constitute a first volume of the Flora.

Continuing his work to produce a treatment of the Urticaceae for North America Dr. Boufford travelled to Washington, Philadelphia, and New York in January to examine specimens and to record distributions. He attended the Annual Systematics Symposium in St. Louis and remained therefor several days to examine the North American Urticaceae in the Missouri Botanical Garden Herbarium. The illustrations of all of these taxa have been prepared by Mr. C. Z. Ji of the Institute of Botany, Beijing, while Boufford completed the descriptions and keys. Additional specimens from the central United States and from all of Canada will have to be examined to complete distribution records.

Since January 1986 Boufford has served as an Associate Editor of Rhodora, the journal of the New England Botanical Club. Boufford with Ms. Emily Wood, Curatorial Assistant, went on several field trips to less well collected parts of New England to search for extensions in distribution of New England plants, and to collect exchange material for the Harvard Herbaria.

Professor Richard A. Howard has completed the manuscript for volume 4 of his Flora of the Lesser Antilles, with help from Dr. Elizabeth Kellogg, post-doctoral fellow, and George Staples, project assistant. Work on volume 5 is also proceeding.

Professor Howard is also preparing floristic treatments of *Polygonaceae* and *Icacinaceae* for the Flora of Venezuela, Flora Meso-americana, Flora of the Guyana Highlands, and for the Flora of Nicaragua for which the manuscript is completed.

With Dr. Kellogg, a manuscript was completed on the Flora of Anguilla in the Lesser Antilles, which has been submitted for publication in the Journal of the Arnold Arboretum.

Professor Howard is collaborating with Ms. Iris Bannochie to prepare a book entitled Gardening in the Carribbean and other Tropical Countries. This year he has acted as consultant to the Netherlands Antilles government of Aruba for the establishment of a botanical garden, and has continued to investigate revegetation of a strip mined area in Hawaii in collaboration with the Pacific Tropical Botanical Garden.

Elizabeth A. Taylor, graduate student advised by Professor Stevens, is proceeding towards completion of her revision of Sterculia in the New World. Anna L. Weitzman, also advised by Stevens, is completing a revision of Fraziera (*Theaceae*), a genus which has proven to be more speciose than formerly thought: some 50 taxa are now recognized of which 15 are being described for the first time.

Dr. Bernice G. Schubert, retired Senior Lecturer on the staff of the Arnold Arboretum, has a manuscript on the genus Desmodium, on which she has been collaborating with Professor Rogers McVaugh, in press. She is currently completing a manuscript for treatment of the same genus for the Flora of Ceylon, and for the Flora of Nicaragua. The Dioscoriaceae and Begoniaceae of Central America continue to be of interest to her.

Ms. Emily Goldblatt, Arboretum Associate, has begun gathering materials for a biography of Wilson Popenoe, the celebrated plant explorer, agricultural research botanist and educator of Central America. His life story, dedicated to the diversification of tropical plantation agriculture and to the education of young agricultural botanists in the Neotropics, is particularly apposite at the present time when the dangers of loss of ancient cultivars and species alike have become acute.

Developmental Biochemistry and Physiology

Progress in understanding the hormonal (cytokinin) regulation of plant growth and development has been especially rapid during the last year in the experimental laboratory of Professor John Einset at the living collections in Jamaica Plain. On the basis of biochemical research with Actinidia, he has proposed a synthetic pathway to describe the mechanism of cytokinin production in flowering plants.

Understanding exactly how plants produce cytokinins is fundamental for devising new ways to use them to regulate growth, either by chemical or genetic methods. This knowledge is

also helping Einset to answer an additional important question about hormones and plants, namely, location of cytokinin production in plant organs and tissues.

In view of the crucial role of cytokinin in micropropagation, Einset's biochemical results provide a powerful, theoretical framework that guides his tissue culture research. Einset believes that as more is learned about the scientific basis of micropropagation, the technology will become feasible with an ever wider spectrum of species. Moreover, improved understanding means that problems become amenable to logical procedures for solution.

The most important advance during the last year has involved the determination of the critical cytokinin concentration for growth of Actinidia shoots. Not only do these studies confirm, for the first time, the basic assumption that cytokinin treatments elevate internal plant hormone levels, but they set the stage for research to explain why certain plants fail to respond in tissue cultures. Are negative species, for example, able to generate a critical cytokinin concentration within their stems? If they are not, is it because of poor cytokininuptake or transport, or are these plants especially active in destroying cytokinin? Answers to these deceptively simple but crucial questions about micropropagation will advance further our knowledge of the scientific basis underlying the technology.

The Wood Laboratory

The past year witnessed juxtaposition of growth and stagnation at the Bailey-Wetmore Laboratory. Major changes were the addition of new equipment and the understandable but unfortunate reduction of Professor Emeritus Ralph Wetmore's appearances to weekly intervals.

Dr. George Rogers and Mark Skinner used the facility for embedding and sectioning plant material; Mr. Skinner's anatomical work is part of his dissertation research. Dr. David Michener, Research Associate on the Arboretum staff, continued his work on wood anatomy of Scrophulariaceae and saw another technical article into press. Other graduate students and visiting workers have used the facilities on projects as diverse as sectioning of spider spinarettes and the identification of sub-fossilized woods of Juglandaceae from archaeological sites associated with the Statue of Liberty.

The equipment in the lab was substantially upgraded thanks to a grant from the National Science Foundation to Professor Barry Tomlinson. New equipment included a Zeissmicroscope with camera, camera lucida, and ultraviolet attachments; two new compound microscopes; a knife sharpener; and a rotary microtome. Older lab equipment and supplies continue to appear and to be consolidated with the current materials. Stagnation is evident in the budget and curatorial care. Both are at a skeletal level. The volunteer who had been working with the collection has moved out-of-state. Before a new volunteer is recruited the staffing needs of the collection need to be addressed: volunteers need supervision and there is at present no permanent Arboretum staff to oversee such a volunteer.

Instruction

This year Professor Ashton taught Biology 147: Biogeography, in collaboration with Professor Rolla Tryon.

Professor John Einset offered Biology 166: Plant Growth and Development, in the spring; in the same semester he also contributed two weeks of lectures to Professor Lawrence Bogorad's Biology 11: Plant Physiology, and cotaught a freshmen seminar on plant propagation with Professor John Torrey.

Professor Carroll Wood taught Biology 18: Diversity in the Plant Kingdom in collaboration with Professors Donald Pfister and Nicholas Welschmeyer, in which Professor Richard Howard also offered guest lectures.

Professor Peter Stevens taught Biology 148: Systematic Biology, with Professor Melanie Stiassny. This course is now under review, with the possibility of offering a broader tween-level course on the same subject in the future.

THE HERBARIA

It is well appreciated that, as the population of the developing world continues to increase, the native vegetation and flora of these regions will rapidly disappear. Nowhere is this process more advanced than in the ancient countries of the Far East. It is not alarmist to anticipate the disappearance of all but a few pockets of native vegetation from Indo-Burma and the Philippines within the next twenty years, and the confinement of natural ecosystems to sanctuaries, nature preserves, and parks in China, Malaysia, and Indonesia (with the possible exception of New Guinea) within the next fifty years. Yet, whereas the organization of a data base through plant collecting has increased four fold in the developing countries of the New World over the last two decades, it has actually declined in Asia. The herbaria of the Arnold Arboretum hold the leading collection of Asian plant material in this country. This institution has a particular responsibility therefore to ensure that knowledge is not unnecessarily lost through extinction before material is gathered for research.

Currently, less than 10,000 new accessions are being received by the herbaria of the Arnold Arboretum each year. Even if this number was increased to 50,000 for the next twenty years, which represents approximately what would be needed to complete a reasonable inventory of the plant resources of the Far East while the opportunity exists, the current building could accommodate the intake and have space still remaining afterwards.

Even with our present inadequate efforts to meet the need for plant inventory, the greatest problem continues to lie with the backlog of specimens awaiting mounting. Until specimens are mounted they are essentially unavailable for any kind of use. The insertion of newly mounted specimens is more or less dependent on the availability of Work Study students and the pressures of other herbarium duties. Nevertheless before they are stored to await insertion, mounted specimens are still sorted by our curatorial staff into smaller groups of closely related families, or into several of the larger families, making it relatively easy to retrieve particular genera at this stage of processing them. The 22,696 sheets received on exchange, through staff collections, and as gifts were 2561 sheets more than the number of sheets mounted. Although this figure is much lower than in previous years, it still means that essentially none of the material in the 42 cases of specimens awaiting mounting from previous years were touched. If, as estimated, each herbarium case holds around2500 specimens, it would take one additional full time technician over 11 years to eliminate the backlog. This is assuming that no additional material is added to the backlog each year. Although volunteers

are making a considerable contribution it cannot be expected that they will be able to make a significant dent in the backlog. There is an urgent need for one additional full time preparator.

During this fiscal year, the exchange material remaining in Jamaica Plain and in Cambridge was distributed. This at last completes the distribution of the large sets of Chinese material collected during the late 1930s and early 1940s as well as the majority of miscellaneous lots which were stored in Cambridge. Currently, only small sets remain to be processed, and the amount of quality exchange material these sets will yield is questionable. The New England Botanical Club is now in the process of removing duplicate material from its holdings and some of these can be used for exchange, but again, the material must be checked to see that it is labeled and of reasonable quality. With the exception of these small lots, future exchange activity will be dependent upon the collections that staff can generate each year.

This year, over 35% of our exchange accessions were from Eastern Asia. Also of note this year are the shipments of cultivated plants, all of which were generated by the Arboretum's Verification Project.

As indicated in the summary sheet, over 26,000specimens were received this year as outright gifts; the large majority of these came from the Clark University Herbarium in Worcester, Massachusetts. Much of the work needed to accession these specimens was completed in the last fiscal year, but they, along with the Bang and Rusby material from Wellesley College in Wellesley, Massachusetts are now being inserted into the collection.

Gifts for determination sent to specialists at other institutions again primarily represent collections from the Arboretum's Verification Project. Those received were directed mostly to Drs. Howard, Schubert, and Anna Weitzman and Liz Taylor, with fewer to other faculty, staff, and students.

We are once again keeping a reasonable pace with insertion of mounted specimens with the help of Work Study summer staff member Harry Tsomides. As mentioned earlier, the incorporation of the Wellesley College and Clark University material is well under way; however, because of older names on much of the material, progress is sometimes slow. Both herbaria contain a significant number of type specimens as well, requiring segregation and annotation.

Dr. Boufford continued to search out type specimens of Crataegus and to annotate them with the basionym, author, type status, and place of publication. These are filed alphabetically by basionym in Jamaica Plain for the time being, but once all of the Crataegus types have been located they will be moved to Cambridge. Six hundred forty two type specimens in this genus were annotated during the 1985-86fiscal year; the total number annotated to date is 1319.During the coming year some time will be spent entering the information from the Crataegus types into a data base on the Digital Rainbow computer for eventual publication.

Allan Bornstein joined the staff in September 1985 as the first Herbarium intern. During the internship Allan took part in all herbarium activities to gain experience in herbarium curation and management. As a special project he took on the curation of the Piperaceae, working partly on are conciliation of the many herbarium names generated by Trelease and Yuncker, partly on bringing the nomenclature and identification of specimens up to date, and partly on the preparation of a computerized data base of the types of Piperaceae in the Harvard Herbaria. Bornstein hopes to have available a computerized list of all of the Piperaceae types

within the next few months. The Piperaceae will then be among the best curated families of plants in the Harvard Herbaria. We intend that work on identifying types in the Harvard Herbaria can continue in this way, through the efforts of the Herbarium Intern, and that we can continue to make available lists of the known types to the botanical community.

Professor Howard continues actively to identify our material from the West Indies, including the retrieval and curation of the hitherto unrecognized type specimens.

Professor Ashton is similarly curating the dipterocarp collection, a task that will be completed in the coming year with a complete identification list for publication.

As time permitted, work continued on the annotation of cited specimens in Irwin and Barneby's treatment of the Cassiinae (*Leguminosae*). Over 500 sheets were annotated, including over 20 types.

A data base was created to accommodate the current exchange activities of the herbaria, and another for miscellaneous transactions including gifts, gifts for determination, staff collections, special exchanges, and subsidies. Since the ledgers must still be maintained as a written record of these transactions, no effort is being made to put past transactions on the computer. The computerization of current activity, however, will certainly facilitate curation of new material and transactions with other institutions.

With the completion of the computerization of exchanges, all current herbarium records are now computerized. Addresses of many of the world's herbaria are stored in a mailmerge and loan and exchange forms, address labels, and letters can easily be generated. A Digital letter quality printer is now associated with the Herbaria computer and is being used to produce high quality forms and letters.

The Arnold Arboretum Associates provided $1,200 from the proceeds of the Arboretum's plant sale and auction to convert the plant drier in the basement from steam heat to electricity. Bids were accepted during the spring and a contract has been given out. Asbestos insulation around the old steam pipes has been removed, and only the wiring remains to be done to make the drier operational during the collecting season.

The condition of the herbarium cases on the fourth floor of the herbarium of cultivated plants at the Hunnewell Building in Jamaica Plain received attention this year because an infestation of beetles reappeared. Specimens in many of the cases that had been infested previously had new damage and evidence of insects, and many cases that had previously been insect free were also infested. The contents of over 20 cases were bagged and frozen. Despite precautions and the anticipated purchase of a microwave oven to deal with future infestations, new cases for the fourth floor in Jamaica Plain are clearly needed.

TABLE 1

Statistics for the Arnold Arboretum Herbaria

Fiscal Year 1986

Accessions

Specimens received during the year:	
By exchange	10,443
As gifts	665
In exchange for identification	659
Special exchange	352
Subsidy	835
Staff collections	8,073
Total accessions	21,027
Provenance of accessions:	
United States and Canada	3,339
Rest of New World	2,454
Subtotal	5,793
Temperate East Asia	9,028
India	1,455
Western Malesia	1,916
Papuasia	131
Philippines	1,303
Subtotal	13,833
Polynesia and New Caledonia	846
Australia	171
Africa	2
Europe	482

Processing	
Number of sheets:	
Through mounting:	
Cambridge	5,047
Jamaica Plain	7,899
Total	12,946
Through direct incorporation	182
Number of sheets incorporated:	
Cambridge	13,128
Jamaica Plain	1,307
Total	14,430
Number of sheets removed:	
Cambridge	52
Jamaica Plain	72
Total	124
Number of sheets repaired:	
Cambridge	366
Jamaica Plain	55
Combined total	421
Inventory	June 30, 1986
Number of sheets in herbaria	1,167,068
Number of sheets in cultivated herbarium	175,426
Service	
Number of sheets sent out:	

On exchange	11,887
As gifts	913
For identification	1,658
Loans sent out	29,246*
Loans returned	19,960
Total number of orchid specimens placed on indefinite deposit in the Oakes Ames Orchid Herbarium	94

*Combined figure with Gray Herbarium

Due to their being moved several years ago and also to settling of the building, many of the old cases, which are fastened in groups of 10 to 12, are warped and doors do not close tightly. A proposal for a matching conservation grant to the Institute for Museum Services for the purchase of 80 new herbarium cases has been funded. New cases will be installed during the winter of 1986-87.

In September 1985 Amy Eisenberg joined the Jamaica Plain staff as Herbarium Technician. She trained with Zepur Elmayan and Edith Hollender for two weeks in Cambridge, and then came to Jamaica Plain full time to mount specimens for the Arnold Arboretum. Ms. Eisenberg also assists in overseeing volunteers.

In addition, since November 1985 there have been 10 to12 volunteer mounting specimens each week in Jamaica Plain. Together, the volunteer technicians have mounted the equivalent number of specimens of one full time person working for 4.35 months. This year they mounted 2137sheets, including most of the 1778 verification project specimens that were ready for mounting. They have become an indispensable and very much appreciated group of workers.

A Herbarium Open House on May 8, 1986 was the major event of the year and an outstanding success. Approximately400 curious, highly interested and enthusiastic Friends of the Arnold Arboretum, Friends of the Farlow, members of the New England Botanical Club, and members of the Harvard community took advantage of the opportunity to explore Harvard's wealth of botanical resources. Through prepared exhibits visitors were also able to observe staff research, botanical illustration, the preparation of botanical specimens, some of the botanical history of the Harvard Herbaria, the routes of past and present botanical exploration, the beauty of the plant world as exhibited by microscopic ferns spores, and the diversity of orchid flowers. Although everyone played a major part in making the evening such a complete

success, Ida Hay, Betsy Shaw, Nan Sinton, and Emily Wood deserve special credit for the many hours of preparation that they put into organization and publicity. It was generally agreed that the Open House should be held again.

LIVING COLLECTIONS

In spite of the extra work resulting from the depredation of hurricane Gloria, good progress has been made with the Bradley Rosaceae collection, with the improvement of the pathway system and, most notably, with the verification of plant names and the record keeping which are basic to the satisfactory curation of a living botanical collection.

This was the last full year of current funding from the National Science Foundation for the verification of the collections. Priorities were therefore focused on completing tasks underway, lest further funding is not obtained. A proposal for the third and last phase of the project was submitted by year's end. One thousand four hundred twenty five accessions were vouchered, during which 962 records anomalies were brought to light. One thousand seven hundred seventy eight specimens were transmitted to the herbaria for incorporation; 1850 were sent as gifts to specialists in exchange for verification, and 2645duplicates were sent in exchange to other herbaria.

Dr. David Michener, Curatorial taxonomist responsible for executing this project, was personally able to verify most Fabaceae, Chamaecyparis, and Ulmus during the period. He spent much time in voucher label preparation, which requires evaluation of accession records and tracing of lineages among repropagated material, interpretation of previous labels and field notes, and re-checking of the literature. Ms. Sandi Elsik continued her very successful voucher collecting program with the assistance of a team of more than thirty trained volunteers. Special mention is due to Dr. Richard Warren, Arboretum Associate and honorary Curator of the Conifer Collection, who was instrumental in the collection of 885 vouchers from the conifer collection, and in the verification of 233 plants in the genera Larix, Picea, and Pinus, besides Chamaecyparis in which he aided Michener.

The third phase of the verification project, if funded, is aimed both to complete the verification of all taxa found in nature and growing in the Arboretum's collections, and to draft a curatorial manual for living scientific plant collections, for which there is currently a major worldwide need.

The work of the verification project has inevitably required extensive checking and revision of the existing records and maps. This activity, plus the effects of the hurricane and the sale of land at the Case Estates, have led to an unprecedented number of records alterations and deletions. This combined with an exceptional 674 new accessions to the permanent collections to make one of the busiest years that the plant records office, under Curatorial Assistant Jennifer Hicks, has witnessed.

Thanks to a gift from John Morss in memory of his wife, the late Jane Morss who was an Arboretum Associate and loyal volunteer, the Arboretum has acquired an IBM-based computer system to serve plant records as well as other functions. It will be linked with a terminal at the greenhouses to facilitate integration of our former three independent records systems. Dr. Kerry Walter, Center for Plant Conservation, has served as consultant with Hicks and other staff to develop appropriate software, compatible with that of other collaborating institutions, to meet the Arboretum's internal needs.

A new format for reduced-size maps, for use on the grounds, was prepared and distributed in 1986. It has proved less cumbersome and has increased ease of plant location.

Interns Elaine Jones and Ricardo Austrich completed field checking of two map areas on Peters Hill and new maps for these areas, last checked in 1969 and 1970, have been made. Three existing maps have been revised along the Willow Path with assistance from volunteers Nell Walker and Bob Seigel. Intern Ethan Johnson has been responsible for mapping the new Rosaceae beds as they have been developed; ten beds, each with a separate map, are now completed. Field checking of records for five other map areas was also undertaken.

The new computer has the capability for automatic drafting and updating of map records. Replacement of the printed display labels with metal photo plates continues, but has been found to be slow to implement than with the former. A replacement of the wooden shrub labels is still being sought, while a standing label for use in the shrub collection is being tested.

In the collections, major plantings continue to concentrate in Rosaceae, where subfamily Rosoideae is now almost completely planted out into the Bradley collection. A start has been made in other sections, including a substantial number in Spiraeoideae.

Hurricane Gloria represented over one thousand man hours of extra work, lasting through May 1986. With the exception of stump removal all was accomplished by our own staff. Thanks to pruners Jim Nickerson and Mark Walkama the immediate task of pruning or taking down damaged trees was quickly accomplished. In all, 100 trees were removed, while minor damage was extensive. For the fourth continuous year some 30 to 40 declining lilacs had to be removed. Though major repropagation has been carried out, none of the new plants will be planted out until means have been found to fund major restoration of this celebrated collection, beloved of the public.

This spring witnessed the planting out, through the collections, of more than 600 trees, shrubs, and vines, one of the largest single new plantings in recent years. Among these plantings were the first of our accessions of threatened U.S. species, acquired by us as members of a national consortium of seventeen gardens under the aegis of the Center for Plant Conservation which is headquartered in our Hunnewell Building. The aim is to bring population samples of all three thousand rare and endangered species of the United States into cultivation ex situ for purposes of research and education. The Arboretum already holds individual specimens of twenty-six of these. During the year, and with financial support from-the Center

for Plant Conservation, population samples of thirteen were collected by Assistant Propagator Rob Nicholson from the southern Appalachians and successfully propagated. Thirty sites were visited by him and 151 collections of other plant material of interest were made. Two hundred eighty four seed packets were distributed to botanical gardens here and overseas. Meanwhile, Arboretum Associate Julie E. M. McGeoch has continued efforts to gain material of hardy rare and endangered woody plants from other regions of the temperate world. This year, she has searched for sources in Japan and North Korea, from whence she has requested accessions representing seven and twenty three taxa respectively.

In order to gain better access to remote sections of the Arboretum with machinery, and to encourage the public to visit sections further from the asphalt road system, major improvements to the grass and gravel path system have been implemented. Sargent trail, a two mile, closed loop around the main block of the Arboretum, beginning at the Hunnewell Visitors Center, was planned and laid out by Managing Horticulturist Gary Koller. Signs designed to clearly mark the trail were designed and printed onto metalphoto and stationed along the trail. Funds for the trail markers were provided by the Arnold Arboretum Associates. On Thursday, August 1, 1985, however, the Arboretum received four inches of rain within a 24-hour period (the second heaviest 24-hourrain accumulation recorded for the Boston Area). This resulted in major washouts of newly installed gravel. Owing to lack of manpower repairs have yet to be undertaken. In addition, during 1985 a permanent walkway from the Arboretum across Stony Brook Marsh was built as a direct link to the new Forest Hills subway station. This work was designed and implemented with the help of the Boston Natural Areas Fund and Continental Construction Company. In addition, the company set a ring of granite blocks around the summit of Peters Hill which now serve as seats and a barrier against vehicles.

A casualty of the August 6 rainstorm was one of the Olmsted bridges over Bussey Brook, which has been temporarily repaired until major restoration funding is sought for the physical structures of the Arboretum. This year one backhoe was replaced by a new front end loader/back hoe for use at Jamaica Plain. Statistics for the propagation department have been tabulated. In addition, a gift of sixteen taxa were propagated and donated to the Sino-American Friendship Garden at the National Botanical Garden in Beijing; seeds and plants were provided for the Eastern Region Convention of the International Plant Propagators Society in December 1985.

Horticultural research this year includes Head Plant Propagator Jack Alexander's continuing work on the breeding of lilacs resistant to mildew and leaf roll necrosis. Professors William J. Manning and William A. Feder, University of Massachusetts, collaborate with Alexander in a search for the cause of necrosis. Craig Cribben, Research Pathologist at Brooklyn Botanic Garden, has been studying witches broom disease on our lilacs, and also on our ashes (which are in the same family). Both are attributed to a mycoplasma-like organism which is not highly infectious but which requires removal of infected plants.

Research at the propagation department has led to a successful method of propagating the elegant, but rare, endangered and refractory Appalachian shrub *Hudsonia montana* for the first time.

Assistant propagator Rob Nicholson has continued his studies of the dormancy requirements of Ostrya species (hop hornbeams). Assistant Propagator Peter Del Tredici has devised procedures for rooting cuttings and germinating seeds of *Heptacodium jasminoides*, a magnificent shrub introduced into cultivation in the West from China by Curatorial Taxonomist Dr. Stephen Spongberg in 1980. DelTredici continues also to work on ecotypic variation, notably in cold hardiness, in the widespread North American tree Prunis serotina, and has devised a means of vegetative propagation of a handsome fastigiate genotype of *Pinus cembra*, collected wild in Turkey.

Dr. Spongberg with Dr. Howard continues to keep the Rehder Card Index to the bibliography of cultivated wood plants hardy in North America current. He also continues to serve as registrar for cultivar names at the Arboretum.

The Case Estates experienced reduced horticultural activity owing to staff illnesses and transfer. Following sale of the forty-acre field, operations have been scaled down while a plan for the Case Estates is formulated in the coming year. Presently, existing plantings are being maintained. No further nursery stock is being received. The inventory of current nursery holdings at the Case Estates is almost complete. The American Rhododendron Society has halted plans for further development of their garden pending future planning decisions.

Professor Richard Primack, Boston University, who is an Associate of the Arnold Arboretum is one of several active users of the living collections for research and instruction. This year included the third field season of a research project his is undertaking into the pollination biology of the Pink Lady's Slipper Orchid, for which he uses the large wild population at the Case Estates.

Dr. Spongberg remains as Curatorial Taxonomist for the Living Collections. Executive Director Lydia Kowalski is currently reviewing staff' structure in the Living Collections, and has assumed executive responsibility overall living collections staff for the period of review.

A number of staff changes occurred during the year. Ground staff member Charles Mackey retired after 24productive and dedicated years at Jamaica Plain. He will be remembered both for his major contribution in preparing all plant display labels over many years, and for the assiduous way in which he took on the unpopular task of keeping the grounds free of litter.

Grounds staff member Bruce Munch transferred to Jamaica Plain; and Martha Hansen has obtained a one-year maternity leave of absence. New staff include Nancy Gomez-Ibanez, who became officially appointed as part-time Events Coordinator at the Case Estates after serving in this capacity unofficially in previous years; Albert Hill who has joined the permanent

grounds staff; and James Allen who has joined on an initial one-year contract. Hill and Allen were formerly interns at the Arboretum.

We have welcomed Zhang Shih-ming, horticulturist from the Beijing Botanical Garden who departed home after two and one half years in the United States; Philip Williams, a Diploma Student from New Zealand who has spent six months working at the Case Estates at Jamaica Plain, and Mark Sparrow, a student of the Kew course in horticulture who joined the staff for three weeks as a requirement of his course program.

Patrick Willoughby, Assistant Managing Horticulturist at the Case Estates, has continued to attract outstanding volunteers to assist him. Margaret Thompson has continued to provide invaluable administrative assistance; Marie Dempsey and Barbara O'Connor have helped in innumerable ways. Claudia Strubble is completing a guide book to hardy ground covers, based on the Case Estates collection.

The Living Collections staff have been even more active in contributing public lectures both for the course program of the Arnold Arboretum and for other organizations' They have been active in the meetings of local and regional horticultural societies, and have increasingly been requested to give technical advice. Managing Horticulturist Gary Koller is a Lecturer at the Harvard Graduate School of Design where he provides a spring course for the Department of Landscape Architecture and a fall course in the Division of Professional Development. He is also instructor for a course in the Radcliffe Seminars in Landscape Design.

TABLE 2

Statistics for the Arnold Arboretum Living Collections

Fiscal Year 1986

Accessions

New accessions received into the nursery	1,178
Taxa represented in new nursery accessions	1,009

Processing

Individuals or massed single taxon groups accessioned into the permanent collections	674
Plants in the permanent collections repropagated prior to removal	276
Plants deaccessioned: missing or removed	1,395
Deaccessioned plants from which wood specimens were collected	123
Accessions representing taxa new to the permanent collections	113
Taxa occurring in nature represented in new accessions	316
Cultivars represented in new accessions	48
Total number of taxa represented in new accessions	364
Accessions readied for verification through collections of herbarium vouchers	1,425
Label replacements in permanent collections:	
Record labels	2,067

Display labels	367
Total	2,434

Inventory, June 30, 1986

Total number of woody-plant individuals and massed single-taxa groups in the permanent living collections	14,551
Number of species represented	2,707
Number of infraspecific taxa found in nature	1,047
Number of entities named as cultivars, including spontaneous forms	2,298
Total number of woody taxa in the Arnold Arboretum	6,052

Service

Number of accessions for staff research	164
Taxa distributed to other educational and research institutions	619
Taxa distributed to private and commercial recipients	446
Total number of items distributed:	1,065
Total number of shipments distributed:	138

LIBRARIES

Members of the committee for the combined botanical libraries of Harvard University are currently Professor Ashton, Librarian Ms. Barbara Callahan, Assistant Librarian and Research Archivist Sheila Geary, Farlow Herbarium Librarian Ms. Geraldine Kaye, Professor Andrew Knoll (Curator of the Botanical Museum), Ms. Lydia Kowalski, Professsor Donald Phister (Director of the Combined Herbaria, Curator of the Farlow Herbarium, and chair), Dr. Elisabeth Shaw, and Professor Peter Stevens. Professor Richard Howard resigned from the Committee in November 1985. His many services to the library continue to be appreciated.

Ms. Callahan received promotion to Librarian II, effective July 1, 1986.

The combined libraries of the Arnold Arboretum at Cambridge endured two complete turnovers among the assistants during the year. Mr. Jon Perry has replaced Ms. Erika Ketelhohn who in turn had taken the place of Ms. Sarah Goldstein earlier in the year. Mr. William Connor has replace Ms. Lexie Walther, who had earlier replaced Ms. Maureen Mulhern. Morgan de Tarr has continued to serve as work-study student, part-time.

Dr. Shaw rejoined the Library Committee this year to assist in the planning of a collection development policy for all of the botany libraries. Journals received on subscription by more than one library were reviewed and duplication was reduced. A review of accession priorities was begun.

A subcommittee to coordinate the technical services of the botanical libraries was formed. Chaired by Professor Peter Stevens, the members are Ms. Barbara Callahan, Ms. Shiela Geary, and Ms. Gerry Kaye. Library procedures, staffing, and needs have been reviewed preliminary to planning more efficient library operation.

Other discussions of the library committee concerned the new fee structure for subscriptions to the Distributable Union Catalog (DUC) and related issues concerning the costs and benefits of joining Harvard's on-line acquisitions system, HOLLIS. The combined libraries of the Arnold Arboretum and Gray Herbarium and the Farlow Library will each subscribe to the DUC, and will forward superseded DUC microfiche to the Horticultural Library in Jamaica Plain.

In February 1986, Sargent Lawrence Fennelly from the University Police Department met with Dr. Pfister and Ms. Callahan to assess Library security and to make recommendations for improvements.

Morgan de Tarr completed an inventory of the Arnold Arboretum duplicates held in reserve in the back of the library stacks. Of the 400 titles, over half required

TABLE 3

Statistics for the Arnold Arboretum Libraries Fiscal Year 1985

Accessions	
Monographs:	
Purchased	178
Acquired through gifts or exchanges	168
New continuation volumes (e.g., journals) purchased	8
New continuation volumes (e.g., journals) obtained through exchange	8
Total volumes and pamphlets added	741
Microfilms added	3*
Processing	
Titles:	
Catalogued	165
Recatalogued	35
Total, titles catalogued and recatalogued	200
Volumes bound:	
Monographs	198
Serials	395
Total volumes bound	593
New volumes added after cataloguing and binding:	
Subtotal for Cambridge	344
Subtotal for Jamaica Plain	397
Total new volumes added after cataloguing and binding	741
Inventory, June 30, 1986	
Total number of volumes and pamphlets in the Arnold Arboretum libraries at Cambridge and Jamaica Plain	91,140

Total, microfilm reels	225*
Total, microfiches	10,904*
Number of continuation titles:	
On order	602
Received through gift or exchange	380
Total, continuation titles received	982

Service

Total volumes used by visitors	1,295*
Photocopies supplied in lieu of interlibrary loans	2,354*
Interlibrary loans received	50*
Number of reference requests serviced	1,308

*Combined figure with Gray Herbarium

original cataloguing and the remainder needed revision of existing cataloguing records.

In November 1985 a Leading Edge Model D microcomputer, an Okidata printer, and the Leading Edge word processor were purchased for the Cambridge library. Use priorities and procedures will be decided by the technical services subcommittee, with particular reference to codifying the journal exchange records. Already, the microcomputer issued to store and manipulate circulation records, revise stacks guides, create contents lists of collected works, record titles held in reserve and prepare reports.

The Jamaica Plain Library purchased an IBM Personal Computer. It will initially be used to sort the records of E. H. Wilson's collections and to create new finding aids.

Part of a gift for general library expenses received from Mr. G. K. Fenderson will be used to purchase software for the IBM Personal Computer in the Jamaica Plain Library.

The Arnold Arboretum Associates donated $1200 during Fiscal Year 1985 and Fiscal Year 1986 for the purchase of Chinese botanical literature.

The papers of Dr. Henry Knute Svenson (1897-1986) were donated to the Gray Herbarium Archives in April 1986. The two linear feet of papers and scrapbooks date from 1930-83and contain unpublished notes on the Cape Cod Islands and the Galapagos Islands, letters from well-known botanists, and notes on the genus Eleocharis.

Ray Angelo found a specimen of Aster radula collected by H. D. Thoreau on August 15, 1854 among the duplicates of the New England Botanical Club Herbarium. It was donated to the Henry David Thoreau Herbarium in October 1985.Dr. Alice Tryon donated photographs and manuscript materials concerning Una Foster Weatherby in February 1986.The Libraries received numerous gifts of books, journals, and reprints throughout the year.

PUBLICATIONS

Ms. Elizabeth Schmidt continues to serve as Publications Officer. Activity during fiscal year 1985-1986 has again consisted of small but important projects.

On June 1, 1986 Edmund Schofield, Assistant Publications Officer, was confirmed in a Harvard appointment. During his initial one-year contract appointment he made great strides in improving the content of *Arnoldia*.

With the Fall 1985 issue, the Office of the University Publisher (OUP) began printing *Arnoldia*, succeeding Heffernan Press of Worcester. The result has been a dramatic improvement in the magazine's quality. OUP has taken a very active interest in *Arnoldia* and deserves much of the credit for the improvement. By concentrating on quality, OUP has greatly enhanced *Arnoldia*'s chances for increasing circulation.

The Fall 1985 issue was unique in its foldout cover and in the amount of color it contained. The extra color was made possible by a generous gift from an anonymous donor.

Beginning with the Winter 1986 issue, "The New England Horticultural Calendar" has appeared as a several-page center insert in each issue of Arnoldia. Elise Sigal, a volunteer, compiles and edits the "Calendar." Her conscientious approach made the "Calendar" immediately useful to *Arnoldia*'s readers. The hope is that *Arnoldia* will gain new readers and subscribers on its account.

Next to getting *Arnoldia* printed on a timely publishing schedule, a primary goal has been to introduce greater diversity of subject matter, style, and approach into each issue, and greater integration among articles.

A special effort has been made to increase the number, quality, and diversity of illustrations in Arnoldia over the past year. Since little money is available, most illustrations have had to come from the Arboretum's extensive archives and from classical botanical and horticultural works. Dr. John W. Einset supplies computer-generated graphics for many installments of his column, "Botany: The State of the Art."

Volunteers have made invaluable contributions to *Arnoldia* over the past year. In addition to the "Calendar" editor, Elise Sigal, Marion D. Cahan has reviewed manuscripts from the point-of-view of the general reader; her special perspective has identified problems of style, organization, and content that might have gone undetected. Tom W. G. Coulson, a professional forester from Britain with several decades of experience, has been very generous with his time, serving also as a reviewer. Jan Brink advised on the design aspects of Arnoldia for several months. Three issues of Arnoldia have benefited from her advice. Towards the very end of the fiscal year a new volunteer, James D. Wadleigh, began reviewing articles and initiating the index of the current volume (Volume 46).

Among the several strategies being considered for reducing the costs of producing Arnoldia, the most significant is computerization of the typesetting, layout, and pagemaking operations. Financial analysis has revealed that *Arnoldia*'s budget could easily accommodate computerization and that savings in time and money would be realized.

Arnoldia's circulation appears to have experienced a modest increase already. Marketing is a goal of paramount priority for the next year. Efforts to sell back issues, reprints, and other publications were suspended until an effective and uniform system for storing, inventorying, and to supervise the Education and Exhibitions programs for the institution.

Interpretation of the Arboretum takes place in a number of ways. The adult education program provides continued educational opportunities in botany, horticulture, and interpretative studies. The certificate training programs offer a series of in-depth classes on gardening as a craft, horticultural maintenance, and propagation. Classes for special interest groups and members of the arboricultural and nursery industries offer intensive training sessions in tree and shrub identification, growth habits, and care. The children's education program offers instruction in botany and natural history to third and fourth grade students through the field study experience program. Participation by the children's education program in the development of instruction workshops for teachers in the Museum Institute for Teaching Science and other appropriate groups has also begun this year.

This year, a conscious attempt was also made to use events, such as Arbor Day, Lilac Sunday, and the open house which the public programs staff helped organize for the Harvard University Herbaria as a means to increase public awareness of the Arboretum's mission and programs. The volunteer and membership programs serve as further means to this end.

The Hunnewell Visitor Center again hosted plant related exhibitions during fiscal year 1985-1986. Their intent is to provide visitors to the Center with a variety of perspectives on the world of plants. Local artists are encouraged to interpret the Arboretum. Five exhibitions were presented during the year.

Public Lectures and Courses

The educational program offered 133 classes, workshops, lectures, and symposia for course takers during the year. Attendance at those programs held at the associated Luncheon Lecture Series was more than 4500, a substantial increase over previous years. Programs paid particular attention to plants in the Living Collections of the Arnold Arboretum and at the Case Estates in Weston. Courses that most attracted students were on viburnums, dwarf conifers, bulbous plants, perennials for shade, roses and hostas. With the start of the development of the Bradley collection of rosaceous plants the education program presented three courses related to roses. Practical workshops on propagation, tissue culture, grafting, pruning and bonsai regularly filled to capacity. In October 1985, a symposium, "Landscaping with Perennials," offered in cooperation with the New York Botanical Garden, presented an international roster of speakers and drew over 550 participants to Gund Hall at the Graduate School of Design. The workshop offered in conjunction with the symposium had to be expanded to three sections to accommodate the 77 registrants who attended the program at the Case Estates. Both the symposium and the workshop will be offered again in 1986.

The expertise of the professional plant societies was sought in presenting classes on begonias and hostas. The Arboretum joined with cosponsors to promote and widen the range of programs for its course takers through cooperation with the Trustees of Reservations, the Department of Environmental Management, the Museum of Science, Friends of Franklin Park, Boston Society of Landscape Architects, Massachusetts Arborists Association, the Associated Landscape Contractors of Massachusetts, Massachusett's Audubon Society's Drumlin Farm, Habitat Institute for the Environment, and the Massachusetts Horticultural Society.

The increased registration and range of programs was aided by gifts from the Arnold Arboretum Associates which enabled the Education program to develop a custom-designed computer system and purchase the related hardware and software to handle the numbers of course takers. The outstanding energy and commitment of Dr. Kerry Walter, designer of the program, and Sandra Pallett, Education Registrar, were crucial to this year's achievements.

A series of ten free lectures on botanically related topics drew attendees to the Arnold Arboretum Hunnewell Visitor Center in the winter months. Popular topics ranged from Director Peter Ashton's talk, "People and Forests Collide in Southeast Asia: Searching for Reconciliation, “to "The Fossil Record of Plants in New England" by Professor Andrew Knoll, "The Great Sahara Forest" by Robert Nicholson, and "Antarctica: Ice, Lichens, and Penguins" by Arnoldia Editor Edmund Schofield. Average attendance at these lectures was sixty five. In June Dr. John Sales, Garden Advisor to the National Trust for England, Wales, and Northern Ireland, spoke on the theory and process of restoring historic gardens in Britain.

The 1985 horticultural internship/work program brought16 students to work at the Arnold Arboretum's locations in Jamaica Plain and the Case Estates in Weston. The students attended lectures on aspects of the Living Collections and took field trips, accompanied by Peter Del Tredici and Nan Sinton. This program, which it is hoped will become the basis for a larger scale training program, now includes required participation in a ten-week series in horticultural maintenance. Students who attend the programare in general preparing for a career with a botanical garden or arboretum or with a public park system. The classes are intended to introduce them to topics of daily maintenance, including insect problems in trees

and shrubs, weed identification and weed control, planting and transplanting, pruning, soils, mulches, turf installation, etc. The class is also open to registrants from the general public.

The plant information hot line, which operates a telephone information and written referral service every Monday and Tuesday throughout the year from 1 p.m. to3 p.m., is staffed by Volunteers Barbara Emeneau and C. J. Patterson. They estimate that they answer some eleven hundred callers throughout the year. Questions come from the United States and Canada with written requests answered from Europe, Australia, and the Far East. In addition, the Arnold Arboretum cooperates in a poison call information network. Calls are answered by qualified staff in Cambridge and Jamaica Plain.

A number of special educational and informational programs were also organized. These included a special all day educational symposium for the Landscape Design Critics Council of the Federated Garden Clubs of Massachusetts, programs in cooperation with other museums of Boston for Museum-Goers-Month, and a series of educational walks in cooperation with the Olmsted Historic Restoration Program of the Department of Environmental Management of the Commonwealth of Massachusetts. This latter series brought the Arboretum's programs to residents in Worcester and New Bedford.

The Children's Program entered the second full year of Field Study Experiences with a veteran staff of trained volunteer guides, a complete year of programming, and a history of success providing an alternative to classroom science education for local schools. One thousand four hundred forty nine children attended, and 48 tours were offered.

In August, the Arboretum's Children's Program staff were one of four groups from cultural institutions to take part in a one-week "Summer Science Institute" sponsored by the Massachusetts Board of Regents and Simmons College. In attendance were 44 Science Fellows, representative science teachers drawn from the Boston Public Schools grades K-5.The workshop generated a spring follow-up tour at the Arboretum, which took place in May. In November, the Children’s Program took part in the Boston School's "All Professional Day.”

The fourth grade teachers of the Brookline Schools are strongly encouraged by their science coordinator to schedule class visits to the Arboretum as part of their curriculum. This is now an established part of our Children's Program.

In May, twenty Newton elementary teachers received an introduction to the Children's Program and to the areas of the Arboretum that are part of the outdoor Field Study activities. These teachers will return next fall with their students. Twenty Newton elementary grade teachers will participate in an Arboretum class entitled "Tree Identification." This class is qualifies as credit for teachers' professional advancement.

Two volunteer guide training session were held during the year to train instructors for the Field Study Experience.

At the Case Estates, Nina Gomez-Ibanez conducted 48classes for the 140 third grade children from the Weston Public Schools.

Funding in excess of $25,000 for the Children's Program was raised from the Globe Foundation, the Junior League of Boston, the Junior League Garden Club, and from the Friends of the Arnold Arboretum and the Arboretum Associates.

The Arnold Arboretum has joined with other science museums of Boston to form a special institute designed to enhance the teaching of science education among elementary and middle school teachers. The program received funding in May 1986. Diane Syverson, Children's

Education Coordinator, and Peter Del Tredici, Assistant Plant Propagator, are preparing a series of workshops for twelve teachers who will study at the Arnold Arboretum in July 1986. This will be the first session of a three year program.

Membership

The year followed an already established trend in growth and development. At year's end, membership in the Friends of the Arboretum stood at 3249. The total number of new members through June 18 amounted to 604 with 435 either lapsed or requesting deletion.

The Sargent Society has been formed to honor patrons of the Arnold Arboretum. The Society's 37 charter members were invited to a convocation ceremony in June, when the new Sargent Trail was dedicated and a lecture was presented by Professor Andrew Knoll.

Volunteers

This has been a year of evaluation and reorganization for the volunteer department. In September of 1985 the volunteer coordinator position was increased to full time, including weekend work. The additional hours have made it possible to evaluate and reorganize administrative procedures, develop and expand existing programs, and increase public service through consistent weekend opening for the Visitor Center. Improvements in these areas have resulted in increased numbers of volunteers, especially docents, increased volunteer involvement and satisfaction, and substantial increases in revenue.

TABLE 4

Summary of Volunteer Assignments, Fiscal Year 1985

Assignments	No. of Volunteers
Public Programs:	
Education	4
Plant Information	2
Membership	2
Public Relations	10
Tour Guides	39
Gift Shop	3
Weekend & Special Events	82
Children's Program	24
Publications:	
Arnoldia	4
Living Collections:	
Propagation (Greenhouse)	10
Collection & Verification	33
Labelling & Mapping	5
Case Estate	4
Herbaria:	
Cambridge	1
Jamaica Plain	14
Libraries:	
Cataloging	3
Archives	2
Slide Collection	3

Staff Research:	
Dr. Hu	1
Dr Schubert	1
Dr. Einset	1
Total:	248*

*Differs from total number of volunteers because some volunteers work in more than one work area

The contribution of volunteers to the work of the Arboretum has been tabulated.

The newly designed docent training program was extremely successful. The program was designed to appeal to those interested in a substantial, long-range educational/service volunteer commitment. Many volunteers have chosen to work at the Arboretum because they are seeking a challenging educational experience. The program has attracted high quality trainees and should keep them actively involved while they increase their expertise.

To complement the new docent training program, a program to provide free guided tours to local senior citizens was developed in conjunction with the Family Service Association. It has demonstrated the Arboretum's interest in serving the public and has expanded relationships with local agencies and officials.

Full time availability of the Volunteer Coordinator and new, more professional forms and procedures were the most important factors in the increase in revenue from tours and rentals. Gross revenue increase in Jamaica Plain doubled. At the Case Estates Nina Gomez-Ibanez developed a highly successful parallel program.

Peter Shaw Ashton, Director